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PRESIDENT WRITES

Dear Fellows and Members,

Good looks and image of the self in conformity or not with ideal of the day has been and always will be a pot boiler for churning emotions. Advances in medical science have made it possible to chisel the human body to the likes of the person involved in a tussle with the body image. From the days of the yore, deformity correction for better appearance has been practised and the innovations of the Master Sushruta is well known. Body sculpting is here today, in addition to the mounds of creams, lotions and potions. Health is physical, mental and social wellbeing and appearance surely has its own unique niche and is, cost abounding.

In this issue of our journal we have an overview of the science and art of many 'Plasties' as well as other interesting produres. I am certain that many of us will find it possible to be at the IMSACON 2006 at Lahore and share the scientific and cultural get together furthuring the international vision of our organisation.



Dr. K. Jagadeesan,
President, IMSA



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FROM EDITOR'S DESK



There has been a tremendous increase in demand for cosmetic surgery world over; statistics reveal that cosmetic procedures were performed 280 times more frequently in the year 2005, as compared to 2004. Women outnumbered men twice as much; though men often chose to get their nose reshaped; women usually go in for breast augmentation and abdominal liposuction. Increased demand for cosmetic surgery is attributed to growing awareness and also consciousness about the looks and appearance. Advancements in aesthetic techniques have made these procedures safe. Cosmetic/aesthetic surgery is a relatively new field; opportunities are expanding rapidly and the challenges faced by surgeon are rather too many. In view of the ever increasing demand; a need for a comprehensive and critical review of the practical issues and new developments in the field of cosmetic surgery had long been realized; as such this special issue was planned.

Friends, I take pride in presenting to you a medical bonanza – ‘Special issue on **Cosmetic Surgery** – New Horizons; which has been possible due to unstinted efforts of **Dr. Rajeev B. Ahuja** - a senior plastic surgeon heading the department at one of the premier institutions of the capital city. I am extremely grateful to him for having personally seen that high standard of the articles is maintained. Thanks are also due to several eminent contributors to this issue; selection of topics has really been good. This issue amply highlights the latest techniques and treatment advances in the field of cosmetic surgery. I am confident that the readers of JIMSA will appreciate that a commendable task has been achieved and will most certainly find this publication useful for their personal libraries.

I would like to take this opportunity to express my sincere thanks to the editorial board members for their fruitful suggestions, cooperation and help extended at various stages of the preparation of this issue. I am thankful to all the advertisers without whose help this special issue would not have been possible.

P. D. Gulati

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Our Guest Editor



Dr. Rajeev B. Ahuja MS, MCh, DNB, FICS, FACS, FAMS is presently Working as a Plastic Surgeon and heading the Department of Burns Plastic, Maxillo facial and Microvascular Surgery at Lok Nayak Hospital and associated Maulana Azad Medical College, New Delhi, India. His total Experience in Plastic Surgery extends to 24 years of which 11 years he has been Head of the Department. He is the Immediate Past **President of Association of Plastic Surgeons of India** and of **National Academy of Burns – India**. He is also currently, **South East Asia Representative of the International Society for Burn Injuries, and an Executive Member of the International Confederation of Plastic, Reconstructive & Aesthetic Surgery - Asia Pacific Section**. Besides, **Dr. Ahuja is a Treasurer of the American College of Surgeons (India Chapter)**; he has held other very important and significant offices in professional bodies. Dr. Ahuja has been a merit scholar during his under graduation period. **He is the recipient of the prestigious State Award from Government of NCT of Delhi for Excellence**

in Service., Recently he was awarded **Phoolan Devi Award for outstanding work in field of burns-** by National Academy of Burns –India. Academically, he has received best paper awards on several occasions. Dr. Ahuja has been an **expert** in the apical selection committee of Sher-i-Kashmir Institute of Med. Sciences, Srinagar on several occasions. He has also been expert to the UPSC, Baba Farid University, Punjab and the Rajasthan Public Service Commission.

Dr. Ahuja has also been an examiner to several institutions/universities including AIIMS, PGIMER, National Board of Examinations, Baba Farid University, Sher - i - Kashmir Institute of Medical Sciences, Pune University, for MCh and MS examinations. Dr Ahuja has published 15 papers in indexed, international journals and more than 25 papers in other Indian Journals of Professional Associations. He has contributed chapters in 6 textbooks and has been the Editor of one textbook himself. Besides, **Dr. Ahuja is the founder Editor of the Indian Journal of Burns**. Several research projects have been successfully undertaken and completed by Dr. Ahuja. He has been invited more than 80 times in his career as a Guest Faculty to deliver lectures, orations or to operate in workshops. He is a very keen organizer of National events and has organized several Conferences, workshops and seminars of National level. As Chairman of the Organizing Committee, Dr. Ahuja will be hosting the 7th Asia Pacific Burn Congress in January 2009 at Delhi. Dr. Ahuja has attended more than 85 conferences Nationally and Internationally. He was recently elected unanimously to be the National delegate from India to represent the Association of Plastic Surgeons of India (APSI) in International meetings.

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COSMETIC SURGERY: CURATIVE OR CREATIVE SCIENCE

Modern day plastic surgery has evolved from a curative to a creative science in the last few decades with aesthetic surgery emerging as one of the most challenging and rewarding branches of this field. Aesthetic (cosmetic) surgery comprises of procedures which restore and reshape body structures, in both men and women, to improve appearance and self-esteem. In modern society self-improvement is no longer considered a sign of self-indulgence or vanity. There is enough evidence that improved appearance and self-esteem has a beneficial effect on relationships and career advancements. Thus, taking steps to improve appearance is considered an investment in health and well being. Naturally, then, there has been a tremendous growth in demand for aesthetic surgery in recent years. An aging population, living long and healthy lives, and wanting to look young, continues to additionally fuel the growing demand for aesthetic surgery.

Nearly 6.9 million cosmetic surgical and non-surgical procedures were performed in the United States in 2002, according to the American Society for Aesthetic Plastic Surgery (ASAPS). ASAPS reports the overall number of cosmetic procedures has increased 228 percent since 1997. The five most popular cosmetic surgical procedures in 2002 were lipoplasty (liposuction), breast augmentation, eyelid surgery (blepharoplasty), rhinoplasty (nose reshaping) and breast reduction (females). The top five non surgical procedures were Botox injection, microdermabrasion, collagen injection, laser hair removal and chemical peel. Botox injection continued to rank first among all cosmetic procedures, increasing a modest 4 percent since 2001 but more than 2400 percent since 1997.

As the demand for aesthetic surgery continues to grow an objective means of assessing the patient is mandatory¹. Almost 5-6 decades back it was 'normal' to refer patients seeking cosmetic surgery, for psychiatric evaluation as it was felt "essentially every patient seeking cosmetic surgery...(has a) psychiatric problem..."². Today, cultural norms have expanded, and what was once considered socially abnormal may now be acceptable.

A proper patient selection is mandatory, and therefore, first and foremost the surgeon must understand the motivation of the patient. The patient may not openly explain the true reason for his/her desiring the surgery. Also, patients should not have unrealistic expectations because such patients will never be satisfied by the outcome of surgery. Thus, a cosmetic surgeon also plays the role of a psychiatrist. This requires the surgeon to obtain a complete history with emphasis on social and family background. Preventing patient dissatisfaction depends upon proper patient selection. The selection process begins with the initial interview and if the surgeon feels uncomfortable he should defer the surgery and request a proper psychiatric evaluation. Many patients seeking cosmetic surgery suffer from *body dysmorphic disorder (BDD)*. This is a syndrome in which patients dislike their bodies and are perpetually preoccupied with their appearance. A survey by the American Academy of Facial Plastic and Reconstructive Surgery (AAFPRS) revealed that 6 out of every 100 women who seek plastic surgery suffer from BDD, as do 7 out of every 100 men. Cosmetic surgeons must distinguish between patients who want multiple surgeries, and those who are dysmorphic.

The goals of aesthetic surgery are a satisfied patient and surgeon. A preoperative communication with the patient and family members, if necessary, should establish an acceptable outcome to obviate any misunderstanding later. It is now known that the most frequently expressed dissatisfaction by a patient is the physician's lack of communication prior to treatment³. In spite of a meticulous preoperative evaluation there will still be dissatisfied patients. It requires great maturity to be able to handle such patients to avoid litigations. The physician must listen to these patients patiently and in their entirety. Listening does not imply agreement, but is often therapeutic⁴. If the surgeon feels the patient is correct in their concern, the surgeon should be forthright, and if necessary, offer revision surgery. If the surgeon does not feel revision is warranted, return visits at regular intervals may be scheduled. These patients concerns and dissatisfaction often resolve with time⁴.

Safety during surgery is a priority. There are very few medical conditions which preclude cosmetic surgery. Since alcohol consumption, smoking and some medications can impact surgical results, full disclosure by the patient is necessary. Many cosmetic surgery operations may be performed as 'office

procedures' with complete monitoring. More complex surgery or that requiring admission in excess of 24 hours is performed in a hospital setting. Majority of cosmetic surgery procedures are simple to perform and almost 'risk free'. But, the results can be disastrous in the hands of unaccredited or unqualified surgeons. Since there is no law governing accreditation for cosmetic surgeons in India, there are many who project themselves as cosmetic surgeons. An initial yardstick in selection of a surgeon could be his membership of the Association of Plastic Surgeons of India (APSI) or of Indian Association of Aesthetic Plastic Surgeons (IAAPS). Even then, it is essential to enquire of the surgeon's reputation and experience, as is also mandatory in case of many dermatologists who practice surface cosmetic surgery procedures.

There are some disconcerting trends developing in the realm of cosmetic surgery; 'Botox parties' and 'bidding on the internet'. Both need to be condemned! Responsible surgeons must educate the public and encourage them to understand and read what the procedure entails. Many plastic surgeons are not motivated by purely monetary reasons.

In late 1980s and early 1990s there was a fear that silicone breast implants led to autoimmune disorders or even malignancy, but these fears have receded after many published studies established the safety of these implants. The demand for breast augmentation is consequently surging again.

Many younger patients are demanding moderate cosmetic enhancement with comparatively lower 'downtime'. Thus, non surgical options for rejuvenation are becoming more popular and surgical procedures are being deferred for a later date. Recent advances in aesthetic surgery allow a surgeon to perform very refined and controlled procedures with natural results and a quicker recovery. Patients should understand the procedure's risks and benefits, and expect to sign a thorough informed consent. It is important to know that certain risks accompany any kind of surgery, including cosmetic surgery. Possible complications include excessive bleeding or scarring, adverse reactions to drug or anesthesia, nerve damage and postoperative infection. Aesthetic surgery is no longer a symbol of luxury afforded only by the wealthy. People from all walks of life are seeking cosmetic enhancement. This trend can also be noticed in the outpatient clinics of government institutions. Ofcourse, cosmetic surgery will never be covered by medical insurance, and to that extent it is expensive because the costs will have to be borne by the individual patient. With an overall surge in demand and the substantial cost disparity between the western world and India, 'aesthetic surgery tourism' is set to become a booming industry in our country. So much so, that we may run short of cosmetic surgeons! India has just over 1000 plastic surgeons for 1.2 billion people when the norm in USA is one plastic surgeon for every 50000 people!

The compilation of these articles on cosmetic surgery is quite unique because it will not only serve to acquaint doctors from other specialties but the articles are also very topical with sufficient material for postdoctoral students in plastic surgery. I thank all the contributors for the valuable time they have spared in writing these articles.

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LIPOSUCTION

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Abstract : Liposuction is a fairly recent technique in the armamentarium of plastic surgeons to restore body contours. It is only since mid 1980s that the procedure has become standardized, safe and widely practiced. Liposuction has evolved over the last two decades with the introduction of the tumescent and super-wet techniques, ultrasonic assisted liposuction, power assisted liposuction and laser lipolysis. These advances have made possible the removal of larger volumes of fat with negligible blood loss and relatively trifling complications. It is essentially a body contouring procedure where localized collections of fat are sucked out to restore shape. However, with the mega liposuctions being practiced by a few surgeons its usefulness has been extended to include obese patients. Liposuction is also a useful adjunct in management of gynaecomastia, lipomas, breast reduction etc.

HISTORY

The concept of removing excess fat from localized body sites is credited to Charles Dujarrier, who in France in 1921, attempted to remove subcutaneous fat using a uterine curette on the calves and knees of a ballerina. An inadvertent injury of the femoral artery led to amputation of the leg of the dancer. This unfortunate complication arrested further progress in this field and but it sure was a valiant attempt of the time.

Schrudde in 1964, revived interest in this procedure and extracted fat from the leg, gaining access through a small incision with a curette, but was faced with the daunting task of managing difficult hematomas and seromas that resulted from this technique. Subsequently, Pitanguy favored an en bloc removal of both fat and skin to remove excess thigh adiposities, however the extensively noticeable incisions did not allow the technique to become popular.

MODERN LIPOSUCTION

Modern liposuction began with Giorgio Fischer and Arpad Fischer in 1974. They developed the technique of crisscross tunnel formation from multiple access sites with their improved cannulae and demonstrated good results with fewer complications. Kesselring and Meyer in 1978 published results of a sharp curettage aided by suction. The technique could not gain much acceptance in view of the significant complications.

Pierre Fournier of Paris, France improvised on the Fischer's liposculpture technique and was the initial advocate of the 'dry technique' in which no fluids were infiltrated prior to liposuction. Illouz, began favoring the "wet technique" in which a solution of hypotonic vasoconstrictor saline and hyaluronidase was infiltrated into the adipose tissue prior to aspiration.

Julius Newman was the first to use the term "Lipo Suction". The first articles on liposuction appeared in literature in July 1984. Ever since, lipo-aspirations and fluid managements have added a greater safety dimension. Ultrasonic liposuction was developed by an Italian surgeon, Michael Zocchi.

INTRODUCTION

Liposuction is more of an art rather than a surgical procedure. Principal indications for liposuction are fat deposits in the gluteo-crural areas, hips and the abdomen. While the ideal body shape is trim and athletic, a well contoured shoulder and chest, a flat abdomen and a narrow hip and thigh area are sought-after shapes.

An increase in fat content can be either hypertrophic or hyperplastic. An increase in total fat cell numbers is hyperplastic obesity. It predominates as body fat levels exceed 40 kg and is more resistant to dieting and

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Fig.1a. Pre operative view of a 21 years old girl showing localized fat deposits in the trochanteric area (the riding breeches).



Fig.1b. Post operative view at 1 year following correction by liposuction.

exercise regimens. In those cases where the actual number of fat cells remains stable, the cells increase or decrease in their volume with weight gain or loss.

Localized fat accumulation patterns also vary by race and age patterns. Decrease in the subcutaneous fatty layer and elevations in intra-abdominal fat contents are seen with increasing age. Women have a proportionately higher percentage of body fat than men. They have a gynaecoid pattern of fat deposition characterized by increased deposits over the lateral thigh (fig.1 a&b), buttocks (fig.2 a&b) and truncal (fig.3 a&b) region while men show an android pattern that centres on the truncal region. Liposuction is effective in changing contour as it permanently removes fat cells that are unevenly distributed. The remaining adipocytes can still store fat. For that reason, liposuction cannot prevent further weight gain, it but rather affects weight distribution.

Fat in the trunk and extremities has a superficial and a deep layer. The superficial layer is composed of small dense pockets of fat separated by



Fig.2a. Preoperative view of a 42 yrs old female showing fat deposits in buttocks.



Fig. 2b. Post operative view after 2 years following liposuction.

vertical well-organized fibrous septae. The deeper fat layer is organized more loosely, with loose areolar fatty tissue interspersed with less regular fascial septae intervening between the pockets. Vertical septae originate from the fascia and extend upward toward the dermis.

Liposuction (suction assisted lipectomy) was initially advocated for the treatment of localized collections of fat and for the removal of less than

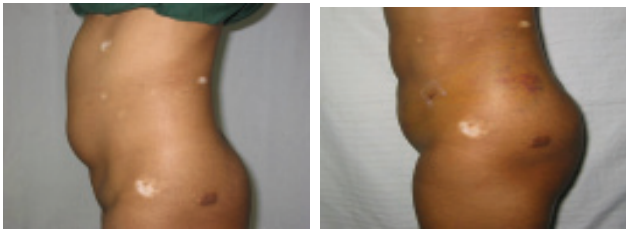


Fig.3a. Pre operative view of a 32 years old female with localized fat deposits in the abdomen. Fig. 3b. Post operative view at 8 months following liposuction (total aspirate - 3.0 liters).

1500 ml of material. However, many patients wished to have multiple areas treated or had diffuse collections of fat. In such instances, the removal of over 1500 ml of material and circumferential lipectomy are necessary to present optimal aesthetic results. However, when over 1500 ml of material is removed, anesthetic requirements, fluid replacement, and treatment of blood loss become important if the procedure is to be performed safely.

OTHER INDICATIONS

Somemore applications of liposuction were pioneered by surgeons of other specialties. Liposuction could be used to remove lipomas, angioliomas, and improve hyperhidrosis. Liposuction techniques can assist in hematoma evacuation. It is also routinely used for breast reduction, to facilitate skin flap movement, for gynecomastia (fig 4 a & b) etc.

TUMESCENT ANESTHESIA

Tumescent liposuction uses large volumes of very dilute, hypotonic solutions of a vasoconstrictor agent that is gently injected into the subcutaneous fat and it virtually eliminates blood loss (fig.5). It also permits the procedure to be done under regional anesthesia with sedation. Local anesthesia may be supplemented for areas proximal to the level of the regional anesthesia.

Maximum safe dose of tumescent lidocaine was a major issue in contention. Limits of lidocaine dosage have been reported to be 35 mg/kg to 50 mg/kg. It has now been demonstrated that the peak lidocaine concentration in the blood occurs at approximately 12 hours of initiating of the tumescent infiltration as against the two hours as was originally conceived. The stinging pain originally associated with infiltration of local anesthesia as a result of the acidic pH of commercially available lidocaine has been eliminated by adding sodium bicarbonate to the anesthetic solution.

EVOLUTION OF INSTRUMENTATION

The standard cannulae of the 1980's were huge, having diameters of 6 to 10 mm. These instruments caused damage to neurovascular bundles and occasionally led to uneven contours, seromas or hematomas. Illouz and Fournier popularized liposuction using their newer generation of the blunt-tipped cannulae and the 'wet technique'.

Cannulae used today are extremely small, some with an inside diameter of less than 0.6 mm. Blunt-tipped cannulae are standard as they decrease



Fig.4a. Pre-operative view of a 22 years old male with gynecomastia. Fig. 4b. The patient underwent suction assisted lipectomy. Post operative view after 6 months.



Fig.5. Liposuction – A 2.2 liter aspirate containing fat and wetting solution seen in the collection jar of the suction machine. Appreciate the minimal loss of blood following tumescent infiltration.

injury to blood vessels and reduce bleeding. The use of multiple side ports allows for efficient evacuation of fat. Manual systems consisting of syringes and cannula tips have also been developed as some surgeons prefer the use of quiet, disposable instruments. Aspiration units were developed by manufacturers in consultation with surgeons and have gradually become more powerful and quieter and allow for an efficient, pleasant surgical environment.

SURGICAL TECHNIQUE

Precise and accurate pre operative marking is essential for a good result. With the patient standing, areas to be treated are outlined with a fiber tip marking pen. Areas to be avoided or areas for fat grafting are also separately identified. Port sites per area are defined to allow cross-tunneling aspiration to minimize surface abnormalities

The patient is prepared circumferentially in the torso and the lower extremity as these can be treated without repeated prepping and repositioning. The patient's skin is painted with 10 percent povidone iodine solution while he/she stands next to a sterile draped operating table. Upon completion of the skin preparation, the patient lies on the table and is sedated or is given regional anesthesia as required.

All areas to be treated are injected with large volumes of a dilute epinephrine solution till turgor of the tissues is appreciable equally on both sides. Effective vasoconstriction is achieved in about ten minutes, but the effect is more pronounced after about twenty minutes.

Tumescent Fluid		
1.	Normal Saline	1000 cc
2.	Distilled Water	300 cc
3.	Inj. Adrenaline	1 amp
4.	Inj. Hyalase	1 amp
5.	Inj. Triamcinalone	10 mg

The intense local vasoconstriction reduces blood loss to insignificant amounts for most procedures. If lidocaine is used in the tumescent solution a profound and long standing anesthesia is created at the local site. Local anesthesia lasts 6 to 10 hours into the post operative period and patients rarely require additional analgesia in the first few hours after surgery.

The desired planes of fat removal are created without suction as it increases instrument control by preventing an inadvertent removal in the sub-dermal fat layer. Thus contour irregularities can be obviated. Access incisions are placed at the periphery of operative field in concealed areas and are used separately for all areas as removing all fat from a single incision may lead to a depression around the access site.

The cannulae move parallel to the fat plane with their openings

directed away from skin surface in a to and fro motion along the same path. The site is changed when the aspirate tends to become blood stained. Feathering of the peripheral areas is done once the basic earmarked areas have been contoured.

The end point of liposuction is a smooth overall shape and contour. The 'skin pinch' should be less than an inch. If done bilaterally, it should look symmetrical. Aspirate volumes from bilaterally symmetrical areas should be approximately the same, although, the volume of the preoperative injection will influence the volume of the aspirate.

Port sites are excised to improve cosmesis as they sustain friction burns. They are closed with a loose deep dermal, absorbable suture. Absorbant dressings are applied to prevent spoilage of compressive binders and dressings.

The authors prefer small diameter cannulae (2 to 5 mm) as they permit small access incisions and the scars are inconspicuous. They also produce fewer surface irregularities and give a smoother finish. The Mercedes-Benz cannulae (diameter ranges from 1.8 to 2 mm) are preferred to treat limited areas of fat deposits and they allow better skin retraction.

POST OPERATIVE CARE

Early ambulation is encouraged within 24 hours for mobilization of third space fluid shifts, to expedite recovery, and to prevent deep vein thrombosis. Prolonged sitting is avoided for 3 to 4 weeks. Pressure garments are worn for 3 to 12 weeks (fig.6). Pressure (finger tip) massage or an ultrasonic massage is advised for persistent oedema, pain or firmness.



Fig. 6. The pressure garment which the patient wears continuously for 3 to 6 months following liposuction.

DISCUSSION

The use of unprecedented large doses of the tumescent solution with dilute epinephrine produces intense and widespread capillary constriction in the targeted fat, which in turn greatly delays the rate of absorption of the drug. Larger cannulae remove fat rapidly but there is a risk of removing too much fat which can produce skin depressions and irregularities. An attempt to make a small change in the direction with a large cannula results in a tendency to re-enter a pre-existing tunnel within the fat. This, lack of precise control, results in skin irregularities. Large bore cannulae are suitable only in those cases where the panniculus is to be excised to correct abdominal ptosis (fig.7 a&b). Microcannulae with an external diameter of less

than 3 mm can remove fat very efficiently and are effective in achieving a smoother contour with better control.

Fat layers are treated from deep to superficial, in sequence, in parallel tracks. As the procedure is moved more superficially, cannula size can be decreased along with suction intensity to help decrease the risk of irregularity on surface layers. Most traditional liposuction treatment involves removal of the deeper layers of fat. Superficial liposuction is done in individuals with flaccid or less elastic skin to aid better skin retraction. It is done with a very narrow cannula to make multiple closely spaced tunnels in the sub-dermal fat to affect an undermining of the tissue.

HIGH VOLUME LIPOSUCTION

For the significantly obese, a safe and limited surgical intervention that achieves even a minimally acceptable aesthetic contour of their profile in proportion to the body structure greatly enhances their self esteem. This is the prime indication for large volume liposuction. In most of these instances the technique should be combined with a block dermolipectomy. The earlier concerns with large volume liposuctions were that patients are exposed to prolonged procedure and anesthesia, high doses of lidocaine / adrenaline, and fluid shifts. However, as practiced by the authors the procedure is very safe with minimal potential for complications.

ULTRASONIC ASSISTED LIPOSUCTION (UAL)

High ultrasonic energy produced by passing electrical energy through a piezoelectric crystal creates microcavities in a liquid or semi liquid medium during the expansion cycle of the sound wave. This property of microcavitation is used in UAL. There is an enhanced fat removal with minimal blood loss, improved skin retraction and safer large-volume procedures with the UAL. It is especially indicated in male patients and in areas of dense, fibrotic fat.

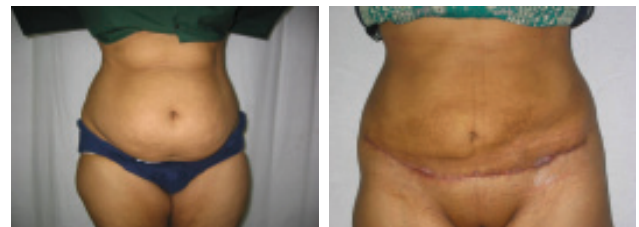


Fig.7a. Pre operative view of a 35 year old female showing abdominal wall ptosis and excessive fat deposit. Fig.7b. Post operative view at 6 months following suction assisted lipectomy with mini abdominoplasty.

POWER ASSISTED TECHNIQUES (PAL)

Power Assisted Liposuction (PAL) is the liposuction using devices that use power supplied by an electric motor or compressed air to produce either a rapid in-and-out movement or a spinning rotation of an attached liposuction cannula. It makes the physical process of liposuction easier for the surgeon who may then direct their faculties towards better sculpturing.

COMPLICATIONS

An unsatisfied patient is by far the most common complication and it often is a result of the patient's unrealistic expectations. Careful and accurate communication between patient and surgeon helps the

patient make a well-informed decision and obviates many a fact justifying consultation in the post operative period.

Minor complications include superficial irregularities of the skin, seroma, haematoma, focal skin necrosis, allergic reactions to drugs, visible or disfiguring scars, discoloration of the skin, fainting during or after surgery, temporary bruising, numbness or nerve injury and temporary adverse drug reactions.

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HAIR RESTORATION SURGERY

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Abstract : *With the evolution of finer techniques in hair transplantation the results look more and more natural. Hair restoration is one of the most exciting and innovative surgical fields in cosmetic surgery today. A precise appreciation of the anatomy has allowed the use of follicular unit grafts. With better methods of harvesting and implantation, hair transplantation results reveal a blend of art and science.*

INTRODUCTION

Hair transplantation is one of the most rapidly evolving procedures in cosmetic surgery, with improvement in techniques occurring regularly. The recent advances in technology and the concept of using *follicular unit grafts* have made this procedure reach a new plateau. The ability to provide very natural appearing results has augured larger number of balding men and women to opt for this surgical solution.

PATHOPHYSIOLOGY

The clinical onset of baldness in both men and women is generally around the age of 30 to 40 years. A strong family history is one of the best indicators of *male pattern baldness* or *androgenic alopecia*, which is the commonest cause of hair loss. An autosomal dominant genetic linkage is believed to cause this hair loss. Male pattern baldness may begin in the teenage years, and becomes more common as men age. It is known that the male hormone, testosterone, gets converted to another male hormone, 5 dihydroxytestosterone (5-DHT), in the hair follicles. In genetically susceptible men, under the influence of 5-DHT, the hair follicles on the front and top of their scalps begin to become more fine over the years. The hair growth also gets restricted and eventually the hair disappears completely.

Like most tissues, hair undergoes a continuous turnover throughout life. Hair follicles are replaced periodically, and at any given time they are in one of the three stages of the growth cycle. The actively growing stage (*anagen phase*) is followed by a brief period of morphological change or the involution stage (*catagen phase*). This is then followed by a resting stage (*telogen phase*). In normal human beings, the total number of scalp hair is usually one lakh. Hair grows at the rate of 1 to 2 cm every month and the average duration of anagen phase is 3 years whilst that of telogen phase is 100 days. Approximately, 40 to 100 hairs are shed daily, but this rate increases in late summer and early autumn, and decreases in late winter or early spring, due to effects of temperature. Norwood has classified baldness into seven stages (fig.1). In women, the frontal hairline is usually spared and baldness in them has been classified separately by Ludwig (fig.2).

Hair transplantation is based on the '*theory of donor dominance in androgenic alopecia*'. If a graft is taken from an area destined to be permanently hair bearing and transplanted to an area of future or currently suffering male pattern baldness, it will after an initial period of effluvium, grow hair in its new site as long as it would have at its original site. This is the scientific basis of hair transplantation surgery.

TERMINOLOGY

Terminal hair is androgen-dependent male-type hair on face (mustache, beard and sideburns) and body (chest, areola, linea alba, inner thighs). It increases in hirsutism. Vellus hair is non-pigmented fine "peach fuzz"

hair covering the body, in both children and adults. It increases in hypertrichosis.

The *follicular unit graft* (FUG) as described by Headington² includes 1 to 4 terminal hair follicles, 1 (or rarely 2) vellus follicle, associated sebaceous lobules, insertion of erector pili muscle, perifollicular



Fig.1 Norwood's classification of male pattern baldness. Grade 1 is near normal. (V) means Vortex.



Fig.2 Ludwig's classification for baldness in females.

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neurovascular network etc. This definition suggests that the unit is a physiological entity rather than an anatomical one. It is best to describe a *follicular unit* for all practical purposes as an aggregation of hair shafts emerging from the scalp in which the distance between the hairs is less than the distance to the nearest aggregation of hairs. This pattern has to be kept in mind whilst harvesting, dissecting and transplanting hair to achieve maximal efficiency and to give a natural appearance to the patient.

TECHNIQUE OF HAIR TRANSPLANTATION

Planning

Although, age is no bar for hair transplantation, the pros and cons of a transplant need to be carefully evaluated in the younger age group. Patients between 20 to 30 years of age should have a stabilized rate of hair loss before they are considered for hair transplantation. A detailed family history is useful in assessing hair loss and planning a new hairline. The colour, quality and density of the donor hair, and the contrast between the hair colour and the skin colour, are important factors that affect the result. The lesser the contrast between the donor hair and the skin, the better is the result¹. It is also noted that frizzy, curly or wavy hair are advantageous characteristics in transplanted hair.

Single hair grafts are used to create a natural hairline. The planning of the hairline is one of the most important steps in hair transplantation. The hairline is the most visible landmark and the quality of work of a surgeon is often judged by the quality of the hairline. To locate the ideal hairline in a bald patient it is necessary to divide the face into three equal segments as suggested by Michaelangelo³. In the midline, the hairline starts at least eight centimetre or more from the glabella (fig.3). A curve sweeps around to the lateral side of the forehead from the center. At this point, the sides of the hairline should be oriented parallel to the curve when the subject is looking straight ahead. The lateral hairlines are usually 9.5 to 11.5 cm above the lateral canthus of the eyes. The temporal angles should form relatively sharp right angles or acute angles in most men but in women these angles should be more rounded. The hairline shape also varies according to the variation of the shape of the face – round, oval or triangular. The patient's desires and constraints are also other factors that can affect the shape of the hairline.

Usually 250 to 300 single hair (micro) grafts will be necessary to create a new hairline in any individual. The micro-grafts in the hairline should be placed in an irregular saw-toothed pattern of macro- and micro-irregularity⁴ to give a natural appearance. Behind the hairline, two-hair FUGs are used to provide new hair. Three or four hair FUGs are used just further behind. The less ideal the hair and skin characteristics, the more important it is to use smaller grafts. In alopecic recipient areas, punch grafts of diameter 1 mm, 1.25 mm and 1.5 mm are used by some surgeons behind the hairline to give good density. The punch grafts have an advantage of removing a circular area of bald tissue where the grafts will be placed. These punch grafts should not be used in areas where hairs are already present as they would punch out existing hair and the surgery will be counter productive. But in areas of total baldness punch grafts can be useful.

Pre-operative Preparation

The patient is asked to shampoo his head with povidone iodine surgical scrub on the day before the surgery and on the morning of the surgery.

Preparation of the Donor Area

Local anesthesia is used for the entire procedure. A solution is made from 30 ml of 2% xylocaine with 100 cc of normal saline, to which 1 ml of adrenaline (1:1000) is added. The hair in the donor area (occipital region) is trimmed to about 2mm length and the local anaesthetic solution

is injected just under the donor area. The donor area is then tumesced by injecting normal saline into the entire zone. Allow 10 minutes for complete haemostatic effect to minimize bleeding. The donor area should be turgid at the completion of infiltration because this provides excellent anesthesia and results in minimum bleeding.

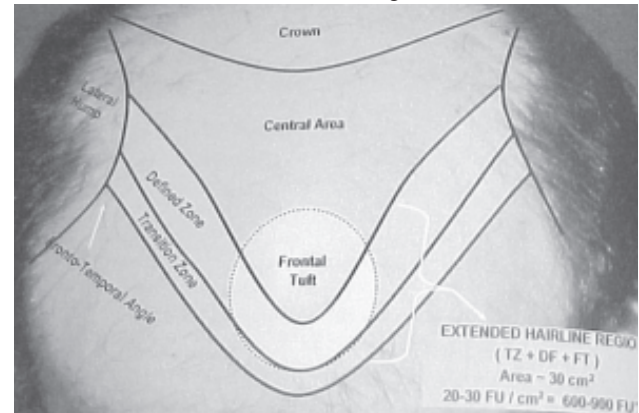


Fig.3 Illustration to show how the hairline is planned in a bald patient.

Harvesting

The donor strip can be harvested with a single bladed knife or a multiple bladed knife containing three to seven blades. The multi-bladed knife harvests numerous (two to six) parallel strips of varying width, depending on the spacer used, which may be 1.5mm, 2mm or 2.5mm. These blind incisions, with a multi-bladed knife, increase the chance of follicular damage, and therefore, it is better to use a single or a double-bladed knife (fig.4). It is very important that whilst harvesting the donor area the blades remain parallel to the direction of the hair so that the hair roots are not damaged. The hair in the lower part of the occipital area and the temporal area are finer, and these should be used to create a new hairline. After the strip has been harvested, the gap can be closed either by staples or by sutures. Some surgeons prefer deep sutures in the galea or the subcutaneous tissue to reduce the width of the scar, but this is not always necessary. The skin can be opposed by a running suture of 2 '0' monofilament nylon. Care is taken to take the bites close to the skin margin to avoid more damage to the tissues. Also, it is important to take the bites only up to the dermis so that the deeper hair roots are not damaged, and can be utilised in subsequent surgery.

*Follicular Unit Extraction*⁶ is a technique that involves the removal of the intact follicular unit directly from the donor area using a 1 mm punch. The yield by this technique of harvesting can diminish due to transection and avulsion injury to the follicular unit.

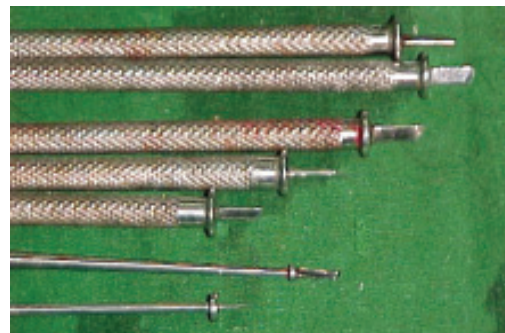


Fig.4 Instruments used in hair restoration surgery for follicular unit harvesting, making of recipient slits and implantation.

Harvesting donor hairs which are white or light coloured is more difficult. Extra care has to be taken to preserve the hair follicles. These patients are instructed to dye the hairs a few days before the procedure to enhance visibility. Extra care is also required in patients undergoing a second procedure because scars from previous surgery distort the direction of the hair in the donor area.

Graft Preparation

The harvested donor strips are immediately immersed in chilled normal saline. Proper hydration of the donor grafts with cold saline is very important throughout the surgery as it influences the survival rate of the grafts. In case a single large strip has been harvested it can be divided into smaller pieces or slivers⁵ before the cutting of individual grafts. The subcutaneous fatty tissue below the hair roots or bulbs is stripped leaving up to 2mm of fat below the hair bulb. FUGs are made having one to four hairs. Grafts are immersed in saline, in a petri dish, or kept on a moist stockinet in kidney trays, in bunches of 25. Good illumination is essential during the cutting of the grafts. The grafts may be cut on wooden tongue depressors or on a clear vinyl dissecting surface, with a backlighting system. It is important that no piece of wood sticks to the grafts after they have been cut, because these foreign bodies can later form troublesome epidermal cysts. Loupe magnifications with power 2x or 3x is useful in creating FUGs. Graft preparation with a dissecting stereo microscope makes the dissection a little slower, but it is much more accurate. Some surgeons prefer slicing the epidermis in the grafts at an angle of 45 degrees, but this is a personal preference.

Preparation of the Recipient Area

Anesthesia for the recipient area includes a supra-trochlear and supra-orbital block followed by a ring block in the frontal area beyond the zone of hair transplantation. The recipient area itself should be tumesced well with normal saline. It is author's preference to avoid using adrenaline in the recipient area because this has shown to diminish the uptake of the grafts and it also increases telogen effluvium in the immediate post operative period. Adrenaline must definitely be avoided in the recipient area in women⁷ because severe effluvium has been reported after its use. The recipient area should be turgid before slits or holes are made, to minimize bleeding and pain.

While making slits or holes in the recipient area it is very important to follow the direction of the existing hair in that region. The hairline should have a ragged, saw-toothed natural look. Holes are made with a No. 18 / 20 gauge needle in a pattern of organized disorganization. About 250 to 300 micro-grafts are necessary to create a normal hairline. Behind the hairline, slits can be made by Nokor needles, a Minde knife (A - Zee Surgical, USA), a No. 5 scalpel blade or by needles. The author has devised a new instrument which is patented as "Kolkata slit". The Nokor needles and Minde knife are disposable instruments and not easily procurable in our country. The scalpel blades make holes that are too large and often deep, because of which the inserted grafts float and loose direction. Scalpel blade can also cause significant damage to the existing hair in the recipient area. In females, a large number of hair strands get cut by the scalpel blade during the procedure. The 'Kolkata slit' is an instrument which can be re-used and comes in different sizes. It creates a gap just about the size of the graft to be inserted and ensures the graft maintains the direction of orientation. The slit must be used in areas where there are existing hairs in an attempt to increase density.

In patients undergoing secondary or tertiary procedures an increased amount of bleeding has been noticed in the recipient area. Increased bleeding is also seen in patients who have been using minoxidil in the pre-operative period. Good tumescence, and a waiting period of 10 to 15 minutes, before making gaps can reduce this disturbing ooze. It is also noticed that the gaps in recipient areas are tougher to make in secondary procedures because of fibrosis from earlier procedure.

Graft Insertion

The grafts are placed into the recipient slits / holes using fine angled forceps (fig 5). It is important to employ an atraumatic technique for graft placement. The FUGs are grasped on the 2mm of subcutaneous tissue left below the hair bulbs to position them into the recipient sites. The grafts should not be grasped by the follicle end to avoid damage. A steady pressure is applied to ensure that the grafts are flush with the surrounding skin. Burying the grafts beneath the level of the skin must be avoided because it can give a pitted appearance and also lead to formation of epidermal cysts. If the grafts are too elevated from the surface it creates a cobblestone appearance. Two, or even three, persons can insert grafts at the same time to make the procedure faster and efficient. Grafting sessions can last up to five or six hours, in which 2000 - 3000 FUGs may be transplanted.

Post-operative Care

The patient is discharged the same day, usually without any bandage.



Fig.5 Follicular unit grafts just before insertion in to the recipient slits.

Some surgeons still prefer to bandage but it must be done very carefully to avoid shearing. The bandage must also be removed very meticulously because grafts can stick to the undersurface and get removed inadvertently.

Some swelling is obvious after a hair transplantation surgery and the patient should be informed of this prior to the procedure. A head-band worn immediately post-operatively is useful in preventing the swelling from coming down on to the face and creating a puffy appearance. The patient is instructed to wash his hair with a mild shampoo on the 2nd or 3rd postoperative day. Whilst combing his hair in the transplanted area, the tooth of the comb should not strike against the transplanted plugs for three weeks. Wearing clothes like T-shirts or pullovers which have to be taken off over the head should also be avoided for three weeks. Hair oils or other stronger shampoos and helmets are also avoided for the same period. 5% minoxidil is applied in the areas of hair transplant once the shampooing has begun, and continued for a period of two to six months. This has shown to promote earlier growth of the transplanted hair. In females the concentration of minoxidil used is 2%.

Sequel

The epidermis and dermis along with the shaft of the transplanted hair outside the skin fall off as scabs in the two to three weeks after the surgery, but the follicles remain and go into a resting phase. New hairs start growing about 3 months after the procedure. It has often been noticed that with the use of 5% Minoxidil the hairs don't fall and start growing immediately in the post-operative period. It usually takes six to nine months to appreciate the result of a hair transplant. If a second procedure has been planned, it must be at least three to six months after the first sitting. Some patients may complain of

hypoesthesia of the scalp in the donor area. It is usually temporary, but may persist for as long as 18 months in some cases.

The density of transplanted hair is usually thinner especially in areas that are totally bald. The patient should be informed of this pre-operatively and a second sitting can be undertaken to increase hair density (fig. 6 a&b).

Complications

Complications of hair transplantation are few and rare. True infections in the recipient areas occur infrequently. In the donor areas, infection may be seen around the sutures but it usually resolves easily after suture removal. Epidermal cysts may be seen occasionally and need drainage. It is important not to harvest too big a donor area because tension on the suture line can lead to



Fig.6a & 6b: A 25 year old male with grade 7 baldness. Before (a) and after (b) Showing the hair restoration after a single sitting of follicular unit transfer with 1500 grafts.

dehiscence and a wide scar.

HAIR TRANSPLANTS IN SPECIAL SITES

eyebrow transplantation can be done to improve or recreate eyebrows. It is an aesthetic essentiality to follow the direction of the eyebrow hairs whilst creating a new line. Around 150 micro-grafts are usually required for an eyebrow of one side. The donor site for eyebrow transplantation should be of finer hair preferably from the nape of the neck or the temporal region⁸. Recipient holes are made with a No. 20 or 21-gauge needle or a 0.7 mm micro blade. Cyanoacrylate glue may be used over the grafted areas to keep the them in place during the immediate post-operative period.

Grafting eyelashes is a more challenging procedure. Fortunately, only a few lashes are necessary to produce a good result. Six, one-hair micro-grafts per lid may satisfy most patients. The cyanoacrylate glue is again very useful in keeping the grafts in place.

The rate of hair growth of the scalp hair is much faster than those of the eyebrows and elsewhere. Patients must be informed pre-operatively that this transplanted hair will need trimming from time to time.

Moustache reconstruction by hair transplantation is especially useful in patients who have had a cleft lip or a scar following trauma. The hair in the moustache area is much more wiry and courser than hair in the scalp. Probably harvesting hair from the beard area just inferior to the jaw line provides better donor hair for moustache reconstruction⁹.

Patients who have undergone hair transplantation using older techniques have larger plugs. This gives the hairline a pluggy, cornrow appearance, which needs correction. The current approach is by plug reduction and recycling, and it is applied aggressively to the front two rows¹⁰.

CONCLUSION

Recent advances in technology have made hair replacement surgery a viable option for many people but we must utilize this technique prudently. It is

very important to form a team because one individual cannot perform the entire procedure single-handedly. Fine tuning and accuracy in all steps of the surgery are essential in getting good results. No compromise should be made with proper lighting in the operating room and with the quality of instruments. A comfortable ambience in the operating room and use of audio-visual entertainment break the monotony, both for the patient and the surgical team. A patient is worse off after a poorly performed hair replacement surgery. If done judiciously, transplantation is a very rewarding procedure, both for the surgeon and the patient (fig.7 & 8).



Fig.7a & 7b A 26 year old male with grade 7 baldness. Before (a) and after (b) Showing appearance of the patient after a single sitting of follicular unit transfer with 1300 grafts.



Fig.8a & 8b A 26 year old female with cicatricial alopecia from childhood. Before (a) and (b) Showing the same patient after two sittings of 1000 grafts each.

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Nobel Prize in Medicine

Drs. Andrew Fire and Graig Mello have been awarded Nobel Prize in Medicine for the year 2006 for the discovery of "Silence Genes" which has opened new pathways for treating diseases by the nobel assembly of stock Holmel Karlinsaa Institute. Through their experiment with Nematode worms; both scientists form of RNA can switch off targeted genes in a process known as RNA interference. This technology has become a hot area of research for pharmaceutical companies who view this as a promising new way to tackle a range of conditions.

SURGICAL FACIAL REJUVENATION

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Abstract: The signs of facial ageing can tremendously affect how a person feels about himself and how he is seen by others because the face is an individual's most visible feature. Current thinking regarding the causes of facial ageing is that there is more to facial ageing than just loss of elasticity and the effects of gravity as has been hitherto thought. Loss of firmness, sagging of tissues, development of deep lines, and wrinkles as well as depressions and irregularities in the face are now thought to be due to a combination of factors. These include loss of volume, migration of tissues and their entrapment by ligaments that extend from the skin to the deeper tissues, as well as ptosis of subcutaneous fat which result in the formation of jowls and nasolabial folds. Current concepts of surgical facial rejuvenation for the upper third, middle third and lower third of the face are geared at restoring volume with fillers, repositioning ptotic tissues, liposuction of excess and displaced fat, and excising cutaneous or other redundant tissue.

INTRODUCTION

There are many factors which contribute to the loss of youthful appearance of the face. Ageing of the face is dependant on heredity, gravity, environmental conditions, and stress. These factors can result in the development of depressions, deep lines and furrows, grooves under the eyelids, deep nasolabial folds, and jowls (fig.1 & 2). The development of hollow areas in the face is the result of facial tissue atrophy. Tear through deformity of the lower eyelids and nasolabial folds are caused by entrapment of sagging subcutaneous fat by cutaneous ligaments. Jowls are the result of accumulation of displaced fat trapped by labiomandibular ligament. Submental lipodystrophy is due to excess localized fat deposit. Loose skin under the neck is due to

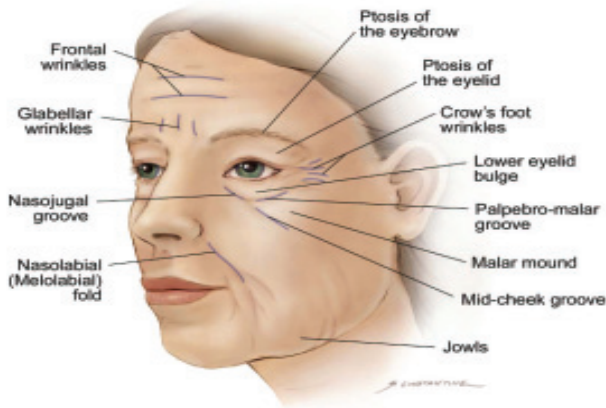


Fig.1 An illustration to show the signs of ageing on the face (courtesy Contour threads).

skin redundancy. Current concepts of surgical facial rejuvenation are aimed at addressing these etiological factors either individually or in combination. Surgical facial rejuvenation is presented under the following topics- upper third, middle third and the lower third. In addition to direct surgical excision of redundant skin, SMAS (submusculo-aponeurotic system) plication, ancillary procedures such as fat grafting and the judicious use of implants in the malar or chin region need to be addressed.

While addressing facial rejuvenation, it is very important to consider the overall face. Patients desiring only segmental rejuvenation should be warned that after surgery, the untreated areas can by a contrast look worse than they did before surgery (fig.3). It is, therefore, important to

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Fig.2 Two patients showing all the signs of facial ageing as marked in fig. 1.

consider total facial rejuvenation rather than regional correction of facial ageing.

UPPER THIRD 1. Forehead; 2. Eyebrow; 3. Upper eyelids

Forehead : The wrinkling of forehead and sagging of tissues in this region has traditionally been corrected by performing a forehead lift. Several different ways of lifting the forehead have been used in the past. Until recently, the coronal forehead lift was traditionally popular¹. This entailed making an incision from the upper pole of one ear to the other across the frontal scalp. Through this approach the entire forehead was undermined up to the eyebrows and then this



Fig.3 Showing pre and post operative views of a patient who underwent rejuvenation of the middle and lower thirds of the face but declined forehead and brow correction. The upper face is now disharmonious with the middle and lower thirds.

undermined flap was pulled back and excess tissue in the anterior flap was resected. The undermining was sometimes combined with removal of the frontalis muscle, either totally or segmentally, to correct the brow furrows. This sometimes resulted in an expressionless and mask-like appearance. It was an extensive procedure and it was difficult to convince the patients to undergo a surgery of such magnitude for drooping forehead. This procedure also left a scar in the hairline. The scar was sometimes devoid of hair resulting in an unsightly band of alopecia which could be very noticeable in dark-haired individuals. Another frequent complication was the loss of sensation due to the transection of the supraorbital neurovascular bundles. This could sometimes be associated with troublesome dysaesthesia such as itching, tingling, or numbness. Other disadvantages of this technique included the alteration in the height of the forehead. Pretrichial incisions (in front of the hairline) were used to prevent increasing the forehead height. However, this placed the scar in a more noticeable position. This procedure is now seldom used as much better alternatives are available and they are discussed below.

Eyebrows :

Browlift : Sagging of the brows can give a sleepy look and sometimes they contribute to impairment of the visual field. There are many different ways of correcting sagging eyebrows. In the past, direct excision of the skin just above the eyebrow was used. However, this can result in an unsightly residual scar. Mid-forehead excisions were also used. These can still be used judiciously to excise very deep horizontal forehead furrows. These direct excisional procedures are not indicated in dark-skinned individuals as they often result in unsightly and visible scars on the forehead.

More recently, an endoscopic browlift has been used². This procedure is done through three small vertical incisions in the hairline. Using an endoscope, the forehead is undermined up to the level of the superior orbital rims. The periosteum under the eyebrows, along the supraorbital rim is incised endoscopically. The supraorbital and supratrochlear neurovascular bundles are identified and preserved. If the patient desires excision of glabellar frown lines, then the procerus and the corrugator supercillii muscles can also be excised endoscopically. The scalp is undermined posteriorly. The entire undermined forehead flap is then pulled posteriorly to elevate the brows. Fixation of the flap can be achieved in different ways. In the past, galeal overlap stitches were used. Later, temporary K-pins³ and metal screws were then used for fixation to the outer table. However, metallic screws were permanent and they sometimes caused difficulties with subsequent MRI evaluations⁴. Presently, these are not in favor. Absorbable screws have now been developed which can be used for fixation⁵. The most recent advance has been the use of endotine⁶. This device has several tines into which the flap is engaged by digital pressure. The device gets resorbed in four to six months. It has many advantages over the other methods like the ease of placement, multiple point fixation and resorbability. The endoscopic browlift has enjoyed great popularity because of the small incisions which are located within the hairline, and gratifying functional and cosmetic results (fig 4a-d).

Browpexy: More recently, the development of transpalpebral browpexy has become popular for correction of brow ptosis. In this procedure, the eyebrow is elevated through the upper eyelid incision during upper blepharoplasty procedure. The sub-brow fat is dissected just above the orbital margin, excess fat is removed and the brow can be sutured with a non-absorbable suture to the underlying periosteum of the supraorbital rim. Even more recently, an endotine fixation through the



Fig.4(a&b) Showing pre operative views of a patient with drooping eyebrows and upper eyelids.



Fig.4(c&d) Post operative views of the same patient after a bilateral upper lid blepharoplasty and an endoscopic brow lift procedures.

transpalpebral approach is being favoured. Small three mm absorbable devices which have spikes at an angle are anchored into the supraorbital bone by a drill hole. The eyebrow is then cinched into the tines and brow fixation is accomplished through the transpalpebral approach. This procedure is very recent, but initial results in the author's experience have been very satisfying.

Upper Eyelids : The redundancy of skin in the upper eyelids can also lead to a sleepy appearance. If the redundancy is severe it can also compromise peripheral visual field (fig 5a), particularly on upward gaze. This can be corrected by doing an upper blepharoplasty (fig 5b). The procedure entails removal of redundant skin and the herniated fat pads which are the cause of the bulge. In performing the upper blepharoplasty, care is taken to ensure that the incision is concealed within the supra-tarsal fold when the eyes are open. An over aggressive resection of fat pads can result in sunken eyes. More recently, some surgeons have advocated preservation of fat and repair of the orbital septum following reduction of the herniated portion⁷. Some patients may have dehiscence or fenestration of the levator aponeurosis which gives rise to ptosis in addition to blepharochalasis. In these cases repair of the levator aponeurosis by plication or reinsertion into the upper border of the tarsal plate is necessary, in addition to removing the redundant skin.

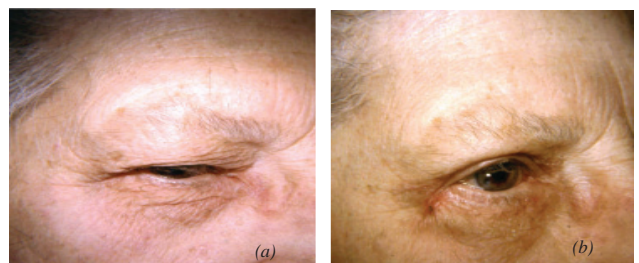


Fig.5 Showing pre(a) and post(b) operative views of a patient after blepharoplasty for drooping upper eyelids which are giving the patient a sleepy appearance and limiting his visual fields.

MIDDLE THIRD (1) Lower eyelids (2) Eyelid-cheek junction
(3) Malar eminence (4) Nasolabial folds (5) Midface (6) Perioral lines (7) Lip augmentation

Lower Eyelids :Ageing of the lower eyelid is evident as laxity of the lid margin, sagging of the lower lid tissues, wrinkling of skin of the lower eyelids, and bulges due to herniation of lower eyelid fat pads⁸. The lower lid blepharoplasty is a very rewarding procedure in facial rejuvenation. It is also one of the most difficult procedures because there is very little room for error, and the complications can be both functionally and cosmetically devastating. There has been a change in the concept of lower lid surgery⁹. In the past, skin was removed through a subciliary incision extending into one of the crow's lines laterally. Either skin alone or skin muscle flap was elevated, and the redundant tissue was excised. Extreme care is required in removing the exact amount of skin. If too little skin is removed patient's preoperative deformity will persist. However, removal of even 1 or 2 mm of excess skin can result in lower lid lag or frank ectropion. As in upper lid blepharoplasty, it was customary to aggressively resect the herniated fat pads¹⁰. Again recently, the concept has changed and now an attempt is made to preserve the fat by strengthening the lax orbital septum to prevent the herniation of the fat pads. Repositioning the herniated fat, particularly to correct the tear through deformity and the nasojugal folds has become increasingly popular¹⁰ (fig 6). In younger patients where there is only herniation of fat pads without much skin redundancy the deformity can be corrected by removing the herniated fat through



Fig.6 Showing pre and post operative views of a patient who underwent bilateral upper and lower lid blepharoplasty with redistribution of herniated fat pads.

a transconjunctival approach, which eliminates an external scar. Sometimes, a transconjunctival fat resection is used in conjunction with the transcutaneous skin excision in the so called 'no touch' technique to prevent any manipulation of the middle lamella, thus eliminating the possibility of lid lag or lid retraction¹¹. Horizontal laxity of the lid is corrected by excising a full thickness wedge of the lid margin. Many surgeons routinely use some form of lateral canthal suspension with tarsal strips or non absorbable sutures in conjunction with lower lid blepharoplasty⁹. Complications of lower lid blepharoplasty include dry eye syndrome, lateral bowing, scleral show, frank ectropion, and lid retraction due to middle lamellar scarring¹².

Nasojugal Groove : In a youthful face, there is imperceptible transition between the lower lid and the cheek. The earliest manifestation of facial ageing is the development of a groove between the lower eyelid and the cheek, called the 'nasojugal groove'. This is due to the presence of a ligament which extends from the skin along

the lower border of the lower eyelid which extends down to the malar region¹³. As the fat pads herniate with age, and descend due to gravity and loss of elasticity, the migration of the tissues is trapped by this palpebro-malar ligament resulting in a bulge and a depression. Recently, there has been much interest in correction of this deformity. This is frequently accomplished by taking some of the fat excised during the blepharoplasty and placing it into this so called 'tear through' region (fig 6).

Malar Eminence: A high cheekbone is a hall-mark of youthful appearance. With ageing, there is descent of the malar fat pads giving rise to malar bags'. Malar bags can be corrected during blepharoplasty procedure by plicating the involved tissues. It is not always possible to completely correct it. The sagging of the malar eminence can be corrected by elevating the malar region through a subperiosteal facelift which can be done through a lower eyelid incision. Other methods of elevating the malar pad include the recently introduced subcutaneous thread lift. Flattening of malar eminences can also be corrected by placing malar implants¹⁴. This can be done in combination with a facelift or during lower lid blepharoplasty. The author has frequently used autologous tissue, such as SMAS, as malar grafts during facelift surgery. The malar implants are of many different types, and the choice of the implant is dictated by whether correction of the malar eminence alone is desired or a sub-malar augmentation is also desired. The implant can also be inserted through an intra-oral route to eliminate the need for an external excision.

Nasolabial Folds : The nasolabial folds are a prominent sign of facial ageing. Its etiology has been controversial, as has been its treatment. The current hypothesis for the development of the nasolabial fold is that there is migration of fat inferiorly and its accumulation at the nasolabial ligament. The correction is geared at elevating the tissues during facelift or by removing the accumulated fat by suction-assisted lipectomy¹⁵. During a facelift the nasolabial fat pad can be aspirated by liposuction done at the time. If this deformity has to be addressed individually, then liposuction, using a small cannula, can be performed through the transnasal approach. Quite recently, subcutaneous thread lifts have become popular for correcting nasolabial folds and for lifting the middle third and lower third of the face¹⁶. Nasolabial folds in younger individuals can be improved by injecting fillers, such as autologous fat or hyaluronic acid.

Midface : The ageing of the midface and the correction of deep nasolabial folds has traditionally been accomplished by doing a cervicofacial rhytidectomy or conventional facelift¹⁶. In this procedure, an incision is made in the temporal region up to the upper pole of the ear and then anteriorly in the preauricular region (sometimes taking it posterior to the tragus) up to the level of the lobule of the ear, from where it is directed posteriorly into the auricular cephalic sulcus, and then across the mastoid and along the posterior occipital hairline¹⁷. Through this incision, the skin is undermined over a predetermined area (fig. 7a). If the focus is on correcting the midface, then the dissection is limited to an area up to the free border of the mandible. If there is redundancy of the skin in the submandibular region and the neck, then the undermining is continued inferiorly up to the midline of the neck. The fat pads in the nasolabial folds and the jowls are suctioned. In doing an open liposuction, a flat spatula type of cannula works much better than the traditional round cannula. If necessary, the SMAS layer is dissected, elevated and plicated. If more definition along the free border of the mandible is desired a SMAS flap can be sutured along the mastoid region. The platysma muscle can be elevated as a flap and pulled posteriorly to correct the platysma bands¹⁸. Sometimes, it requires a more direct approach and the bands can be resected at different levels under direct vision. The skin flap is pulled upwards



Fig.7a Showing the extent of skin undermining done for a surgical facelift operation. It is also showing the extent of skin excision being made in the preauricular and post auricular regions.



Fig.7b Showing skin closure after a surgical facelift operation.

and posteriorly, and the redundant skin is excised before closure¹⁹ (fig. 7b).

Facelift surgery has undergone considerable evolution in recent times. In the past, skin only was undermined and resected. This gave short lived results. Then, came the development of SMAS dissection, excision or plication. This has given better and enduring results (fig. 8). More recently, short scar facelifts have been introduced in which the scars are limited to the face and the area just behind the ear, eliminating the scars in the temple and in the mastoid region²⁰. In author's experience, the short-scar facelifts can be used very effectively in younger patients and in secondary facelifts. Short-scar facelifts can frequently be done as outpatient procedures under local anesthesia.

Currently, 'thread lifts' are in vogue²¹. The procedure has been around for many years but the results were disappointing because the threads used earlier were plain sutures²². The pull was concentrated at points of placement along the nasolabial folds resulting in dimpling and inadequate elevation of tissues of the mid face. The recent introduction



Fig.8 Preoperative and postoperative views of a patient who underwent a surgical facelift with SMAS plication and a simultaneous insertion of chin implant to improve the cervico-mental projection.

of the barbed threads has remarkably improved the results as the pull is distributed along the entire extent of the thread²³. It is believed that the results of this lift should last at least five years. In the author's experience, the preliminary results are very encouraging (fig. 9a-d). Barbed threads are also being used for brow lifts, and in the neck for defining the cervico-mental angle.

Perioral Ageing: Signs of ageing around the mouth can be very distressing²⁴. These consist of marionette lines, stomal creases, and perioral rhytides²⁵. Surgical correction of perioral ageing involves use of fillers to correct the marionette lines and stomal creases²⁶. Many different types of fillers are available, but the most commonly used substance is hyaluronic acid²⁷. The only drawback of hyaluronic



Fig.9 (a&b) Preoperative views of a patient showing signs of facial ageing. The profile view also shows the direction of the three threads proposed to be inserted.



Fig.9 (c&d) Postoperative views of the same patient after a 'Contour Thread' facelift.

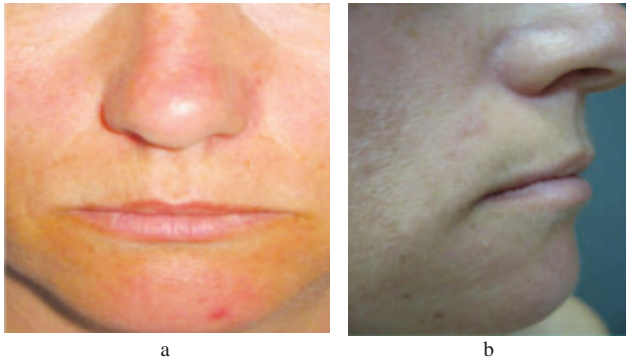


Fig.10 Pre (a,b) and post (c,d) operative photos of a patient who had lip augmentation using autologous dermal fat grafts.

acid is that it is temporary and the effect lasts for nine months only. Use of more permanent fillers is fraught with long-term complications and is not advocated by the author^{28,29}. Intra oral mucosal flap transposition can be used to elevate the down turned commissures of the mouth. Perioral rhytides can be corrected by using fillers, chemical peels, or laser resurfacing. Judicious use of Botox is also rewarding in the hands of the very experienced³⁰.

Lip Augmentation :With advancing age there is hypoplasia of the lips³¹. Lip augmentation can be done as an isolated procedure but it is frequently done as a part of facial rejuvenation³². There are many different ways of augmenting the lips³³. The author does not endorse the use of alloplastic materials as it gives an unnatural appearance and feel. Fat grafts are favored by many surgeons but has the drawback of an uneven take³⁴. There is also a significant resorption rate of the injected fat³⁵. The author has had much success with the use of 'Alloderm' but autologous tissue, like temporalis fascia, is preferred. During a concomitant facelift the use of SMAS graft has been very satisfying³⁶. If the patient has scars in other parts of the body or if she is undergoing another surgical procedure, dermal fat grafts can be harvested for lip augmentation and they also give very gratifying and long-lasting results (fig. 10a-d).

LOWER THIRD 1. Jowls; 2. Cervicofacial angle; 3. Neck-a) Lipodystrophy; b) Receding chin; c) Mandibular border; d) Mandibular angle; e) Platysma bands; f) Submandibular gland;

Jowls : The development of jowls is a very prominent feature of facial ageing³⁷. This is again due to ptosis of subcutaneous tissues, particularly migration of fat inferiorly, and its entrapment by the labio-mandibular ligament. The author feels that the most effective method of correcting a jowl is by



Fig.11 Showing pre and post operative views of a patient who underwent a surgical facelift operation along with simultaneous liposuction of the face and neck.

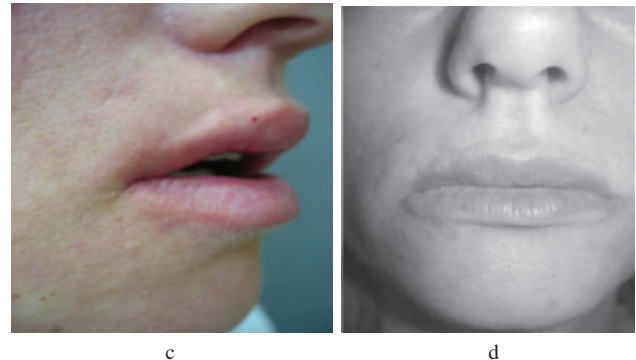


Fig.12 Showing pre and post operative views of a patient who underwent neck rejuvenation by liposuction alone.

suction-assisted lipectomy³⁸. SMAS dissection, its elevation and plication also improve the jowl deformity during facelift surgery (fig. 11).

Cervico-facial Angle and Neck : The angle between the face and the neck is very important. The sharp youthful cervico-facial angle of the neck gets obtunded with age. The restoration of a sharp cervico-mental angle and the establishment of a clean jaw line is a hallmark of youthful appearance and is, a very important facet of surgical facial rejuvenation. The obtunding of the cervico-facial angle can be due to a single or multiple factors. These include accumulation of fat, receding chin, loss of definition of mandibular border, presence of platysmal bands, and the ptotic submandibular gland. Surgical rejuvenation of this region will depend upon which of these factors are operative³⁹. The treatment is geared at addressing each of these factors individually or in combination. Liposuction alone can be used to correct the deformity of the lower face and neck (fig.12). For the most part, liposuction alone should suffice in correcting lipodystrophy, eliminating jowls, defining the mandibular border or the mandibular angle.

Mandible :The appearance of the mandible has a great impact on the lower face. Three key elements of mandibular importance include chin projection, a well-defined mandibular border and the mandibular angle. The judicious use of chin implants can greatly enhance the cervico-mental angle⁴⁰ (fig. 8). An ill-defined mandibular border and angle can be aesthetically enhanced by performing liposuction and placement of alloplastic implants⁴¹. More recently, barbed threads have been used to define the face neck angle⁴³.

Platysma Bands :Platysma bands can be resected or plicated through a submandibular incision. A very popular procedure for addressing this deformity is the called 'corset platysmaplasty'. In this procedure the platysma muscles are sutured in the midline through a submental incision⁴². Another method of addressing the problem includes raising platysma flaps which are

then pulled laterally towards the mastoid^{43,44}. The author has also corrected these bands by simple fraying at different levels with the blunt tip of a suction cannula, under direct vision, during a facelift⁴⁵.

Submandibular Gland : Ptosis of the submandibular gland is a difficult problem⁴⁶. In the past, elevation of the submandibular gland during facelift operation, and reinforcement of the fascia around the submandibular gland and the platysma muscle have been used with limited success. More recently, a total excision of submandibular gland has been recommended. Others have used partial excision of submandibular gland⁴⁷. Total excision of the gland is a rather radical cure and can be associated with significant morbidity.

CONCLUSION

Facial ageing is the result of multiple factors⁴⁸. The surgical rejuvenation of ageing face entails a detailed analysis of the factors causing the ageing⁴⁹. Surgical rejuvenation should be approached comprehensively to address the etiological factors affecting each region of the face⁵⁰. If executed properly, surgical facial rejuvenation is a very rewarding procedure.

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NON SURGICAL FACIAL REJUVENATION

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Abstract : *Hope springs eternal in the human breast, more so concerning our desire to stay or appear young. Non surgical options for facial rejuvenation are fast emerging as quick, effective and simpler options to achieve the desired goal. Various options are now available for dealing with the myriad of aesthetic ageing problems of the face, including programs of topical lotions & creams, 'Botox' for reducing wrinkles, fillers to fill in the scars and fixed rhytides, thread lifts as a quicker option to conventional face lifts in selected patients, facial peels and / or laser resurfacing to achieve a smoother, tighter and more youthful skin, non ablative laser rejuvenation tackling the triad of vascular, pigmentary and laxity components of the ageing facial skin, and lastly, but not in the least mesotherapy, which may emerge as a revolutionary technique to rejuvenate the ageing skin.*

INTRODUCTION

The process of ageing is first reflected in the skin. While many of these age-related changes are inevitable, some can be reduced with healthy lifestyle choices and good skin care. Many people accept that changes to their skin are part of the normal ageing process. Rejuvenation of the face is basically concerned with partly undoing damage caused to skin by photoageing, and also to correct / improve changes which happen with ageing in general.

SIGNS OF AGEING

Skin thinning - The basal cell layer of the epidermis slows its rate of cell production and thins the epidermis. The dermis may become thinner. Together, these changes mean skin is more likely to crepe and wrinkle.

Sagging - Aged skin produces less elastin and collagen, which means it is more likely to sag and droop. Aged skin is particularly vulnerable to the effects of gravity – e.g., jowls along the jaw and bags under the eyes are simply examples of skin that has yielded to gravity.

Wrinkling - Reduced elastin and collagen fibres in the skin, along with thinning of skin result in wrinkling of those 'high movement' areas of the face (like the eyes and mouth) which are especially prone to these effects.

Age spots - The remaining pigment cells (melanocytes) tend to increase in certain areas and cluster together forming what's known as *age or liver spots*. Areas that have been exposed to the sun, such as the backs of the hands, are particularly prone to age spots.

Dryness - Aged skin has fewer sweat glands and sebaceous glands. This can make the skin more prone to dryness and lead to roughness and itching.

Broken blood vessels - Blood vessels in older, thinner skin are more likely to break and bruise. They may also become permanently widened/stretched.

RISK REDUCTION STRATEGIES

Limit actinic exposure - Sun exposure leads to premature ageing of the skin known as photoageing. This is easily proved if one compares the skin of hands with that of the buttocks. The exposure can be limited by wearing a hat, loose fitting clothes, sunglasses and by applying SPF15+ sunscreen lotions when outdoors. Sunbathing should be avoided.

Stop smoking - Smoking promotes skin wrinkling and is thought to accelerate the damage caused by sun exposure. The action of puckering up for each drag on a cigarette increases the likelihood of wrinkles around the mouth.

Healthy diet - A healthy, well-balanced diet is as important for healthy skin as it is for a healthy body. Antioxidants help in keeping the skin youthful.

Skin care - Harsh skin irritants, such as perfumed soaps, heavily chlorinated swimming pools and long hot showers should be avoided. Instead, neutral pH balanced soaps, body washes or equivalents should be used.

Moisturizers - Dry skin is more likely to show fine lines and wrinkles. Moisturizers should be used regularly especially on dry skin.

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ANTI-AGEING TREATMENTS (FACIAL REJUVENATION)

Currently the following anti-ageing treatment modalities are available.

- | | |
|------------------------------|-------------------------|
| (i) Topical lotions & creams | (v) Thread lifts |
| (ii) 'Botox' | (vi) Laser rejuvenation |
| (iii) Fillers | (vii) Laser resurfacing |
| (iv) Facial peels | (viii) Mesotherapy |

Topical Lotions and Creams

If used regularly, they have been shown to visibly reduce fine lines, improve the quality of skin and improve skin discoloration.

These can be broadly classified in to three groups.

- | | | |
|---------------|--------------|----------------|
| a) Exfoliants | b)Tighteners | c)Depigmenters |
|---------------|--------------|----------------|

Tretinoin (Retino A cream/ gel), Adapalene (Adafarin gel 0.1%) and alpha hydroxy acids like glycolic acid, kojic acid etc. act as *exfoliants* when applied to the skin over a period of time. Exfoliation helps in taking off dead cell layers from the top of the epidermis and cause a faster turnover of younger cells, making the skin clearer, fresher and smoother. Retino A is a strong exfoliant available in various concentrations, has a remarkable ability to modify collagen, thereby producing significant tightening and reduction in fine wrinkles of the face. The main disadvantage of Retino A cream is the photosensitivity it causes, which necessitates strict avoidance of direct sunlight and use of appropriate sun block creams (SPF 30 or more). It still will cause redness of the skin which lasts well beyond the period for which it is used. Newer retinoids like Adapalene cause much less photosensitivity but the exfoliant effect is also significantly reduced. Alpha hydroxy acids are good exfoliants without the undesirable effect of photosensitivity but they do not produce any skin tightening effect. These exfoliants are often used in conjunction with *lightening or depigmenting creams* like hydroquinone (Melalite 2%, Melalite forte 4%, Hyde lotion 5% etc.). Hydroquinone inhibits the conversion of tyrosine to melanin, inhibits the formation of melanosomes and increases their degradation. Hydroquinone also inhibits the DNA and RNA synthesis in melanocytes. Thus, it ensures that the new pigment which is appearing is lighter and uniform as compared to the pretreatment heterogeneous pigment. *Topical steroids* (Mometasone, desonide, fluticasone) act to reduce the inflammatory component of the pigmentary changes in the skin which are existing, or which get induced by strong exfoliation in sensitive skin. There are various protocols to achieve improvement of photodamaged skin in terms of both texture and pigmentation. One such protocol involves using Retino-A, hydroquinone and topical steroids.

'Botox' (Botulinum toxin Type A)

'Botox' is the brand name for botulinum toxin type A, nature's most potent blocker of nerve impulses. A registered trademark of the Allergan Corporation, 'Botox' is expensive probably due to the elaborate manufacturing process. Four botulinum toxin products are available - 'Botox' (type-A, 100 units/vial), Dysport (type-A, 500U/vial), Myobloc (type-B, 2500/5000/10000U/

vial) and the Chinese toxin. The other available brands, though less expensive, are less potent, have more localized effect and are more prone to cause adverse effects.

Dynamic wrinkles on the face are caused by contractions of the delicate underlying facial muscles each time one smiles, laughs and frowns. These emotional expressions gradually lead to deeper lines and wrinkles. 'Botox' injection is a simple and safe procedure, where a very small amount of the toxin is injected precisely into targeted locations on the face, blocking nerve impulses to the muscle under the skin in the treated area. 'Botox' partially blocks the nerve impulses to segments of the tiny facial muscles that are related to expression lines. This causes the muscles to relax. After full effect of the drug, the overlying skin will become smooth and unwrinkled while the untreated facial muscles continue to function normally.

This is a simple and safe procedure. The injection is made with a 30G needle for minimal discomfort. It also allows a greater precision in delivery of 'Botox' to the specified facial area. No sedation or anesthetic is required, and normal activities are resumed immediately. 'Botox' injection generally takes 2-4 days to show full effect, reflecting the time necessary to disrupt the synaptic process. 'Botox' injections are primarily used in the upper third of the face. Forehead lines, glabellar lines, and lines around the eyes ('crow's feet') respond favorably to 'Botox'. Frown lines (below the mouth) and chin creases may also be improved with a 'Botox' injection, but response varies among individuals. Results can last from three to six months. However, with subsequent injections the duration of effect increases. Most patients are candidates for this procedure if they have dynamic wrinkles and lines. Botulinum toxin has beneficial effects only on wrinkles caused by muscular contractions, and is not appropriate treatment for wrinkles caused by solar exposure or other degenerative processes of the dermal tissues. Other contraindications for this procedure are pregnant patients and those who have neurological problems.

'Botox' is also used for correcting masseteric hypertrophy which leads to a square jaw appearance. Recently, it is being used as a chemical brow lift to achieve desired height and shape of the eyebrows. Other indications are suborbital hypertrophic orbicularis, infraorbital crow's feet, nasal scrunch lines ('bunny lines'), nasal flare, nasolabial folds, perioral lip lines, marionette lines, mental crease marionette lines, mental crease, popply chin, platysmal bands, horizontal neck lines and facial asymmetry.

Potential side effects include brow ptosis, temporary swelling or bruising at local site, upper eyelid edema, headache and rarely diplopia. Patients are advised to avoid aspirin and NSAIDs before the injection.

Fillers

Fillers can be used for aesthetic purposes to reduce the effects of ageing and photoageing, and improve the appearance of scars. Fine wrinkles, grooves and folds arising from repetitive muscle action over years, along with depletion of dermal and subcutaneous volume need to be treated in order to rejuvenate the face. Fillers can work synergistically with surgical procedures like mini face lifts. They can also be combined with procedures like laser resurfacing, 'Botox' injections, peels or 'thread lifts' in patients not desiring surgery. Facial fillers are most useful in the middle and lower thirds of the face. Ideally a filler should be easy to use, long lasting, predictable in results and behaviour, injectable through a small needle, painless on injection, non allergenic, should not migrate, be non carcinogenic, non teratogenic, stable at room temperature, free of possible transmissible diseases, have a long shelf life, and not cause significant post-injection morbidity.

Before injection, the patient is asked to discontinue any 'NSAIDs' for at least two weeks. Several other parameters need to be decided before injecting a 'filler'. There are many 'fillers' available in the market and care has to be exercised in choosing the appropriate one depending on its properties, whether it is for deep or superficial rhytides and whether a temporary or a permanent filler should be injected. Other aspects to be decided are the amount of augmentation desirable and hence the amount of filler required, and the proper

plane and areas for injection, which is specific for each filler. Then the number of sittings and follow up visits are decided.

No anesthesia may be required for injections in very superficial locations in small amounts, but deeper areas and particularly the lips, require appropriate nerve blocks for adequate patient comfort. The buccal sulci and skin are cleaned and prepped with povidone iodine and alcohol swabs, respectively, before a nerve block. Patient should be sitting in a chair with his/her head supported. The smallest needle size is used, injecting in the superficial dermis for very fine creases, mid dermis for deeper folds and deep dermis or dermo-cutaneous junction to elevate deepest folds. The linear threading technique-depositing with continuous pressure as one withdraws the needle is a good way to deposit the 'filler' uniformly. In wider areas, one may use parallel deposits of the filler to achieve the desired result. Variations like the 'fan technique' or the 'cross hatching' technique are good for deeper augmentation. Massaging the area injected just after the injection can help spread 'filler' smoothly in the area. Follow up visit is scheduled at about two weeks and any touchup procedure carried out, if needed.

Non permanent fillers

'Zyderm' and 'Zyplast' are derived from bovine collagen. 'Zyderm' is used for superficial lines and 'Zyplast' for deeper folds. A skin test is done prior to injection to ascertain any sensitivity to the product, and the first sitting is scheduled after 6 weeks of the skin test. Some overcorrection is necessary with this product because it has to be diluted with saline which is absorbed over the next 24 hours. Disadvantages with this product are the need to refrigerate, possibility of an allergic reaction and a short duration of effect lasting only 3-5 months.

'Cosmoderm' and 'Cosmoplast' are purified collagen derived from cell cultures of human fibrocytes. These cell lines have been tested for viruses and teratogenicity. No skin testing is necessary and they can be injected without a skin test. Overcorrection is also necessary with these products. It is also possible to layer 'Cosmoderm' over 'Cosmoplast' for greater augmentation. Disadvantages are same as for 'Zyderm' and even flu like symptoms have been reported in 2-4% of patients.

Hyaluronic acid gel (Hylans) is a naturally occurring linear polysaccharide forming the matrix for collagen and elastin fibers in skin and other tissues. It is not immunogenic. 'Hylans' get swollen with water (95%) and show dynamic viscosity enabling injection through small needles. They are removed from the body by isovolemic degradation. They retain most of their volume (95%) till the last bit of it is removed from the body. In this group, 'Hylan B' (Hylaform) was the first preparation used for soft tissue augmentation. 'Hylan B' is derived from rooster combs purified and cross-linked with divinylsulfone. Mild redness, itching, swelling and pain have been reported with its use but these symptoms resolve within a week.

'Restylane' (Q med) is stabilized, partly cross-linked Hyaluronic acid gel produced from cultures of streptococcus equi. It is chemically stabilized through cross-linking and heat sterilized. It has a shelf life of 1.5 years. A study claims that its effect maintains 82% at 12 weeks, and 69% at 26 weeks¹. Another study compared 'Restylane' with 'Zyplast' for nasolabial folds and it found that 'Restylane' was better in 56.9% patients, equally effective in 33.6%, and 'Zyplast' was better in just 9.5% patients². Side effects from injecting 'Restylane' are transient and mild, and noticed in about 0.15% of 1,44,000 patients³. 'Hylans' are more painful to inject than collagen. There have been some instances of delayed reactions ranging from 0.4% to 3.7% of injected patients^{4,5}. 'Restylane Touch', 'Restylane' and 'Perlane' are three variants of 'Restylane', but the quantity of Hyaluronic acid remains the same in all types (20mg/ml). The difference is in the number of particles/ml of injection. 'Restylane Touch' is for fine lines and injected in the superficial dermis, 'Restylane' is for nasolabial folds and lip, and is injected in mid dermis, and 'Perlane' the most viscous variant is injected in deep dermis/dermo-cutaneous junction for deeper folds, and cheek and chin augmentation.

There is no need to overcorrect with hyaluronic acid injections and touchup injections, if needed, can be carried out 2-4 weeks later (figs.1 & 2).

'*Radiance FN*' has microscopic calcium hydroxyapatite particles suspended in a carboxymethylcellulose gel. It is FDA approved for dental use and bone augmentation. Its use as a 'filler' is 'off label' as yet. The gel is absorbed over a period of time and gets replaced by fibrous tissue which holds the correction in place. No prior skin testing is necessary as it is not of animal origin. Sometimes calcium deposits can form lumps in the skin. It is, therefore, to be injected deeply at dermo-cutaneous junction for correction of deeper folds, wrinkles and for lip enhancement.

Reviderm Intra (Rofil Medical International) consists of 40- to 60- μ m dextran beads suspended in hyaluronic acid gel of nonanimal origin. The proposed mechanism of action is an initial macrophage response followed by fibroblast



Fig. 1a. A 60 yr. female showing static wrinkles on her forehead.



Fig. 1b. Showing immediate post - injection result after hyaluronic acid (Restylane) injection in forehead wrinkles.



Fig. 1c. Showing the result at 3 months after hyaluronic acid (Restylane) injection. Note there is a mild residual wrinkling.

proliferation and new collagen formation. The electrostatically charged dextran microspheres stimulate the collagen synthesis on depletion of HA depots. Intradermal injection without overcorrection is used to treat rhytids, skin



Fig. 2a. & 2b. Oblique views of a 60 yr. female showing pre and post injection (hyaluronic acid) improvement of deep nasolabial groove.

surface irregularities (eg, atrophic scars) and, also used for lip augmentation. Compared to other temporary fillers, it is supposed to last longer, but not permanently as is completely biodegradable. It is not FDA approved so far. *Rofilan* is the hylan gel marketed by RMI.

'*Cymetra*' is micronized cadaveric acellular human dermis, and is reconstituted in 1 ml of saline or lidocaine. It is a soft implant without allergenic tendency. Its effect lasts slightly longer than collagen and it also requires refrigeration during storage.

'*Sculptra*' is an injectable form of polylactic acid (used in absorbable sutures). It is synthetic, and proven to be non toxic, immunologically inactive and biodegradable. It is approved in the USA by FDA for treating facial lipatrophy in HIV patients, and in Europe for treating scars and wrinkles. It should be injected into deep dermis or subcutis after local anesthesia. The diluent fluid is absorbed in a week but the improvement lasts for up to 96 weeks. '*Sculptra*' is thought to stimulate collagen growth. It does not need refrigeration or prior skin testing, but multiple sessions are needed at two week intervals. Granulomas have been reported with its usage.

Permanent fillers

These are designed to remain permanently at the implanted site but it does not mean that they give a better result. In fact, permanent 'filler' may be a disadvantage because if the patient is not happy with the result there is no way it can be corrected. It is always wiser to use a non permanent 'filler' in the first instance and if patient is satisfied with the result a permanent 'filler' can be used after the effect of first injection wears off. We know that facial contour changes with time, and therefore, an implant which can be modified subsequently would always be better.

'*Artecoll*' is 'permanent filler' with PMMA (polymethylmethacrylate) microspheres in 3.5% collagen. The latter gets degraded after injection leaving the PMMA spheres encapsulated by scar tissue which cannot migrate. It is injected deeply using the threading technique. If it gets injected intradermally, by mistake, the skin blanches and injection is terminated and the area is massaged. The patient is advised to minimize facial expressions for three days to reduce the risk of implant migration. Prior skin testing is necessary and the product also needs to be refrigerated. It is contraindicated in patients with thin skin. Granulomas and persistent redness has been reported with its use.

Sheba (Hans Biomed) is injectable, micronised human dermis which is processed by elimination of cells and then freeze dried to retain the collagen, elastin and laminin of bioactive protein, to provide revascularisation and cell repopulation. "*Sheba*" makes for a real tissue restoration agent as it is easily transplanted without rejection. It can also be used as substitute for autografts. It is supposed to produce long lasting effect as it becomes incorporated in the body. *Sheba* is at first absorbed and subsequently the surrounding cells enable its incorporation into the body. As *Sheba* is micronised, it needs to be rehydrated with 2% lidocaine and injected into the subdermal plane for best results. *Sheba* offers a near permanent solution to depressed scars, facial creases and lip restoration

'*Dermalive*' / '*Dermadeep*' is a semi-permanent, non animal product,

consisting of acrylic hydrogel which is used in intraocular lens implants. There are reports of granulomatous reactions to acrylic appearing as palpable nodules six months after injection. A skin test is not required. 'Dermalive' is the same as 'Dermadeep' except that particle size is larger in the latter. *Injection silicone* has been available for many years. The original silicone marketed by Dow Corning was of 350 centistokes density. This product had several problems as an injectable implant because of granuloma formation, infection etc. Problems in the past were also seen because of excess volume injected or because of adulteration with substances like mineral oil. Silicone which is used today is 'Silikon 1000' (Alcon Labs) and it has a density of 1000 centistokes. It is FDA approved for retinal detachment and has been used for correction of facial lipoatrophy in patients with AIDS. Its use in correcting scars and wrinkles is still 'off label'. 'Silikon 1000' is a clear and colorless gel with no additives or preservatives. A serial microdroplet technique is used for injecting it and multiple sittings are needed. It does not need prior skin testing. It is stable at room temperature and is not painful if used with EMLA, is inexpensive and has a long shelf life.

Skin Peels

Modern chemical peeling was introduced at the turn of the century by Mackie, a dermatologist who was using phenol to treat facial scars. Over the years, peeling has been popularized by lay operators rather than physicians. Eventually, these procedures began to attract widespread attention because of the remarkable results that were achieved. Scientific investigation was finally undertaken by plastic surgeons and dermatologists, who delineated the indications and limitations of these procedures, with improved safety and efficacy.

Several products are currently available for rejuvenating the skin, including over-the-counter superficial peeling agents, and deeper peeling agents that should be applied only by a physician in a controlled setting. These products have proven very successful in improving the quality and appearance of facial skin. The goal of chemical peeling is to remove a controlled and uniform thickness of damaged skin. Normal wound healing and skin rejuvenation follow, and complications of scarring and pigmentary changes are avoided. The epidermis regenerates from the epidermal appendages located in the remaining dermis. This process begins within 24 hours of the peel application and is usually complete in 7-10 days. The new epidermis shows greater organization and vertical polarity, with the disappearance of actinic keratoses and lentiginos. Dermal regeneration is slower, but is usually complete within several months. The regenerated dermis demonstrates less elastosis and improved organization, with compact horizontally arranged bundles of collagen interspersed with elastic fibers. The ground substance is decreased and telangiectasias get removed. The end result is soft and supple skin, which appears more youthful with fewer rhytides and dyspigmentation.

Some physicians prefer to pre-treat the skin with isotretinoin cream, with or without hydroquinone, for 4-6 weeks to improve the results and reduce the risk of PIH.

Patient selection

One must be aware of the different types of skin to be able to select patients carefully and avoid those at a high risk for post peel hyperpigmentation. The Fitzpatrick's scale of sun-reactive skin types from lightest to darkest is given below;

Patient Type	Skin Colour	Skin Character
I	Lightest	- Always burn and never tan.
II		- Tan with difficulty usually burn.
III		- Tan but sometimes burn.
IV		- Rarely burn and tan with ease.
V		- Tan easily and rarely burn.
VI	Darkest	- Tan very easily and never burn.

Patients with lighter skin types can expect to undergo peeling with minimal pigmentation, whereas individuals with darker skin are at a higher risk for post peel hyperpigmentation .

Cooperation and compliance with the post peel regimen is required to ensure normal wound healing and to avoid complications. Patients likely to be noncompliant or unable to avoid sun exposure because of occupation are unsuitable candidates. Men are less optimal candidates because of thicker, oily skin that risks uneven penetration of the peeling agent. Men are also less likely to be willing to use camouflage makeup in the event of post peel hyperpigmentation. Patients with a decreased number of epithelial appendages from prior radiation treatment, older patients or current isotretinoin (*Accutane*) use are also poor candidates because healing will proceed more slowly and scarring is more likely. It is advisable to wait at least 12 months after stopping *Accutane* to allow some regeneration of epithelial appendages prior to peeling. The technique of chemical peeling is relatively simple, the key to a good result being in the selection of a proper patient and peeling agent. The more severe the actinic damage the more aggressive the treatment approach. However, in darker skin types, as in a majority of Indian patients, the tendency to hyperpigment, along with a noncompliant patient will be a strong contraindication to peeling. Once the appropriate patient is selected to undergo a chemical peel, informed consent is obtained after a thorough discussion of possible complications.

Alfa hydroxy acid peel (AHA, Glycolic acid)

Glycolic acid is derived from sugar cane in concentrations of 50% or higher. Over-the-counter AHA products containing 3-10% glycolic acid or other naturally occurring organic acids (lactic acid, citric acid, tartaric acid, malic acid) cause exfoliation over several days or weeks. These are also used as a pre-peel primer to potentiate the effects of application of a higher concentration of glycolic acid. Unlike other peeling agents, penetration of glycolic acid is time dependent, and thus, the agent is applied for a specific amount of time and then neutralized. The systematic application of glycolic acid with a sponge typically proceeds from one facial region to another, dividing the face into 6-8 regions and treating each in succession. The length of time that glycolic acid is left on the skin relates to its concentration. Glycolic acid is removed by washing off the agent with water or neutralizing it with an alkaline solution such as sodium bicarbonate. It is used as a superficial peel.

Following application, there is an initial erythema which may become frankly red, and it is often accompanied by edema. White patches develop subsequently, indicating separation of the epidermis from the underlying dermis. Glycolic acid is generally used as a superficial peeling agent and development of a frost indicates destruction into deeper dermis, which is not desirable. Exfoliation occurs over several days, and re-epithelialization is complete within 7-10 days. Multiple treatments may be required to achieve desired results and should be spaced several weeks apart. Glycolic acid peels produce the least dramatic of results, but also have the lowest frequency of complications.

Trichloroacetic acid peel

Trichloroacetic acid (TCA) is typically used as an intermediate-to-deep peeling agent, concentrations ranging from 20-50%. Depth of penetration is increased as concentration increases, with 50% TCA penetrating into the reticular dermis. Concentrations higher than 35% are not recommended because of the high risk of scarring. TCA is a keratocoagulant that produces a frost or whitening of the skin, which is dependent on the concentration used. Vigorous rubbing of the agent, as compared to blotting, yields a deeper penetration. This technique is not time dependent, and the agent does not require neutralization. The systematic application of TCA with a sponge also involves treating the face in a succession of 6-8 regions. TCA application is associated with an intense burning that usually resolves within 30 minutes. Administer appropriate analgesia prior to the procedure and consider regional nerve

blockade with lidocaine. Patient comfort may also be improved by having a fan to cool the face and by applying sponges soaked in iced saline prior to moving from one facial region to another.

During the procedure, if the frosting is not uniform or complete, reapplication may be performed until frosting of a desired plateau is reached. The application of topical lidocaine 4% immediately following the peel decreases the burning sensation. Once completed, exfoliation proceeds for several days, and re-epithelialization is complete within 10-14 days.

Phenol peel

Phenol peels may be used in various ways; as pure phenol (88%) or phenol mixed with soap, water, croton oil, and sometimes olive oil. Baker-Gordon, Venner-Kellson, Maschek-Truppman, and Grade are a few of the combinations. The Baker-Gordon formula consists of (USP) phenol, tap water, liquid soap, and croton oil in fixed amounts.

Phenol causes keratolysis and keratocoagulation. In contrast to other agents, increasing the concentration of phenol actually decreases the penetration up to a point, because the ensuing destruction forms a barrier to further penetration. Pure phenol does not penetrate as deeply as the various formulations. Similar to TCA, the time spent applying the agent and the amount of sponge strokes used will be proportional to the depth of penetration. The addition of croton oil to the various formulations as a skin irritant also allows deeper penetration. Although phenol produces the most remarkable resolution of actinic damage and wrinkling among the various peels, it also possesses some of the more significant morbidities. Many have abandoned phenol in favor of other agents or laser resurfacing. Marked hypopigmentation may result following the use of phenol and is correlated to the depth of penetration, use of the Baker-Gordon formula, and the addition of croton oil. Hypopigmentation may occur in all skin types, noticeably lightening the skin of patients with darker skin and making lighter-skinned patients appear waxy or pale. A clear line of demarcation may be present between treated and untreated skin.

Phenol causes an intense burning upon application that may last 4-6 hours, which is much longer than the discomfort associated with other peeling agents. Administer appropriate analgesia prior to the procedure and consider regional nerve blocks. Patients also must be provided with sufficient oral analgesics and anxiolytics for use at home following the peel.

The toxicity of phenol may be significant. Phenol is absorbed through the skin, metabolized by the liver, and subsequently excreted by the kidneys. Some practitioners preload the patient with fluids to facilitate renal clearance. Overdose may injure the liver and kidney and may also lead to myocardial irritability, including arrhythmias. The face is again divided into 6-8 regions, but 20 minutes must be allowed to elapse between treating subsequent regions. This allows for some ongoing metabolism and avoids a toxic systemic dose. Post peel care involves applying a generous amount of any ointment (eg, white petroleum jelly, antibiotic mixed or plain) to the entire treated area and to reapply the ointment throughout the day, any time the face feels tight or dry. As the outer layers begin to shed, the patient is allowed to shower and gently wash the face with nonresidue soap using fingertips only. The face should be patted dry and a new coating of ointment applied. Instruct patients to not pick at the face during the recovery period. Examine the face every 48 hours till complete healing takes place.

Results and complications are generally related to the depth of injury, with deeper peels providing more marked results and a higher incidence of complications. Complications are also more likely with certain skin types and certain peeling agents.

Erythema generally subsides within 90 days but may become prolonged in form of hyperpigmentation. The application of topical hydrocortisone lotion and/or a short course of systemic steroids may lead to earlier resolution.

Following chemical peeling, the skin is very sensitive to the sun, which also may result in hyperpigmentation. Patient is instructed to use sunscreen daily for 6-12 months following a chemical peel. Hypopigmentation is the

result of melanocyte destruction or inhibition from too deep a peel, seen most frequently when phenol is used. Hypopigmentation is more noticeable on darkly pigmented patients. Hypopigmentation may be difficult to assess until erythema has subsided, at which point the condition unfortunately becomes permanent. The line of demarcation between treated and untreated skin is usually the most noticeable.

Delayed healing may lead to hypertrophic scarring, a complication which requires close follow-up and aggressive early treatment. Silicone sheeting, pressure application, and scar massage may improve outcome. Infectious complications are unusual but also demand vigilance and aggressive therapy with oral and topical antibiotics. Herpes exacerbations are treated with oral and topical acyclovir until resolution.

Thread Lift (APTOS, 'Contour threads')

The 'thread lift' is a non-surgical facelift procedure. Patients likely to benefit include all individuals with ageing signs of the face, including droopiness of the skin of the brow, cheeks, jowls and neck. Patients whose faces are very heavy or very thin are not ideal for this procedure. The 'thread lift' is a minimally invasive office procedure performed under local anesthesia that is designed to elevate, reposition and lift lax skin of the brow, face and neck without surgery. The 'thread lift' employs 'cogged'/'barbed' threads which are inserted painlessly under the skin (fig.3).

Under local anesthesia, the threads are passed into the droopy facial element

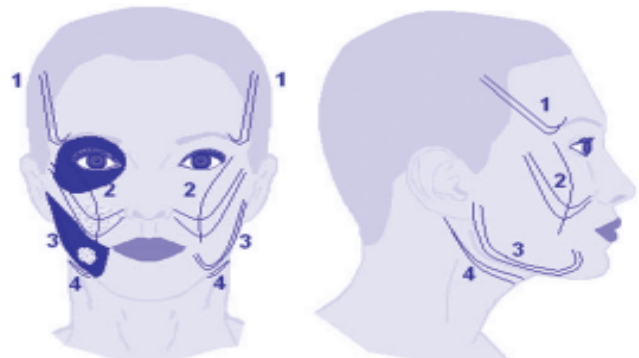


Fig. 3. Diagrammatic representation of the facial zones which are addressed during face-lift with 'Threads'. It also shows the number of 'Threads' and the direction of the insertion to obtain the proper vector for pull. (Photo courtesy: <http://www.facialplasticsurgery.net/forum/forum.php>)

with a special guide needle. Once all threads have been placed, they are tightened one by one. The threads are then able to grab on to the lax soft-tissue and muscle of the desired area to achieve the desired lift. The projecting extra lengths are then pulled and snipped off. Four to six threads will be necessary on either side for adequate correction of the entire face. The threads stay in position like all internal sutures and are well tolerated by the body. The procedure takes approximately 1-2 hours depending on the number of sites to be treated. The threads lift procedure is reliable and even reversible.

The effects of 'thread lift' can be noticed immediately. Patients can achieve 30-70% of what a surgical facelift may achieve, and well over 90% of 'thread lift' patients are very satisfied with the results. The 'thread lift' procedure can also be combined with a mini surgical face lift or any other non surgical rejuvenating procedure to obtain further skin tightening. The effect of a 'thread lift' procedure is expected to last 3-5 years and it can be repeated. Some patients may choose to have a surgical facelift in the next sitting.

The 'thread lift' has very minimal 'downtime' (the time a patient can not function normally). Most patients experience minimal bruising or swelling for 1-7 days. For first 2-3 days after the procedure the skin feels tight and swollen. The 'thread lift' is not a painful procedure and most patients can

return to normal activities, with makeup, the next day (fig.4a-c).

Laser Resurfacing

Advances in laser technology have allowed laser surgeons to improve appearance of skin, scars and wrinkles using ablative lasers. The lasers which are used are the carbon dioxide laser (both scanned and pulsed), the Erbium:YAG laser, or a combined CO₂:Er:YAG laser. Only fine to moderate rhytides (wrinkles) are likely to show improvement with this technique, and other modalities like 'fillers' or fat injection may be needed for more severe rhytides. Superficial pigmentary disorders like lentiginos, and superficial, atrophic, post acne or trauma scars can also be significantly improved. Earlier chemical peels were done to induce reepithelialization and neocollagen formation, but now laser resurfacing is considered more effective and a controlled alternative.

Laser resurfacing, like dermabrasion, relies upon the presence of skin appendages (e.g., sebaceous glands, hair follicles, sweat glands) as sources of epithelium that can migrate to reepithelialize the surface. Therefore, the greater the number of skin appendages per square centimeter of skin, the more rapid the healing and the less risk for scarring. For this reason, carbon dioxide laser resurfacing is largely limited to the face because it has large density of skin appendages. Resurfacing of the hands and neck has been successful, although, much greater risk for scarring exists when treating these areas. EMLA cream (lidocaine cream) and/or regional blocks, with/without sedation are adequate for full face resurfacing.

Carbon dioxide laser

The carbon dioxide laser became a popular tool with the laser surgeon, and its advantages and limitations are well documented. Although, long-term skin tightening and improvement of wrinkles is excellent, marked erythema persists for several weeks or months and the risk of hyperpigmentation occurring especially in darker skin types, deterred many from using it in their patients. Even without complications, the early period of recovery until full reepithelialization can take up to 2 weeks. The newer pulsed carbon dioxide lasers ablate tissue to a depth of 20-30 μm with each pass and cause collateral damage to a surrounding area of 20-70 μm . Collagen contracts by approximately 15-25% during carbon dioxide lasing, producing a shrunken form that serves as a template for tighter, more organized new collagen formation².

Various parameters using different lasers have been described for appropriate effect. In a study comparing scanned and pulsed CO₂ lasers it was observed that maximal skin shrinkage of $5.1 \pm 0.1\%$ per pass occurred using the scanned laser (Sharplan, Silk touch) at 5.9 J/cm^2 . Compared to this a pulsed laser (Coherent, Ultrapulse), achieved a maximal shrinkage of 3.6% at 2.5 J/cm^2 (220 mJ). Skin thermal denaturation, however, was shown to be a maximum of 25 μm with the pulsed carbon dioxide laser at 3.5 J/cm^2 (320 mJ) and 77 μm with the scanned laser at 9.1 J/cm^2 .^{3,4}

Erbium:Yttrium-Aluminum-Garnet (Er:YAG) laser

Other lasers were developed for resurfacing so that light energy could be delivered more selectively to the skin, resulting in less severe adverse effects from collateral damage. The erbium:yttrium-aluminum-garnet (Er:YAG) laser was introduced as a bone-cutting tool in the United States in 1996. The cutaneous absorption of the Er:YAG laser energy by water is 10-fold more efficient than that of the carbon dioxide laser, allowing for more superficial tissue ablation and finer control. Its chromophore (energy absorbing pigment) is water, similar to the carbon dioxide laser. However, the Er:YAG emits a wavelength of 2940 nm, which is absorbed efficiently by water because of water's 3000-nm absorption peak. The passes of Er:YAG laser penetrate to a depth of only 10-15 μm , and several passes only cause collateral thermal necrosis to a distance as thin as 20-50 μm . With the Er:YAG laser collagen contraction is 1-2% during lasing, and it may only reach 14% in the long



Fig. 4a. Front view of a 40 year female with mild sagging of malar fat pads and jowls.



Fig. 4b. Showing markings of proposed site of insertion of bidirectional 'APTOS' to achieve lift of sagging skin and fat pads.



Fig. 4c. Postoperative front view following insertion of 3 'threads' on each side of the face. Note the subtle elevation of the malar and jowl areas. This patient will further benefit from additional 'threads' in the jowl region and by injection of a 'filler' in the nasolabial folds.

term^{5,6}. There is no charring and only a transient white discoloration of the wound bed occurs. Dermal vessels treated with the laser dilate and cause transudation of fluid which in turn increases the water (chromophore) content in the treated area and allows for consistent ablation with each subsequent pass⁷. Spot size, fluence, and pulse repetition rate are the 3 parameters which have to be developed to get adequate ablation. Many laser surgeons use a 3- to 5-mm spot size, a pulse energy of 1-2 J, and a pulse repetition rate of 1-10 Hz. A fluence of 5 J/cm^2 per pass is usually used in delicate areas such as the periorbital and preauricular regions or for superficial lesions. Higher energies ($12-15 \text{ J/cm}^2$ per pass) are used in thicker, more heavily photodamaged or

scarred areas such as the cheeks, chin, perioral areas, and forehead. The epidermis can be completely ablated after 2 or 3 passes using a standard laser, although, severely damaged skin, deep rhytides or scars, and deep dermal growths may require as many as 20 passes⁸.

Combined lasers

Newer laser systems, such as the combined Er:YAG/carbon dioxide lasers and the high-energy variable pulse Er:YAG lasers are also available now. A dual-mode Er:YAG laser calibrated at a fluence of 22.5 J/cm², ablation depth of 90 µm, and coagulation depth of 50 µm is also used. The passes are overlapped 50% to vaporize the epidermis in a single pass. An additional 1-2 passes are applied to residual rhytides and scars. The final layer of desiccated tissue is left in place to serve as a biological wound dressing⁹.

Precautions and Prophylaxis

History of previous resurfacing, prolonged ultraviolet exposure, prior radiotherapy or 'deep peels' should be kept in mind before selecting a patient for laser resurfacing, as there is a possibility of delayed healing and scarring. Similarly, if a patient has been using oral isotretinoin there should be a gap of at least 6 months before starting laser resurfacing. Patients with a history of post inflammatory hyper pigmentation or showing a tendency towards keloid formation are cautioned about these risks post laser resurfacing. Routine prophylaxis against herpes simplex is advisable prior to laser resurfacing of the face.

Postoperative care

Postoperative care can be by an open or closed method. In the open method, which is preferred, application of copious amounts of topical emollients is carried out to promote rapid reepithelialization without risking prolonged occlusion and inability to observe the wound surface. Mild complications do occur occasionally and are of no serious consequence.

Laser Rejuvenation

The term 'rejuvenation' includes treatment of any or all of the characteristic elements of cutaneous 'photo damage'. It suggests a 'reversal' of the photo-ageing process. The name is a misnomer, as it is not the photo-ageing process that is reversed, but it is enhancement of the overall cosmetic appearance through elimination or masking of unwanted effects.

Non ablative laser rejuvenation procedures induce a dermal healing response without notable injury to the epidermis. Improving appearance of the skin without injury to the epidermis is a hallmark of non ablative skin rejuvenation. This is achieved by producing a sub-threshold laser-induced injury to the dermis and/or the dermal vasculature which results in a wound repair response by fibroblast stimulation and collagen reformation.

Coherent and non-coherent light-based laser devices have been used by various operators to perform rejuvenation. These may include several types of vascular and pigment lasers, as well as those that stimulate dermal fibroblasts to produce collagen. Increasing evidence suggests that lasers in the mid-infrared range of spectrum may be the best choice for safe non ablative resurfacing on a wide range of skin types, for e.g. the 1320-nm Nd:YAG laser (Cool Touch) and the 1064-nm long pulse Nd:YAG laser, the 1450-nm diode laser, the 1064-nm Q-switched Nd:YAG laser, and the intense pulsed light source. This field is rapidly evolving, and newer modalities are expected over the next few years. More recently, the use of intense pulsed light (IPL) technology has revolutionized photorejuvenation by its ability to address both the pigmentary and vascular components of photoageing, and fine wrinkling to a lesser degree. This is all performed with relative ease and efficiency, and minimal downtime.

In one study, 49 subjects with varying degrees of photo-damage were treated with a series of four or more full-face treatments at 3-week intervals using a non ablative, non laser, intense pulsed visible light source (IPL). Fluences superscript varied from 30 to 50 J/cm². All aspects of photodamage including

wrinkling, skin coarseness, irregular pigmentation, pore size, and telangiectasias showed visible improvement in more than 90% of subjects with minimal downtime and no scarring. Eighty-eight percent of subjects were satisfied with the overall results of their treatments.¹

In another comparative study patients on with perioral rhytides and Fitzpatrick skin types II and III treatments with the IPL using 590 and 755 nm cut-off filters, and the 1,064-nm Nd:YAG laser were evaluated. The subjects were evaluated at 2, 4, 8, 12, and 24 weeks after the final treatment for improvement in rhytides and presence of any side effects. At 6 months, the patient satisfaction score (1-10) was comparable in all three groups. Evaluator assessment of improved skin quality was also similar in all three treatment groups. Side effects such as blistering and erythema were most commonly seen in the subjects treated with the IPL. The least discomfort was seen with the Nd:YAG laser. It was concluded that although both non-ablative treatment systems improved facial rhytides presumably by causing a non-specific dermal wound, the Nd:YAG laser was better tolerated and produced fewer side effects.²

Mesotherapy

This is the latest modality in non surgical facial rejuvenation. It is a technique by which 'drugs' or 'nutrients' are injected in the skin and subcutaneous tissues to obtain a therapeutic effect. Various delivery methods, ranging from simple fine injection needles to a 'meso gun' are employed. The 'gun' ensures delivery of the required drugs into the tissues in precise amounts, uniformly all over the target area, in a rapid manner. The earliest indication for its use was for 'spot fat reduction' and the drug most commonly injected was phosphatidylcholine, used alone or in combination with other drugs in a cocktail. The therapy has still not received US FDA approval.

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AESTHETIC RHINOPLASTY

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Abstract : Rhinoplasty is the most commonly performed aesthetic surgery procedure. It is universally acknowledged as the most difficult cosmetic surgery operation and requires a precise understanding of the anatomy and high surgical skill. A proper preoperative counseling is mandatory to define a clear set of aesthetic goals as some patients may want a change that cannot be achieved by surgery or that will not be harmonious with the face. It is essential to maintain a photographic record of the deformity and the result in standard views. The nasal deformity may be corrected by a 'closed' or an 'open' approach. Whereas simple operations like correction of nasal hump or dorsal nasal augmentation may be performed by the 'closed' approach, more complicated nasal deformities, including secondary rhinoplasties require an 'open' approach. The change in patient profile is immediately appreciable, however; it can take almost a year to notice the final change. Surgical complications are rarely noticed but aesthetic complications are feared and can only be eliminated by experience. A secondary rhinoplasty is only undertaken after a delay of at least one year to allow for scar remodeling and to obtain suppleness of tissues.

INTRODUCTION

Rhinoplasty, also known as 'the nose job', is the most commonly performed aesthetic procedure all over the world. Aesthetic rhinoplasty is universally acknowledged as the most elegant, but arguably, the most difficult cosmetic surgery operation. Past two decades have witnessed remarkable improvements in the precise understanding of anatomical and physiological aspects of various nasal elements, and their inter-relationship.

A detailed description of all rhinoplasty techniques is beyond the scope of this manuscript.

PERTINENT NASAL ANATOMY

The nose is a pyramidal structure occupying the central 1/3rd of the face. It is divided into two symmetrical chambers by a median septum, lined on the inside by the mucous membrane and covered externally by soft tissues including the skin, subcutaneous tissues and a fibromuscular layer. The nose has been traditionally divided into three compartments: the bony vault, the upper cartilaginous vault and the lower cartilaginous vault (fig.1).

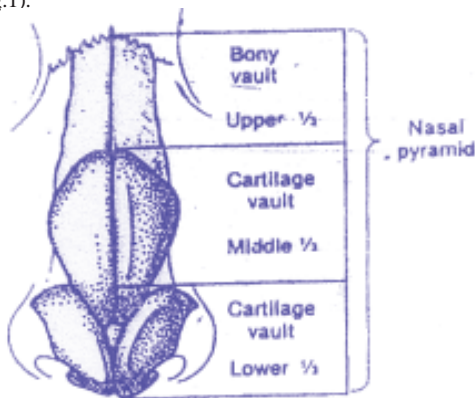


Fig.1 Showing three compartments of nasal pyramid: the bony vault (upper third), the upper cartilaginous vault (middle third) & the lower cartilaginous vault (lower third).

The bony vault is formed by the paired nasal bones supported laterally by the paired frontal processes of maxillae and posteriorly by the nasal spine of the frontal bone. Their articulations contribute the rigid structural

support to the cartilaginous portions of the nose.

The upper cartilaginous vault is formed by the paired upper lateral cartilages and the dorsal cartilaginous septum. Upper lateral cartilages are fused to the septal cartilage along much of the dorsum forming an angle of about 15 degrees in the area of internal nasal valve. The nasal septum has cartilaginous and bony components. The osseous septum is composed of the perpendicular plate of ethmoid, vomer, the nasal crest of maxilla and the nasal crest of palatine bone. The septal cartilage forms the major part of the caudal portion of the nasal septum and protrudes in front of the piriform aperture. Superiorly, it articulates with the perpendicular plate of ethmoid and posteriorly with the vomer and the premaxilla (fig. 2). The junction of the dorsal and the caudal border of the septal cartilage is called the septal angle.

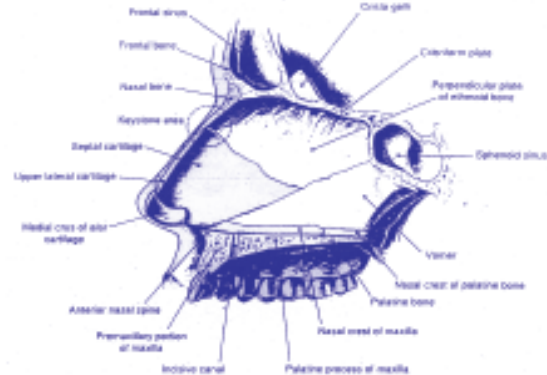


Fig.2 Sagittal view of the nasal septum showing the inter-relationship of its osseous & cartilaginous components. The confluent area of four solid structural elements viz. nasal bones, perpendicular plate of ethmoid, nasal septum & upper lateral cartilages is the 'keystone area' (depicted with a interrupted circle)

The lower cartilaginous vault comprises of the paired lower lateral (alar) cartilages, the accessory cartilages and the fibro-fatty connective tissue. The alar cartilages provide support and configuration to the tip of the nose and the columella. Each alar cartilage is subdivided into three crura (medial, middle and lateral) with two important junctions (columella breakpoint and dome defining point) (fig. 3). The domal segment of the middle crus forms the dome, which is the most projecting part of the alar cartilage. The lobule is the entire mobile area overlying the alar cartilages, whereas the true intrinsic tip incorporates just the area between the tip-defining points transversely, and between the columella breakpoint and supra-tip point vertically. The columella separates the nostrils and joins the tip of the nose to the upper lip.

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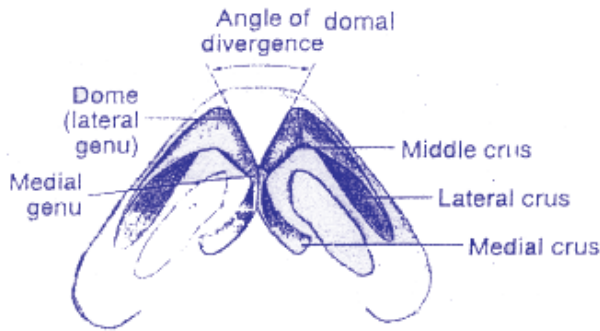


Fig.3 Basal view of the paired alar cartilages showing their subdivisions into medial, middle & lateral crura. The middle crus forms the 'lateral genu' at its junction with the lateral crus, and the 'medial genu' at its connection with the medial crus.

NASAL PROPORTIONS AND AESTHETICS

The distance along the dorsum of the nose from the nasion to the tip defining point is *nasal length*. The horizontal distance from right alar groove to the left alar groove is *nasal width*. The angle between glabella and the root of the nose is *nasofrontal angle* (range: 125-135 degrees) (fig. 4). The angle between the columella and the upper lip is called *nasolabial angle* (range: 90-105 degrees) (fig. 4).

In *frontal view*, the nasal width should be equal to the intercanthal



Fig.4 Showing the nasofrontal and the nasolabial angles.

distance. In *profile view*, the radix of the nose should be located at the deepest point of the nasofrontal angle. There should be 2-4 mm of columellar show. In the *basal view*, the nose should have the appearance of an equilateral triangle.

INITIAL CONSULTATION

It is mandatory to define a clear set of aesthetic goals with every patient. Some patients may want a change that cannot be achieved by surgery or that will not be harmonious with the face. With anxious / depressed / over demanding / unrealistic patients, the best course is to explain that the surgery is not likely to fulfill their desires and refuse to operate.

Preoperative Examination

The whole face should be examined in frontal, profile and basal views for aesthetic proportions.

An assessment is made of skin thickness, relative length and width of the nasal bones, presence of deviations of the dorsum and / or tip, osseo-cartilaginous hump, tip projection, position of the domes, shape and size of alae, nostrils and columella, deviation of the caudal border of the septal cartilage, extent of the columellar show, and also the inclination of nasofrontal and nasolabial angles. The relationship of the chin projection to the nose should also be documented.

The internal nose (vestibules) should also be carefully examined with a fiberoptic rhinoscope or by a nasal speculum. The condition of mucosal lining, inferior and middle turbinates, internal nasal valve area, presence of septal deviation or perforation should be carefully

noted.

The patient is made aware of any limitations the examination findings may impose on the desired surgical outcome, possible complications and the expected post operative course. He/ she should be explained that the surgically altered nose continues to be modified by the healing process and it is seldom possible to designate a final result immediately following rhinoplasty.

Documentation

Besides carefully recording patient complaints and examination findings, color photographs of each patient are taken before, and serially after the operation, in standard views (front, right and left lateral, right and left oblique, and basal). Operative details with diagrams should always be entered into the data sheet, at the end of the operation, by the surgeon himself.

LAB INVESTIGATIONS

Routine blood and urine analysis along with other preoperative investigations depending upon the patient's age and medical history are carried out.

ANAESTHESIA

Most of the patients request for general anaesthesia. However, a combination of monitored intravenous analgesia with local topical and infiltration anaesthesia is preferred by some surgeons. Infiltration with a vasoconstrictive agent (1 % xylocaine with 1: 100,000 dilution of adrenaline) is always used to minimize blood loss. Infiltration must avoid tissue distortion.

OPEN VS. CLOSED APPROACH

A rhinoplasty can be performed by an open or a closed approach. The *closed approach* is performed by making intranasal incisions and is more complex to teach and learn. It has the inherent disadvantage of limited exposure, visibility and flexibility. But, it leads to minimal scarring and oedema. The common indications for an endonasal approach are a dorsal hump reduction, dorsal augmentation, minor tip problems and minor deviation of the nasal septum. Most of these corrections can be done under local anaesthesia supplemented with intravenous sedation.

In the *open approach* the entire nasal skin is stripped off the dorsum. It provides an excellent exposure and is better suited for 'problem noses' (revision rhinoplasty / cleft lip rhinoplasty / complex nasal deviations / severe tip distortion or gross asymmetry / large septal perforations etc).

GENERAL SEQUENCE OF OPEN RHINOPLASTY

The basic steps of rhinoplasty described below are applicable to correction of most of the nasal deformities but they are not necessary in every case.

Incisions : For an *open approach*, *infracartilaginous* / *marginal incisions* (fig. 5a) are made at the caudal margin of each alar cartilage and they are joined by a *transcolumellar incision* (fig. 5b). This allows

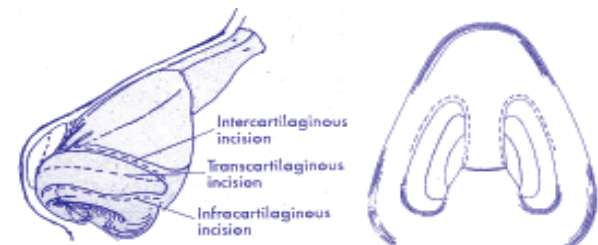


Fig.5a & 5b Diagrammatic representation of the location of the intercartilaginous, transcartilaginous and infracartilaginous incisions (see text for details). Showing the transcolumellar incision, which joins the infracartilaginous incisions on either side to, for open rhinoplasty.

the soft tissues of the nose to be elevated off the underlying osseocartilaginous skeleton. The transcolumellar incision may be curvilinear, chevron, inverted chevron or a stair-step incision. It is generally located in the middle or lower third of the columella.

After incisions, a sharp, curved scissors is used to dissect the skin and the soft tissue off the lateral crus on either side. Likewise, the columellar skin is carefully dissected off the caudal margin of the middle crus, to completely expose the lower third of the nose.

Dorsal Reduction : Dorsal reduction is done conservatively to preserve the structural support of the nose. Overzealous resection is the commonest cause of secondary deformities, as open roof, concave dorsum and collapsed internal valve.

Subperichondrial tunnels are created by reflecting the mucosa, on both sides, under the dorsum of the nose. This allows dorsal reduction without transecting the functional mucosal lining.

Bony dorsum is reduced first. Rasps are preferred over chisels as they allow more gradual reduction of the bony hump. The exact amount of cartilaginous hump (septal cartilage and the upper lateral cartilages) to be removed becomes apparent now. Controlled reduction of the cartilaginous hump is performed under direct vision with a serrated scissor or blade. The nose is inspected and palpated after each incremental reduction to ensure a straight and smooth profile.

Nasal Shortening: A conservative excision of the caudal septum and partial excision of the anterior nasal spine can be performed to achieve shortening of nasal length.

Inferior Turbinates: Turbinates are almost always hypertrophic on the concave side of a deviated septum. There is seldom an indication for turbinectomy because a total resection leads to impairment of function and partial resections are frequently followed by relapse. However, a partial turbinectomy may be performed in a very narrow nose.

Septal Surgery: Correction of any septal deviations or harvesting of the septal cartilage grafts is done at this stage. Septum can be approached either by '*tip split technique*' separating the medial crura from each other or by a '*dorsal split incision*' which detaches the upper lateral cartilage from the dorsal septal border. Mucoperichondrial flaps are elevated from either side of the septum. The flap elevation is carried well past the osteochondral junction of the nasal septum. Minor septal deviations can be corrected by transecting the septal cartilage along its inferior border in the vomerine groove and also vertically at its junction with the perpendicular plate of ethmoid bone. Partial thickness incisions on the septal cartilage on one surface allow it to warp on the opposite side, and can help in correcting deviation.

For major deviations a septal resection is necessary. This is achieved by the Ballengers' swivel knife and the harvested cartilage piece can be used as a graft, if necessary. The deviated part of the vomer should also be resected otherwise the nasal septum will not come to the midline. To maintain the dorsal and columellar support of the nose, and to prevent a septal collapse, an L-shaped strut of septal cartilage measuring at least 1 cm dorsally and 1 cm caudally must be left intact. If this caudal strut is also deviated it must be relocated to the midline and fixed.

Nasal Osteotomies : A major hump resection inevitably results in a flat plateau along the nasal dorsum. Obliteration of this open roof is accomplished by medial mobilization of the lateral bony walls which simultaneously narrows the nasal pyramid.

A *lateral osteotomy* can be performed by either an intranasal or a percutaneous approach. In *intranasal approach*, an incision is given in the nasal vestibule at the pyriform aperture area and subperiosteal tunnels are created along the proposed lines of osteotomies on either side. An osteotome is gently advanced by careful manipulation.

In *percutaneous lateral osteotomy*, a 2 mm wide osteotome is introduced percutaneously about 3 mm medial and caudal to the medial canthus of the eye. Several small perforations in the bone, along the line of the osteotomy, are made through the same incision by altering the position of the osteotome. No subperiosteal undermining is done. When a minimal to moderate amount of medial mobilization is required the osteotomy line extends from the pyriform aperture inferiorly to end at the frontonasal suture superiorly (*low to high*). For greater mobilization a '*low to low*' osteotomy is made where it extends straight up to the level of the inner canthus superiorly. This is always combined with the transverse percutaneous osteotomy.

Now a *hinged* greenstick fracture is created (infracture) by manually displacing the osteotomised bones medially. The stability of the mobilized segments is contributed by the intact mucosal lining, the periosteum and the soft tissues attachments externally. A sustained and uniform pressure is now applied by compressing the nose to reduce the bleeding. The nasal dorsum is checked for irregularities.

A *medial osteotomy* is not necessary in all cases. Only when the bone resection of the dorsum was minimal and the bony base width still needs to be reduced, it is necessary to perform the medial osteotomies before infracturing the nasal bones.

Dorsal Augmentation : Requisite grafts for the dorsum, tip and the columella can be carved from resected nasal septum. If necessary, cartilage can be harvested from concha or costal cartilage. A 'boat shaped' piece of cartilage is placed over the nasal dorsum to correct a saddle deformity of the nose.

Correction of Nasal Tip : In external rhinoplasty, tip sculpturing is usually executed after dorsal profile alignment. It should be assessed whether the tip requires a reduction in the volume, a change in the orientation of the alar cartilages or tip projection, a cephalic rotation to increase the naso-labial angle, a narrowing of the interdomal distance or a combination of the above.

Tip-sculpturing procedures include tip-grafts, suture techniques, alar cartilage excision and columellar grafts etc. In most cases, only a conservative *reduction in the volume of the cephalic border* of the lateral crus is needed to refine the tip. It is necessary to preserve a continuous, 6-8 mm wide strip of lateral crus to ensure long term support and natural contouring. Inherent dangers of scarring and asymmetric healing exist whenever the complete alar cartilage strip is interrupted. *Resection of the fatty tissue located between the alar domes* further improves tip definition.

Domal, transdomal and interdomal sutures (*suture techniques*) also provide predictable long term narrowing and refinement of the tip.

Height and contour can also be added to the tip with *autogenous cartilage grafts* from the nasal septum or auricular cartilage. Placement of a shield shaped infratip lobular graft / onlay tip cartilage graft in the domal area increases tip projection. Columella strut grafts placed in between the two medial crura can be used to provide structural support to the tip. They also enhance tip projection. These grafts can be sutured in place for better and long-term stability.

Closure : After tip remodeling is complete the skin is redraped for final evaluation before closure. All intranasal incisions are closed with 5-0 vicryl. A 6-0 nylon suture is used for closure of the transcolumellar incision.

Nasal Base Sculpting: Aesthetically, the width of the nasal base should be equal to the intercanthal distance. After the incisions for rhinoplasty have been closed, nasal base modifications are carried out by excision of a wedge or crescent from the alar base on either side. They should always be done conservatively. This is necessary when the alar base is excessively wide and thick or there has been an excessive diminution



Fig.6 a,b Pre & Post operative view of young girl after hump removal by rasping using an endonasal approach.



Fig.7 a & b Front and profile views of a 24 year old boy with saddle deformity of the nose following trauma.



Fig.7 c & d Postoperative front and profile views of the same patient following dorsal nasal augmentation with a polyethylene (Porex) implant, using an endonasal approach.

in the projection of the nasal tip leading to flared alae.

Dressing and Splintage : Intranasal packing is done with paraffin gauze. An external dressing is done with steristrips to redrape the skin and position the nasal tip. It is also necessary to apply a conforming nasal splint (POP / acrylic / orthoplast) to maintain the position of the osteotomised nasal bones and to restrict oedema formation.

CLOSED / ENDONASAL APPROACH

Incisions (fig. 5a): An *infracartilaginous / marginal* incision made at the caudal margin of the alar cartilage can be extended to join the 'transfixion' incision (incision along the caudal edge of the septum behind the columella) to provide access.

However, most often a *transcartilaginous / infracartilaginous / cartilage splitting* incision is used for the closed approach. It transects the alar cartilage at roughly the same distance from cephalic and caudal edges and extends from the lateral end of the lateral crus to the dome. It can also be extended to join a transfixion incision.

The *intercartilaginous* incision made between the lower margin of upper lateral cartilage and the upper border of the lateral crus of the alar cartilage is less employed these days because it may result in scarring in the region of the internal valve causing interference with nasal breathing. Often, it has to be combined with an infracartilaginous incision for better visualization (*delivery approach*). This approach is employed for a more difficult tip plasty. The



Fig.8 a & b Basal and profile views of an 18 year old girl who was operated in infancy for cleft lip defect. The secondary deformity of the lip and the nasal deformity are clearly visible.



Fig.8 c & d Showing postoperative views (basal and profile) of the same patient. She underwent a single stage correction of her lip and nasal deformity by an open approach. She required alar modification, submucous septal resection, dorsal nasal augmentation with iliac bone graft and relocation of the caudal septal strut. She also required maxillary augmentation with cancellous bone chips from the iliac crest. Note the improvement in the shape of nasal tip and nostril symmetry in basal view and the improvement in nasolabial angle, columellar show and the maxillary prominence on the profile view.

lateral crura can be dissected free from the overlying skin and 'delivered' as individual bipedicle chondro-cutaneous flaps for sculpting. Many rhinoplasty surgeons have abandoned the 'delivery method' in favour of the external approach.

POST OPERATIVE MANAGEMENT

The head is kept elevated to decrease oedema and oozing. The patient is prescribed antibiotics and anti-inflammatory drugs for 5 days and is kept on a liquid diet for 24 hours. Intranasal packs are removed after 48 hours. They may be left for 3-4 days if a septoplasty has been performed. The nasal splint and sutures are removed on 5th / 6th postoperative day. Strenuous exercises are avoided for three weeks.

Postoperative oedema is maximum at 48 hours and it gradually subsides over 3-4 weeks. The surgically altered nose continues to be modified by the healing process for up to 18 months after surgery.

RESULTS

Aesthetic rhinoplasty is a very exacting procedure but extremely rewarding. The change in patient profile is immediately appreciable (fig 6-8), however, it can take almost a year to notice the final change.

COMPLICATIONS

Despite the complexity of rhinoplasty, complications during the post operative period are relatively uncommon. *Infection* is rare after rhinoplasty. Use of prophylactic antibiotic is always necessary. *Nasal bleeding* may occasionally occur after pack removal. It can usually be controlled by elevation of the head, compression at the base of the nose and by repacking. *Haematoma* formation is rare as the nasal incisions are not closed tightly. Moreover, intranasal packing, application of steri-strips and external splintage obviates any dead space. An undetected intra-septal haematoma may lead to septal cartilage necrosis and loss of nasal support. *Necrosis of the external nasal*

skin may result from an incorrect plane of dissection or from attempts to radically thin the overlying soft tissue. *Vestibular atresia*: Improperly placed intranasal incisions and resection of nasal lining can result in scarring. This can lead to stenosis and airway obstruction. 'Spreader grafts' are small, longitudinally oriented cartilage grafts which are placed parallel to and on either side of the dorsal septum to restore natural nasal width in a case of vestibular stenosis. They may be used after excision of a large cartilaginous hump to minimize upper lateral cartilage collapse. *A septal perforation* can result if the septal mucoperichondrial flaps have been left lacerated on both sides after septal cartilage resection. Septal perforations can lead to crusting, nasal bleed and a whistling sound on inspiration. Every aesthetic procedure can leave an *unsatisfied patient* if a proper pre-operative counseling has not been carried out or there has been under / over correction.

SECONDARY RHINOPLASTY

The challenges in secondary rhinoplasty may involve a wide and complex span of problems ranging from difficult to virtually impossible. Like all other secondary surgeries, secondary rhinoplasty is more difficult because of altered anatomy, presence of scar tissue and damaged blood supply. Moreover, the patient is unhappy and upset. Secondary procedures require exceptional diagnostic and technical skills.

The guiding principles for secondary rhinoplasty are to delay surgery for at least a year to complete scar remodeling, multiple consultation and counseling sessions, an appropriate surgical plan following an accurate diagnosis and the use of only autogenous material as grafts.

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AESTHETIC BREAST SURGERY

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Abstract : Breasts have always been the centre of focus in female form and they play a significant role in acceptability as a female and in being sexually attractive. With an overall surge in demand for aesthetic surgery, it is natural for increasing requests for alteration of breast size and shape. The surge for breast surgery also parallels the increasing trend of western wear amongst women. Various studies have reported that augmentation mammoplasty has significant positive effect on patients' body and self image, sensuality, sexual life and relationship with their partner. Reduction mammoplasty represents one of the clearest examples of the interface between reconstructive and aesthetic plastic surgery. Although, the essential goals of this procedure are the weight and volume reduction of the breast, aesthetic enhancement, preservation of sensation and physiologic functions remain equally important. Mastopexy for breast ptosis involves lifting and fixating the sagging breast, with repositioning of the nipple areola complex to obtain more youthful appearance and improved projection. On the contrary a projecting male breast is a cause of embarrassment. Techniques for correcting gynaecomastia range from liposuction to glandular excision, with or without skin reduction.

INTRODUCTION

The desire for beauty, aesthetics and erotic allure combined with youthfulness is an aspiration that has been shared by human beings through all ages and in all cultures. In females, the body as a whole, and breasts in particular, have been the centre of attraction. Contemporary advances in the perception of female beauty and femininity necessitate that the breasts be aesthetically acceptable in all situations of dress and undress. The complex physiologic responses in breast further multiply the problems in aesthetic restoration ¹.

The continued advances in a plastic surgeon's ability to modify the body image have resulted in an increased demand for aesthetic breast surgery in which size and shape of the breast is altered. It includes breast lift (mastopexy), breast reduction, augmentation and treatment of gynaecomastia (enlarged breast in males). An aesthetic breast is defined by Bostwick in two senses- 'tactile and visual'. The attractive, aesthetically pleasing breast is characterized by proper symmetry, flow, contour and proportion. Tactile aesthetic considerations are softness, smoothness and sensibility to touch, which is particularly important in the nipple areola complex. Normal volume of each breast should range from 300-500 gm with more fullness lateral and inferior to the nipple areola complex and a 45 degree lateral inclination ² (fig. 1a & b).



Fig. 1 : Showing normal breast symmetry, contour and proportion.

ANATOMY

Breast is a modified sweat gland and found in the superficial fascia of the pectoral region. The ideal breast is conical in shape and is positioned within the second rib superiorly, seventh rib inferiorly and

between the parasternal and anterior axillary lines. The breast rests mainly on pectoral muscle with some overhang over the serratus anterior muscle, external oblique muscle and the anterior rectus sheath. The nipple is located at the level of fourth intercostal space and slightly lateral to mid clavicular line. The blood supply is from an intercommunicating subdermal plexus, with the major feeding vessels being internal mammary artery, lateral thoracic artery and intercostal perforators. The principal nerve supply is via intercostal nerves and the nipple areola complex is primarily supplied by the fourth intercostal nerve. Cooper's ligaments are essential for breast support and preservation of this structure provides the rationale for reduction techniques that minimize skin undermining ¹.

PATIENT EVALUATION

All aesthetic breast surgeries are done under general anesthesia or heavy sedation with local anesthesia. The patient should be medically fit to undergo surgery and should also be free from any breast disease like nipple discharge, breast dysplasia or malignancy. Local examination includes noting the size and position of the breast and its nipple areola complex, location of the inframammary crease, and any breast or chest wall asymmetry. In elderly patients, a mammogram should be done routinely to rule out malignancy.

Consultation with the patient regarding her expectations from surgery and proposed procedure should be discussed in detail so as to prevent postoperative dissatisfaction and confusion. Preoperative and postoperative photographs should be taken to objectively evaluate the deformity and the final result.

AUGMENTATION MAMMOPLASTY

Various studies have confirmed that augmentation mammoplasty has significant positive effect on patients' body and self image, sensuality, sexual life and relationship with their partner ³. Primary indications for augmentation are inadequate volume of breast tissue, glandular hypomastia (developmental or age related atrophy) and psychological reasons. In certain patients with underdevelopment of thoracic region (e.g. Poland's syndrome) skin envelope over chest wall may not be adequate and tissue expansion may be required prior to augmentation.

The evolution of breast augmentation dates back to 1895 when a lipoma was transplanted from patients' back to fill a breast defect, but attempts to enlarge the breast with autogenous tissue such as lipoma, fat, dermal graft and omentum had unacceptable and unpredictable results. Later various injectable alloplastic materials like paraffin and silicone were tried but soon discontinued due to severe complications. Modern era of cosmetic breast augmentation started in 1962 when Cronin started placing subglandular silicone gel

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prosthesis. Other solid alloplastic materials used for breast augmentation were polyvinyl ether, poly tetra fluorethylene and poly methane. These were gradually discontinued due to severe local and systemic reactions.

Modern day breast augmentation is done by placing a fluid / gel filled implant under the breast tissue, which gives it a natural feel. An elastomeric solid shell of silicone, filled with either silicone gel or saline is the principal design of current models of breast implants and some type of texturing of the elastomeric surface has been added in an effort to diminish encapsulation. Presently used implants may be smooth or textured and spherical or anatomic. The goal of these various implants is to attain the most natural, aesthetically pleasing shape while keeping complication rate to minimum.

Four separate incision sites- axillary, inframammary, periareolar and transumbilical have been used for placement of the breast implant. Each location has its advantages and disadvantages depending on the individual surgeon's experience. The positioning of the implant can be subglandular (behind the breast tissue), subfascial (under the pectoral fascia), subpectoral (under the pectoral muscle) or in a dual plane position⁴ (fig. 2a & b). Recently, an endoscopic technique of placing the implant has been described to reduce the size of the incision⁵.

Augmentation mammoplasty is performed on a day care basis and the results are highly satisfying for both patients and the surgeon (fig. 3a & b). The inframammary approach is the most commonly used technique for placing

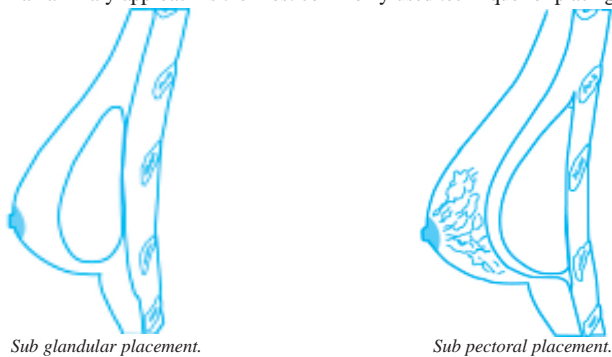
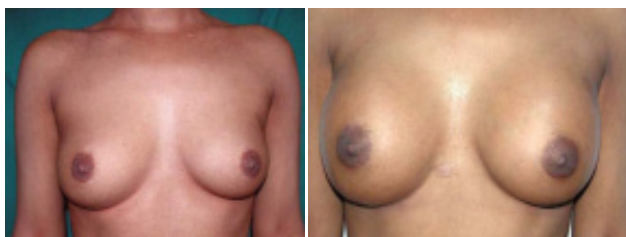


Fig. 2 : Showing placement of the implant in augmentation mammoplasty.



Pre-operative frontal view.

Postoperative frontal view.

Fig. 3. : Showing a patient with augmentation mammoplasty. A 300ml textured anatomical implant was placed in subpectoral pockets, bilaterally, through inframammary incision.

the breast implants. Advantages of this approach include technical ease, more accurate placement of implants, minimal scar visibility, better control of inframammary crease and if required later, the same incision can be used for capsulotomy or any other secondary surgery.

Inframammary approach: Pre operatively inframammary crease, medial, lateral and superior extent of dissection are marked in standing position. Incision is usually given in the inframammary crease but finer adjustments may be required according to the size of implant. The incision starts in the nipple line and extends laterally. The dissection is deepened through subcutaneous and glandular tissues. If subglandular placement is desired,

the pocket is dissected between the glandular tissue and the pectoral fascia. In subpectoral placement, lower fibres of pectoral muscles are incised and a pocket is created deep to pectoralis major muscle by blunt dissection. After achieving absolute hemostasis, implants are placed in the dissected pocket under strict aseptic conditions.

Complications : There was a controversy in the past about silicone gel filled type of implants and their long-term safety. Towards late 1990's, several studies were published, including approximately 20 epidemiologic investigations, which found no increased risk for developing connective tissue disease among women with breast implant⁶.

Serious complications after augmentation mammoplasty are rare but few problems may arise in 1-2% of cases. These may range from formation of hematoma / seroma, infection, altered sensation of the nipple areola complex, asymmetry of the breast, capsular contracture and rarely implant rupture. Most of these problems usually settle with time or may require minor surgical interventions.

REDUCTION MAMMOPLASTY

This procedure represents one of the clearest examples of the interface between reconstructive and aesthetic plastic surgery. Although, the essential goals of this procedure are the weight and volume reduction of the breast, aesthetic enhancement, preservation of sensation and physiologic functions remain equally important. Women seek breast reduction for both physical and psychological reasons. Common complaints in these patients are neck and back pain, grooves in the shoulder skin by the pressure of brassiere strap, maceration and dermatosis in inframammary region. Excessively enlarged breasts are also centre of attention and embarrassment. Reduction mammoplasty is usually performed when breast growth is complete but indicated early in certain cases like virginal hypertrophy where the prospect of an operation is outweighed by the benefit of a more normal psychological development⁷.

In earlier techniques of breast reduction, an elliptical excision of breast tissue and skin was carried out. With better understanding of blood supply and importance of the subdermal plexus, various techniques were developed which transpose the nipple areola complex on a pedicle for better survival, and hence, a precise excision of the breast tissue can be done with safety. Various techniques commonly used today are inferior or superior pedicle techniques, a bipedicle technique and their modifications. By these advanced techniques, nipple sensation is usually preserved and even lactation is possible in selected patients. However, in extremely large breasts an amputation with free nipple grafting may be necessary.

Reduction mammoplasty (Lejour technique) : Vertical mammoplasty technique was described and popularized by Lejour⁸. It is probably the most popular technique used today for reduction mammoplasty due to elimination of a transverse incision. The technique provides an attractive breast shape without the areolar enlargement, relative safety, preservation of neurovascular structures, a short vertical scar, low rate of complication and fairly predictable results.

The markings are done preoperatively in standing position. The inframammary fold and midline of chest is marked and a vertical axis of breast is drawn by joining the midclavicular point with the inframammary crease, passing through the nipple. Planned new position of nipple areolar complex is marked on this vertical breast axis at a point transposed through the centre of the inframammary crease. The new nipple is located about 22cm from the suprasternal notch and 11cm from the mid sternal line. A vertical area around the nipple areola complex is deepithelialized (speckled area in fig.4a) which acts as a pedicle for transposition of the nipple areola complex. This also effectively reduces the size of the enlarged areola. Lateral and medial breast markings are determined by pushing the breast laterally and medially (fig.4a). In surgery, excess skin and glandular tissue are excised (fig.4b) and the remaining glandular tissue

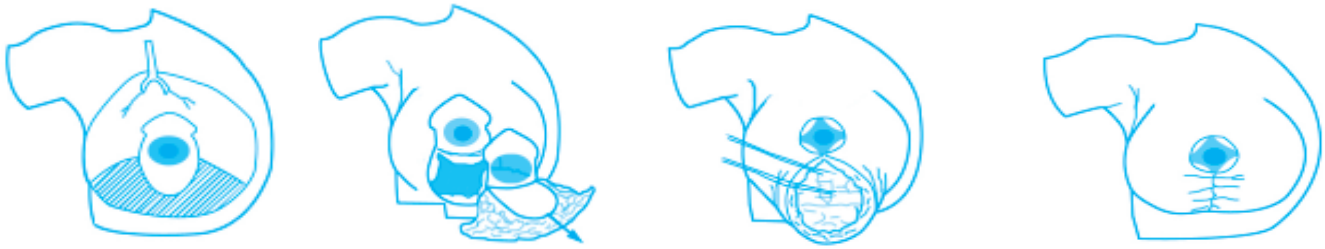


Fig. 4 : Diagrammatic representation of vertical mammoplasty by Lejour's technique. (a) Pre-operative markings. (b) De epithelization and enbloc glandular resection. (c) Plication of glandular tissue. (d) Skin closure by pleating technique.

is sutured to itself (fig.4c) and the pectoralis fascia to give the desired projection. Skin is closed with pleating sutures (fig.4d). Suction drains are used for 2-3 days. Skin sutures are removed after 10-14 days. Scars from this procedure are either a vertical line or inverted T scar below the areola with a short horizontal limb in the inframammary crease, which heals well and is usually unnoticeable (fig. 5a & b). The patient is discharged 1-2 days after surgery but their physical activity is usually restricted for 4-6 weeks to prevent stretching of scars.

Complications : Reduction mammoplasty is a very safe procedure. Complications are relatively uncommon and include asymmetry of the breast, development of hypertrophic scars, too high positioned nipples, partial or complete loss of nipple areola complex, fat or skin necrosis and lateral dog ears.

Follow up : Several studies have shown that most of the patients are relieved of their pre-operative complaints. The patients also show a trend



Fig. 5 : Showing a patient with reduction mammoplasty by Lejour's technique. (950 gm of tissue excised each side)

towards weight loss, their activity levels increase and there is greater ease in finding clothing of their size. Cup size generally decreases on an average of 2 to 3 sizes. Social and psychological complaints such as poor body image, low self-esteem and feeling of insecurity and sexual unattractiveness also improve significantly. Most of the patients feel benefited from surgery and recommend the procedure to others.

MASTOPEXY

In breast ptosis, there is an alteration in relationship of the breast and nipples to the inframammary fold i.e. the entire breast lies much lower to the inframammary fold. However, in pseudoptosis, the nipple is above or at the level of the inframammary fold and there is a loose saggy skin brassiere below it giving the impression of ptosis. Breast ptosis can be due to several components but gravity seems to be a common factor. Breast skin gets stretched during lactation, and later in middle age the breast gland atrophies, leaving loose skin. In post menopausal patients, glandular atrophy, loss of skin elasticity, weight gain and gravity are the main factors leading to breast ptosis⁹.

Mastopexy is performed primarily for aesthetic reasons. It involves lifting and fixating the sagging breast with repositioning of the nipple areola complex to obtain more youthful appearance and improved projection. Techniques for mastopexy are same as those of reduction mammoplasty, however, no breast tissue is excised (fig. 6a & b). Mild ptosis and pseudoptosis are generally

corrected by augmentation mammoplasty, to fill the sagging envelope.

GYNAECOMASTIA

Gynaecomastia is a Greek word meaning 'woman like breast' and it affects 40-60% of men. It is caused by an increase in stroma and ductal tissue in male breast and occurs at infancy, adolescence and old age i.e. at any time of male hormonal change. Gynaecomastia is usually a normal finding at these stages of life but it may be associated with certain conditions like increase in estrogen, decrease in androgens, defect in androgen receptors, liver diseases, endocrine tumors, certain malignancies and debilitating diseases. A thorough clinical and biochemical evaluation is required in-patients with symptoms



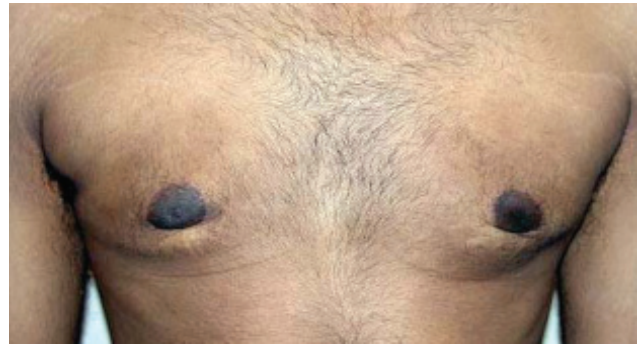
Fig. 6 : Showing a patient with mastopexy. (mastopexy done by relocating the nipple areola complex by Lejour's vertical mammoplasty technique. No glandular excision was made.)

like infertility, extreme obesity, micropenis, jaundice, diabetes and other endocrine disorders. This condition usually disappears during the late teens. In about 7%, it may persist beyond the age of 17 yrs. If the patient presents at puberty, he is usually advised to wait for upto two years to allow spontaneous regression to occur¹⁰.

Treatment of gynaecomastia is essentially surgical. Earlier large inframammary incisions were given to excise the enlarged breast tissue and skin, which used to cause significant scarring and morbidity. The introduction of suction lipectomy has changed the treatment of gynaecomastia. It helps significantly in removing the fatty breast tissue through hidden incisions and allows tapering of the edges. The remaining glandular tissue can be excised through a periareolar incision. Pre-operative markings are done with the patient in standing position. After induction, a tumescent solution (see article on liposuction in this issue) is infiltrated in the breast tissue and liposuction is done through axillary or periareolar stab incisions. After liposuction, the periareolar incision is extended and nipple areola complex is undermined leaving a cuff of tissue under the nipple to prevent its retraction. The chest skin is undermined according to preoperative markings and by sharp dissection, the glandular tissue is excised. Usually skin excision is not required



Pre-operative frontal view.



Post-operative frontal view

Fig. 7 : Showing a patient with Gynaecomastia. (correction was done by liposuction and subcutaneous mastectomy through a periareolar incision).

the skin retracts gradually over 3-6 months time (fig.7a & b). However, in massive gynecomastia it may be essential to do a skin excision in a crescentic manner around the areola. The patients are advised to wear pressure garments for about 3-4 months.

Post operative complications of gynecomastia surgery are uncommon. Nipple retraction or asymmetry is occasionally seen and may need secondary correction. Overall results of this surgery are very satisfying to most patients.

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ABDOMINOPLASTY

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Abstract : *Surgery for improvement in the appearance of the abdomen (aesthetic abdominoplasty) is 100 years old. All the initial operations were done with the primary aim of herniorrhaphy, excising the fatty apron as a bonus. The majority of patients presenting today have neither a hernia nor the severity. They require more of aesthetic body contouring operations designed to give a better look in various states of dress or undress. The modern abdominoplasty techniques developed in the last 45 years consist of a low transverse incision, wide undermining up to the costal margins, correction of divarication of recti (with or without tightening of musculature in horizontal direction), excision of redundant skin and fat, and umbilical transposition. Many times a liposuction procedure is combined with abdominoplasty to provide better contouring. To achieve a successful outcome, appropriate patient selection and attention to minor details during surgery are of extreme importance.*

INTRODUCTION

'Abdominoplasty' is the cosmetic surgery of the abdomen and it denotes only the correction of contour deformities of the anterior abdominal wall. Aesthetic abdominoplasty is also variously referred to as abdominal wall contouring, abdominal liposculpture and dermolipectomy of the abdomen or simply as 'tummy tuck' by a layman. Reconstruction of the abdominal wall is not included under this topic.

HISTORY

It began at the turn of the 20th century, when the operations were primarily aimed at repairing the hernia along with resection of excessive abdominal fat by a wedge excision. Demars and Marx in France (1890)¹ did extensive abdominal wall fat resection. In 1905, Gaudet and Morestin² reported transverse closure of a large umbilical hernia along with resection of skin and fat. Desjardin (1911)³ used a vertical incision to remove skin and fat. Kelly (1899,1910)^{4,5} introduced the term 'abdominal lipectomy' to describe the transverse resection of a large pendulous abdominal wall. His incision extended across the mid abdomen into the flanks, excising a wedge of panniculus, repairing the hernia and closing without any undermining. Babcock (1916)⁶ was the first to advocate wide undermining of the anterior abdominal wall carried out through a vertical ellipse-shaped incision. Thorek (1939)⁷ described a technique, which he called 'plastic adipectomy' for fatty aprons. He excised the umbilicus along with fatty apron through a crescent shaped incision and at the end of the operation transplanted the same as a composite graft at the another appropriate site. He did not mention the success rate of graft 'take' but did suggest the alternative technique of circumcising the umbilicus, leaving it attached to anterior abdominal wall and then, bringing it out through an opening made in the skin.

All these initial operations were done with the primary aim of herniorrhaphy, excising the fatty apron as a bonus. However, the aesthetic advantages of these operations were quite obvious. They were definitely the forerunners of the techniques, which were later developed into the operations performed with the sole aim of cosmetic improvement. The majority of patients coming for 'abdominoplasty' today have neither any hernia nor the severity for which earlier surgeons performed them. Vernon (1957)⁸ was the first to use a low transverse incision with undermining of abdominal flap and transposing the umbilicus. Pitanguy (1967)⁹ reported 300 cases of dermolipectomies with low transverse incision. Regnault¹⁰ described his 'W' technique in 1972. Psillakis (1978)¹¹ first performed the suture plication of external oblique muscle in transverse direction like a belt. The modern abdominoplasty techniques¹²⁻¹⁶ were developed in the last 45 years or so and the principles have

since remained the same, viz., a low transverse incision, wide undermining up to the costal margins, correction of divarication of recti and tightening of musculature in horizontal direction, excision of redundant skin and fat, and umbilical transposition as a flap. The primary aim of all the currently popular techniques is to leave a scar that can be hidden under the bikini.

The last 25 years have seen the development of a new modality, viz. liposuction, to address the problem of milder cases with localized excessive fat but without redundant skin. This has been dealt in detail in the article on liposuction elsewhere in this volume.

CONTOURS OF THE ABDOMEN

The bony framework, the musculo-aponeurotic system of the anterior abdomen, the thickness of subcutaneous adipose tissue and the skin make the abdominal contours. The various depressions, including that of the umbilicus, reflect light i.e. a shadow is formed by the depression. The shadow of the median sulcus is flanked on either side by the shadows from the lateral margins of the rectus muscles. Superiorly the abdomen is bounded by inferior costal margins and inferiorly by the pelvic rim. Alteration in any of these tissues, that constitute the abdomen, changes the appearance by modifying the light reflexes and shadows.

The contours of the anterior abdomen vary greatly not only in different individuals and sexes but also in the same individual at different ages. This variation is caused by the varying amounts and site of subcutaneous fat deposition and the tone of underlying abdominal muscles. In general, very small children have a protuberant belly but in older children and young adults of both sexes, the abdomen is flat on side view in erect position. In pregnant females, the abdomen becomes more and more protuberant as the pregnancy advances. Pregnancy stretches the skin as well as the musculo aponeurotic structures beyond their biomechanical capacity leading to striae gravidarum and diastasis of recti. After the delivery, the tone of muscles returns back, but not completely, unless appropriate exercises are undertaken. In addition, there is fat deposition in infra-umbilical region. Repeated pregnancies increase the laxity of abdominal wall as a whole and the infra umbilical fat deposits leading to an appearance of a protuberant and pendulous abdomen. Even in males, with increasing age, there is a loss of tonicity of abdominal wall muscles, especially the rectus abdominis, and abdomen starts protruding. With more and more protrusion the abdomen becomes pendulous and in extreme cases covers the mons pubis and external genitalia forming a fatty apron.

A number of young and middle aged obese individuals of both sexes have now become 'health conscious' because of media and societal pressures. They strive to loose weight by all means. It is to be noted that while increase in weight of an individual occurs due to uniform deposition of fat all over the body, the loss in fat is not uniform during weight

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reduction, thereby leading to localized collections of fat e.g., in the infraumbilical region. After weight reduction or surgery for morbid obesity the skin becomes loose and unaesthetic. *This conversion of pendulous abdomen into a shape that is normal for a young adult of an ideal weight is the essence of aesthetic abdominoplasty.*

SPECTRUM OF DEFORMITY AND TECHNIQUES

There is a huge spectrum of deformity and consequently the techniques to correct them. A number of factors like the degree of redundancy and flaccidity of the skin, scars on the skin including those of previous abdominal operations, laxity of musculo-aponeurotic system, anterior abdominal wall hernias¹⁷, thickness of subcutaneous fat, overall weight of the patient (body mass index) etc. are taken into consideration. At one end of the spectrum, there may be a case with mild fat deposit without excess skin and with a normal musculo aponeurotic system. At the other end, there may be an individual with great excess of skin and fat with striae or scars and severe laxity of musculo-aponeurotic system (fig.1). While former clearly requires removal of fat alone (by liposuction), the latter needs a traditional dermolipectomy with tightening of the musculo-aponeurotic system. Because of the wide spectrum that exists, each case needs to be evaluated individually and the treatment tailored accordingly. The last 25 years have seen the introduction of liposuction^{18,19} as a body contouring modality: It has radically changed the approach to abdominoplasty. The classical abdominoplasty, in many cases does not satisfy the surgeon and the patient because of superior displacement of pubic skin, long scars, flattening of infraumbilical abdomen etc. Similarly, liposuction alone does not address the skin laxity and it depends on the skin retraction that is not under the surgeon's control. So a number of workers started combining the two procedures. The patients who have isolated mild problems are now offered mini-abdominoplasty. Mini-abdominoplasty utilizes a minimum length of abdominal incision to excise redundant infraumbilical skin and fat. Recently, the divarication of recti has been corrected using endoscopic instrumentation.²⁰

PREOPERATIVE ASSESSMENT

A detailed history and physical examination is very important for a successful outcome. As most of the patients are females, a history of pregnancies and their effect on the patient's abdominal wall, type of delivery (caesarean or otherwise), any post-delivery measures to regain abdominal contours and extent of weight gain during pregnancy and



Fig.1 Front view of the abdomen in a 49 year old female showing extreme laxity of abdominal apron with striae and incisional hernia.

after childbirth should be noted. History of excessive weight gain and / or loss should be recorded in both the sexes. A detailed history of medical illnesses and drug intake especially to reduce weight should be elicited. While smoking increases the chances of flap necrosis, aspirin may increase the chances of hematoma and seroma formation. The emotional status of the patient and immediate reason for his/her desire to undergo abdominoplasty should be assessed. It is of utmost importance to know if the patient has realistic expectations or fanciful goals. The patient must understand that this is not a weight-reducing surgery. Moreover, abdominal protuberance due to intra-abdominal fat accumulation cannot be corrected.

The physical examination should look for condition of the skin, presence of striae gravidarum or previous operative scars, hernias, diastasis of recti, tonicity of muscles and thickness of subcutaneous fat in various regions. The overall weight of the patient with respect to ideal weight is recorded. An ultrasonography of the abdomen must be done to exclude any co-incidental intra-abdominal pathology. Preoperative counseling to apprise the patients of realistic goal is very essential. Preoperative photographs should be taken in standing position from front and sides.

CONTRAINDICATIONS

The biggest contraindication to abdominoplasty is a patient who believes this operation a weight-reducing measure rather than a body contouring procedure. These patients form the biggest lot of unsatisfactory outcome. Similarly, any patient with unrealistic expectations with respect to morbidity or scarring is a poor candidate. A patient must be emotionally stable to undergo any aesthetic procedure.

Patients who have significant associated medical conditions leading to unacceptably high risks should not be offered this operation. A history of upper abdominal surgery through sub costal incisions that may compromise the vascularity of flaps, and patients who have planned future pregnancies are poor candidates for this surgery. A case of morbid obesity should first undergo an appropriate intra abdominal procedure for weight reduction and an abdominoplasty thereafter.

'TRADITIONAL ABDOMINOPLASTY'

Preoperatively, a low transverse incision is marked on the patient in standing position. A number of workers like Pitanguy⁹, Regnault¹⁰ etc. have described low transverse incisions that give excellent results if the operation is executed properly. They can also be modified to suit the individual requirements.

The skin incision is extended to the flanks from the suprapubic region and deepened to the anterior rectus sheath. The skin flap (panniculus) is raised superiorly using monopolar electrocautery with coagulation/ligation of musculo aponeurotic perforators till the umbilicus is reached. It is preferable to allow a small amount of subcutaneous fat to remain on the muscle/fascia. The umbilicus is then circumscribed. The infraumbilical flap is then incised vertically in the midline. This helps in raising the supraumbilical flap under vision without much retraction. The panniculus is raised up to xiphisternum in midline and about 2-3 cm. above the costal margin on either side. Complete hemostasis is achieved using bipolar cautery.

The exposed musculo-aponeurotic layer needs correction in most of the cases especially those following multiple pregnancies. Diastasis of recti and incisional hernia are corrected at this stage. Plication of the rectus sheath is done from the xiphisternum to the symphysis pubis with horizontal mattress sutures of strong nylon or prolene (1 '0', 2 '0') (fig.2a-d). In patients where rectus sheath plication is insufficient a horizontal tightening is done by one of following techniques. Jackson and Downie (1978)²¹ advocated a transverse plication using same heavy sutures at the level of umbilicus and sometimes midway between umbilicus and

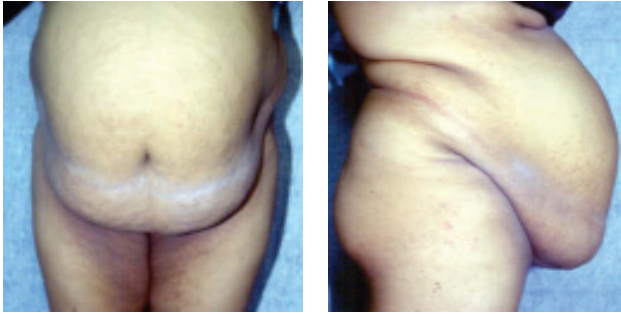


Fig. 2 a & b Front and lateral views of the abdomen in a 47 year old female following multiple pregnancies. Note the huge excess of abdominal apron. She also had divarication of the recti muscles.

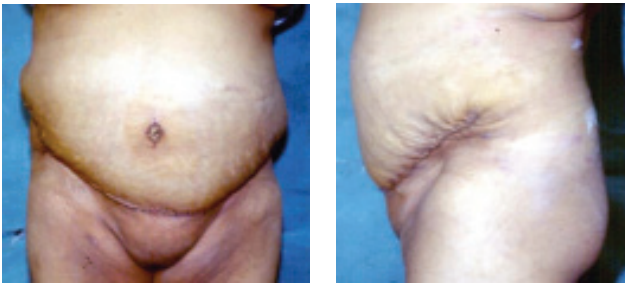


Fig. 2 c & d Showing the front and lateral views at 10 days following a dermolipectomy, abdominoplasty and correction of rectus diastasis. A liposuction of the flanks would have further enhanced her contours. (The procedure was done almost 15 years back when liposuction had not become popular).

pubic symphysis. External oblique musculofascial flaps can be dissected on either side and sutured in midline to further narrow the waistline (Psillakis, 1984)²².

Many surgeons combine this standard abdominoplasty procedure with a liposuction. Skin flaps, which are intended to remain in place, are liposculptured to obtain better contouring (fig. 3a-e).

The umbilicus is the only desirable scar in the human body whose absence causes great mental trauma. Hence, preservation of umbilicus and its relocation is of utmost importance. After the skin flaps are brought down the position for new umbilicus is located just above the centre of the abdomen²³⁻²⁶. The extent of skin flap excision is marked inferiorly. The umbilicus is brought out on the surface through a cruciate incision and all incisions are closed after placing closed suction drains.

POSTOPERATIVE CARE

Postoperatively, the patient is nursed in semi-Fowler's position with legs elevated to relieve tension on the abdominal wound. The patient may be catheterized electively. Gradually, over a period of few days, the patient is allowed to lie straight. Early ambulation increases the risk of hematoma / seroma formation. An adynamic ileus may persist longer in patients with associated ventral hernias where peritoneum was opened. Therefore, a semisolid diet is gradually introduced depending on bowel movement and patient tolerance. Analgesics are given in the postoperative period. A pressure garment or an abdominal binder is prescribed before resumption of full activity.

COMPLICATIONS

The complications^{27, 28} may be the ones that are common to most of such surgical operations or they may be aesthetic, which are specific to this procedure and related to surgeon experience, making the result sub optimal or even poor.

The general complications are hematoma / seroma formation, lipolysis,

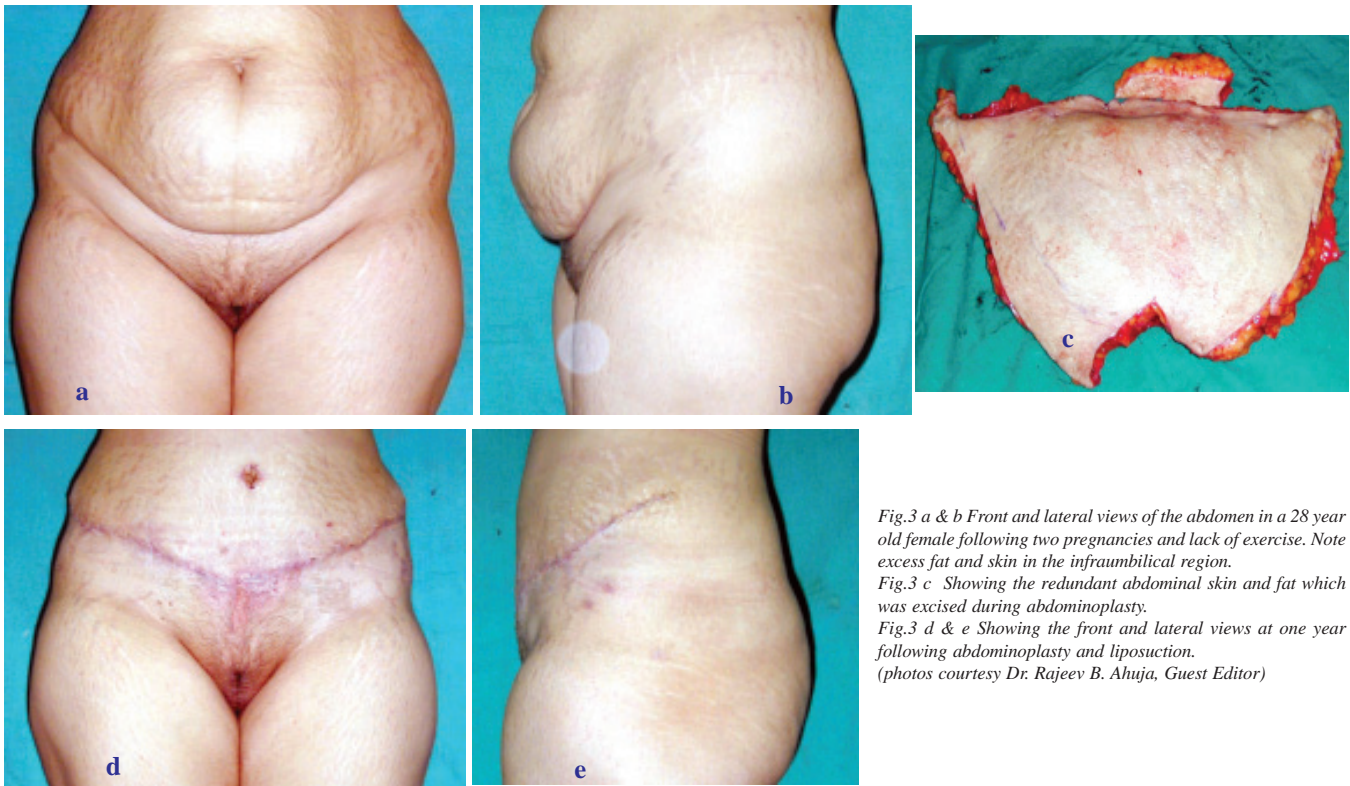


Fig. 3 a & b Front and lateral views of the abdomen in a 28 year old female following two pregnancies and lack of exercise. Note excess fat and skin in the infraumbilical region.

Fig. 3 c Showing the redundant abdominal skin and fat which was excised during abdominoplasty.

Fig. 3 d & e Showing the front and lateral views at one year following abdominoplasty and liposuction.

(photos courtesy Dr. Rajeev B. Ahuja, Guest Editor)

infection, flap necrosis, poor scars etc. By far the commonest complication is hematoma or seroma formation. Wide bore negative suction drains must be kept in place for at least 5-6 days to allow the flaps to adhere to the bed and obliterate the dead space and raw area. Once formed, they need drainage / aspiration. If not attended to early they lead to flap necrosis because extensive undermining compromises the flap vascularity. Since this surgery is performed in obese individuals where thick panniculus flaps are raised, they are always prone to fat liquefaction. Hematoma, seroma, fat liquefaction and flap necrosis make the patient prone to infection. The use of non-absorbable sutures and meshes has a potential of making these infections chronic. Flap necrosis is one of the most dreaded complications in plastic surgery. Thus, meticulous attention to detail especially with respect to tissue trauma, plane of dissection, hemostasis, tension of wound closure etc. is mandatory in getting a good result. When flap necrosis does occur it needs to be managed proactively. The necrotic flap is excised after the line of demarcation has appeared. A small wound may be allowed to heal secondarily or a thin split thickness skin graft is applied once healthy granulations appear.

As in any aesthetic procedure, it is mandatory to counsel the patients preoperatively to have realistic expectations from surgery. By and large majority of patients are extremely satisfied from this procedure. It has to be ensured that dermolipectomy is adequate and symmetrical. Liposuction must be used to give better contouring. Any secondary surgery is only undertaken after about a year to allow the tissues to resolve. Excessive flap resection is another very dreaded complication because it can lead to wound dehiscence and also pull up the pubic region or labia (in females). Further, it can lead to widening of the scars, which are difficult to correct as all laxity of tissues has disappeared because of surgery. However, scars do become supple and less noticeable with time. Hypertrophic scars also settle in due course with oil massage, silicone gel sheets, intralesional triamcinolone injections and pressure garments. 'Dog ears' in the flanks need revision after 4-6 months. Much of the abdominal striae get excised with dermolipectomy but the ones that remain are extremely difficult or impossible to correct. Placement of the umbilicus and its shape needs great attention to prevent it from having an 'artificial' look, being asymmetrically placed or being too deep. There is also a risk of partial or complete necrosis of the umbilicus.

ABDOMINOPLASTY IN MALES

The number of men requesting abdominoplasty is much less than women, nevertheless, it remains a frequently performed aesthetic procedure in males. This is because of increasing incidence of obesity in society. In males also the shape of the abdomen reflects his fitness, health, and sexuality. Increasing body weight with loss of abdominal muscular tone due to lack of exercise are the prime reasons for altered abdominal contour.

Males present for abdominoplasty at an older age and higher weight. Their interest is often in a single region (abdomen) compared to women who generally want contouring of multiple regions like abdomen, thigh, arms etc. The male integument also varies a great deal from the females. It is less prone to overstretching and laxity, and therefore, excessive skin redundancy is generally observed in those who have undergone massive weight loss. With advancing age (from 25 years onward) the fat pattern changes in males. There is an 'internalization' of fat, with an increase in intra-abdominal fat

and a corresponding decrease in subcutaneous fat, as well as infiltration to and between the muscles. This change has the greatest impact on the appearance of the abdomen and is an essential fact for patient appraisal. Overall, there is a decline in lean body mass and a redistribution of fat which is reflected in an increase in the body mass index. The waist-hip ratio and triceps-skin fold thickness (which correlates with visceral abdominal fat) are valid measurement indices of these changes. Differences between the genders exist in the muscular layer as well. Women often present with a lower abdominal rectus muscle diastasis, creating a visible umbilical to pubic 'bulge'. In contrast, men often have a rectus diastasis in the upper abdomen, which contributes along with intra-abdominal fat to a 'bear belly' appearance. Because males have fewer variations in their presentations as compared to females the necessity for a variety of surgical procedures is less in them. Typically, 'liposuction', a 'full abdominoplasty' or a 'dermolipectomy with liposuction' is sufficient, in contrast to the wider range of procedures performed on women. In spite of these differences the endpoints of surgery are identical in males and females.

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LASERS IN PLASTIC SURGERY

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Abstract: Lasers are being increasingly used for aesthetic indications in areas where we had very few or no options earlier. A good understanding of the basics of laser functioning and of laser interaction with tissues is necessary to grasp the various uses of lasers and put them to optimal use. Laser resurfacing with the carbon dioxide, erbium or a combination is yet to be exploited to its full potential. Hair removal lasers have gradually improved to manage hirsutism even in the darkest skin types. Q switching has given us the nanosecond capability to treat various cutaneous pigmentary disorders including various tattoos, while the dye lasers remain the gold standard for vascular lesions. Non ablative rejuvenation of the skin is possible with subablative doses of some long pulse lasers and the intense pulsed light device.

HISTORY

Light has been used for therapeutic purposes by the Egyptians since 4000 B.C. In late nineteenth century, Nils Finck used light to treat vitiligo and psoriasis. It was only after Einstein propounded the theory of stimulated radiation in 1917 that many workers like T.H.Maiman (1960), and N. Patel and C. Kumar demonstrated 'LASER' and CO₂ laser respectively. Later, the acronym 'LASER' was coined for light amplification by stimulated emission of radiation. Three years later, Polanyi and coworkers reported surgical use of CO₂ laser and over the next several years, histological studies revealed the ability of this laser to seal lymphatics and nerve endings, and to coagulate vessels up to 0.5 mm. in diameter. Other variants of lasers were discovered subsequently; Helium Neon laser (1960), Nd:Yag Laser (Neodymium-Yttrium Aluminium Garnet, in 1964), Argon laser (1964), and KTP laser (Potassium Titanyl Phosphate, in 1981).

In late 1970s and early 1980s CW (continuous wave) CO₂ laser found applications with plastic surgeons, dermatologists, otolaryngologists, gynaecologists and neurosurgeons. But, soon the enthusiasm went down because of unwanted complications like thermal injury and scarring. In early 1990s, the Coherent Medical Group developed a 0.2 mm diameter CO₂ laser with high frequency pulse beam which was an improvement. This reduced the thermal effect on surrounding tissue and the edges of the wound. Laser surgery could now be compared with standard scalpel surgery.

The end of 21st century is focusing a lot on aesthetic applications of lasers in non ablative resurfacing and rejuvenation of the face.

LASER PHYSICS

The light is passed through a medium by which it gets stimulated (fig.1). The source of light is a flash lamp, an arc lamp or a tube light. The medium is either gaseous, liquid, solid crystal or a semiconductor as follows:-

Solids: Ruby, Nd:Yag

Gases: Helium-Neon, Argon, Carbon Dioxide.

Liquids: Organic dyes - (Rhodamine, Coumarin)

Semi-conductors: Diodes (Aluminium, Gallium, Arsenide)

The unit of light is a photon. It is stimulated in presence of a medium, and is then called an electron. An electron in the orbit (fig.2) around the nucleus of an atom is excited from its baseline state to an unstable higher orbit, and in the process, it stores an exact quantum of energy. Since the excited state is unstable, the electron returns spontaneously to its baseline state immediately, releasing the energy in the form of light or photons, depending on the characteristic of the atom and the energy level involved. According to Einstein's theory, another photon can stimulate the release of this energy from the unstable, excited electron. Large numbers of atoms can be stimulated to the excited states by the introduction of light, thereby causing a situation known

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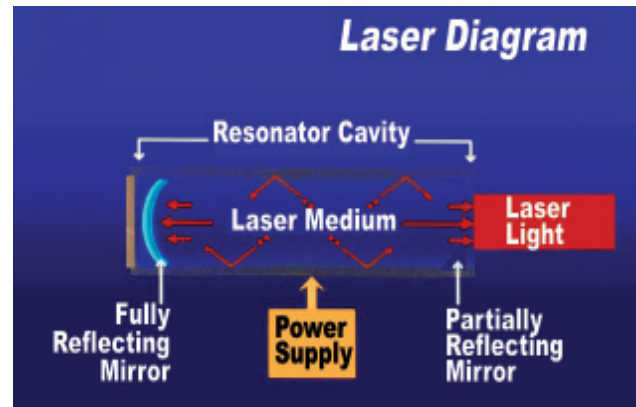


Fig.1 Showing the mechanism of laser generation in a chamber with lasing medium and power source.

as *population inversion*. Since one photon stimulates the release of stored energy of an excited electron (fig.2) in the form of another photon, the wavelength, and the phase of the paired photons are identical. *The result is lasing*. These photons are reflected in the chamber by the reflecting surface (fig.1). Their speed is accelerated and they pass out through a hole on the non-reflecting side, as a radiated beam of *Laser*. This laser radiation is of low frequency as compared to the radiation of x-rays and gamma rays, which have high frequency and very small wavelengths, less than 10 nanoseconds. The laser has no irradiation hazards as compared to the x-rays and gamma rays. Being coherent and collimated, laser light has an ability to focus to the spot sizes as small as a single organelle within a living cell. Fiberoptic cables, which are able to transmit laser light, can pass through the endoscopes and catheters for operative procedures. The infrared lasers need special coated optic fibers or else they are transmitted to the hand-piece and then to the target, by the mirrors in the articulated delivery arm.

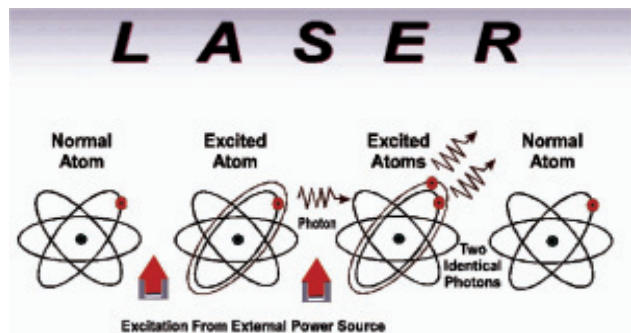


Fig.2 Showing a chain reaction of excited atoms releasing photons of light.

EFFECT OF LASERS ON TISSUES

The factors influencing the effect of laser on tissues are:

(A) The type of laser (quality i.e. wavelength); (B) The dose of laser (quantity i.e. the time for which the laser is in contact with the tissue (or the contact time) and the energy (in Watts). The energy also varies with the spot size of the laser beam;

(C) The mode of delivery of laser.

Type of laser

The laser is named by the medium through which it passes. For example, CO₂ laser is called so because the light is made to pass through carbon dioxide gas before it comes out as laser light. CO₂ laser is highly absorbed by water. The human tissues consist of 80 % water. By its characteristic quality CO₂ laser is absorbed into the skin or the tissue it comes in contact with. Heat is transferred into the water of the skin, which is the chromophore for CO₂ laser. Integral structures like ribonucleic acid, deoxyribonucleic acid and other structures melt at 50^o to 100^oC. The result is penetration of laser into the skin. The effect of the laser will depend on the temperature which is reached in the tissues. This effect is produced by the power of the laser (fluence) and the duration for which the laser touches the skin (contact time). If the temperature produced is around 40^oC, its effect is warming and the result is a reversible coagulation. Such a dose of the laser has been used for experimental tissue welding. There is gross alteration of the extra cellular matrix with various temperature-heating time combinations. It is worth remembering that laser surgery consists of controlling where and how much laser injury is likely, due to the heat produced by laser. Cutting is possible by continuous lasers like CO₂, diode, and Argon lasers. The quasi-continuous (rapid-pulsed) lasers such as copper vapor and KTP (potassium titanyl phosphate) also produce milder effects of cutting. In contrast, there are lasers which do not damage or ablate the skin layers, but only transfer heat to any part of the skin tissue selectively, like cells of the hair follicles, pigment cells or the red oxyhaemoglobin in micro vessels. These are called non-ablative lasers. The CO₂ and Erbium lasers which are ablative lasers can also be used as non-ablative lasers by change in the fluence and pulse duration or the contact time.

When the absorption of the photon of laser into the chromophore occurs, the photon ceases to exist and the chromophore becomes excited. It may undergo the following changes:

- Photochemistry (photochemical reaction)
- May dissipate energy as heat (photo-thermal reaction)
- May cause remission of light (fluorescence);
- Photo-optical disruption, when the optical force is with high energy and short duration, as in Q-switched mode of laser.
- Photo-mechanical reaction, as in Erbium:YAG laser, where it removes the ash by force of several atmospheric pressures, along with thermal ablation.

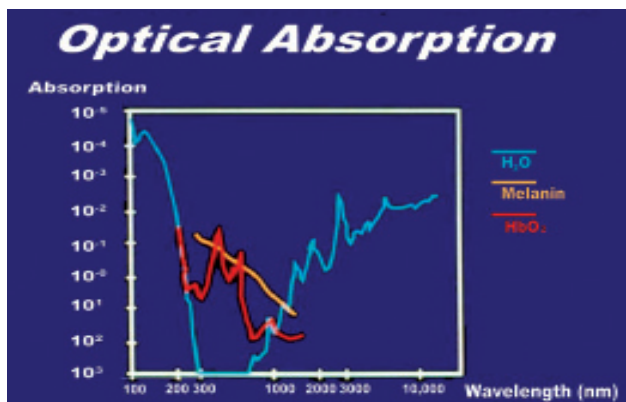


Fig.3 A graphic representation of absorption spectra of major chromophores of the skin, water, melanin and haemoglobin.

The absorption spectra of the major chromophores of the skin must be known to study the effect of lasers (fig.3). The coefficient also depends on the concentration of the chromophores present. The process of selective photothermolysis (SPTL) works in this situation. Selective photothermolysis is the process of controlling tissue reaction by controlling three factors: energy, pulse duration and the wavelength to target a selected tissue. Melanin highly absorbs a wavelength of 694nm (Ruby laser) and the wave length of 755 nm (Alexandrite laser). The absorption of oxyhaemoglobin in the blood vessels exhibit strong bands in the ultraviolet (Excimer), blue (Argon), green & yellow (dye lasers) and 532nm (green) bands. These tissues could be made targets, if a proper selected pulse duration and energy is utilized in the most suitable mode of the laser. For example, the Ruby laser in a Q-switched mode with nanoseconds pulses could target a black chromophore of a nevus of the skin.

A scattering of laser light occurs when the photons change their direction. 5 % of the laser light striking the skin is reflected back, while 95 % of the photons that enter the skin are either absorbed or a part of them are scattered. This scattering is by the collagen fibers and it varies with the wavelengths of lasers. This scattering is responsible for the causation of collagen shrinkage and treatment of fine wrinkles.

Optical penetration

This is governed by a combination of absorption and scattering. In the shorter wavelengths, the penetration is more in the white skin than in darker skin. With the longer wavelengths of lasers, scattering and absorption is dependent on the thickness and water content of the skin. The colour of the skin makes no difference at higher wave lengths. The most superficial penetrating wavelengths are in the far ultraviolet region (protein and water absorption), and far infrared regions (water absorption). For example, the excimer (193nm) penetrates only a fraction of a micrometer into the stratum corneum and CO₂ laser (10,600 nm.) penetrates only 20 to 75 microns, hence they are useful for cutting and vaporization; CO₂ laser for the skin and excimer for the cornea of the eye. The CO₂ laser penetrates more when it is focused to a spot. When it is defocused the spot size increases, the intensity decreases and hence the penetration decreases (fig.4). In case of non-ablative lasers like the long pulse Nd:Yag laser, the penetration is more when the spot size is bigger. With the smaller spot size, the penetration through the skin is less as compared to the bigger spot size.

Thermal injury to cells

This is dependent on the combination of temperature and the contact time. These two parameters control the coagulative process and thermal cell damage. The thermal denaturation is a rate process. As the heat increases it hastens the process to necrosis. This is reversible in the initial stages. Most human cells can withstand prolonged exposure to a temperature of 40^oC. Selective photothermolysis, as explained earlier, is set by the high power of laser causing high temperature in a selected tissue for a very short duration. In such selective and individual cell

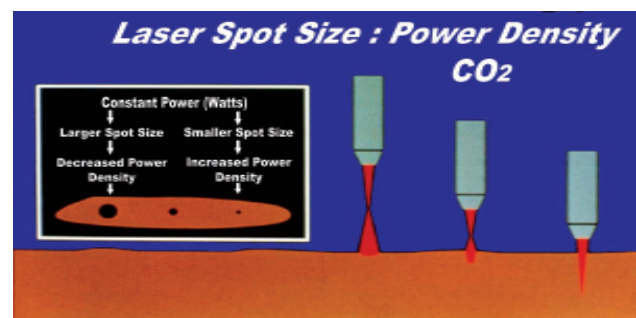


Fig.4 Showing optical penetration of lasers into skin in relation to its spot size.

heating, there is little risk of scarring because the gross dermal heating is minimized.

Dermal coagulation occurs when the critical temperature is reached. There is a histological boundary of dermal coagulation, which defines laser from other burn injuries. The vaporization (boiling) temperature of water at one atmospheric pressure is 100^o C. With continuous wave laser (CO₂) the surface of the skin gets desiccated and charred at temperatures of 120^o C to 200^o C. This temperature can go to several hundred degrees. During cutting and ablation, the thermal injury can occur up to 1 mm depth because of heat conduction, in spite of 20 μ depth of penetration of CO₂ laser. In case of ablation there is a layer of coagulation below the ash, the residual tissue damage (RTD). Beyond the coagulative layer there is tissue shrinkage caused by heat dissipation. Here there is reversible tissue coagulation. In contrast, short pulses of high energy (5 - 10J /cm²) called superpulse or ultrapulse can remove tissue with greater efficiency and less thermal damage. If the entire energy needed for vaporization is delivered in the time equal to or less than the thermal relaxation time of the most superficial layer of the skin the heat remains confined to this thinnest layer. Thus, only this thin layer is vaporized without much heat transfer to the underlying tissue.

Dose of laser

Light is either transmitted, reflected or is absorbed into the target or the tissue. The absorbed energy from the beam of laser transfers heat to the tissue. The heated tissue may be destroyed or show changes such as thermal, chemical, mechanical etc. The time taken by the tissue to cool by 50% is called its *thermal relaxation time* (TRT). The concept of *selective photothermolysis* was propounded by Anderson and Parrish in 1983. A tissue is selectively destroyed if the duration of the pulse of laser is less than its thermal relaxation time. For example, the TRT of hair root is 10 to 100 milliseconds, with some variation depending on the wavelength of the laser. If the pulse of the laser is less than 100 milliseconds it will destroy the hair root by accumulating sufficient laser energy in the hair.

Low power lasers may produce a biochemical change, but a high power laser may be used to create non-linear optical effects, like optical breakdown, thermal effect, an explosion or "plasma" formation.

Mode of delivery

The lasers are delivered in continuous mode or in the pulsed mode. In the continuous mode (fig.5) the laser can cut the skin, or it can vaporize or char a mole or a similar lesion on the skin. In the pulsed mode its effect is different and variable. The principle of selective photothermolysis revolutionized laser treatment. The thermal relaxation time of the skin is about one millisecond or one thousand microseconds. If the pulse duration of the CO₂ laser is less than 1000 microseconds, it will not char or damage the skin surface. By reducing the time and energy a thin layer of the skin can be removed or resurfaced. Laser pulses are of various types:

1. *Chopped pulse* (fig.5): If the continuous laser is cut or divided by small gaps, the effect will remain the same.
2. *Ultrapulse or Superpulse*: It is a pulse of high energy and short duration. The effect will be graduated and controlled by increasing or decreasing the energy.

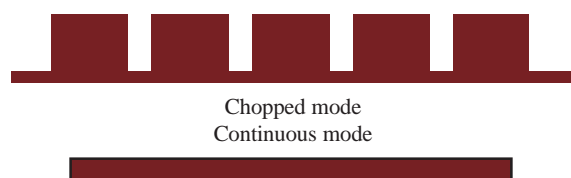


Fig.5

3. *Scanning* by a continuous rain of pulses of short duration is also very useful. The scanned area is smooth and uniform. A beam of laser as a continuous rain of pulses of high energy are delivered to the target so rapidly that the tissue is vaporized before any carbonization occurs, each pulse being within the thermal relaxation time. The scanning of the skin can perform as smooth abrasion or resurfacing of the skin layers. One can also resurface the skin layer by layer. Since there is no bleeding from the surface of the skin, the layers can be identified.

Following a CO₂ laser the experienced eye will see first the pink layer, and then the tanner colour of the upper papillary layer. The reticular layer of the skin looks smooth or coarse and is dirty yellow. In case of Erb:YAG laser the corresponding colours are yellowish brown after the first pass. The papillary layer looks pink. When reticular layer is reached dermal bleeding is noticed. The short pulsed Erb:YAG does not have any thermal energy and thus cannot coagulate blood vessels. The long pulsed Erb:YAG has a thermal component, which can lead to collagen shrinkage and vessel coagulation.

Effects of lasers depending on mode

If the continuous mode is cut into pulses, causing chopped pulses, the effect on the tissue does not change unless the duration of contact time or the exposure time can be reduced. These chopped pulses cannot produce the effect of selective photothermolysis and cause a selective damage of the chromophore, like pulsed lasers. The chopped pulses and the continuous beam laser would increase the thermal damage by excessive heat transfer. The CO₂ pulsed laser with high fluence and short duration would remove the tissue with greater efficiency and can be controlled layer by layer. A CO₂ laser (continuous wave), if scanned rapidly enough along the tissue can also produce intense short exposure conditions needed for the pulsed laser effects. Conversely, a short pulsed laser, when operated at a subablative pulse fluence at repetition rates of about 50 to 100 Hz. will produce deeper injury and charring, usually associated with a continuous wave form laser. Hence, more understanding is necessary regarding the fluence, the contact time, the type of laser, its wavelength, and the spot size of the delivery hand-piece. Therefore, in continuous wave scan, contact time of each unit pulse is important to achieve a uniform resurfacing. In pulsed laser, even if the contact time is short enough, and less than the TRT of the skin, resurfacing is neither uniform nor controllable.

ABLATIVE LASERS

The lasers which ablate the surface of the skin are called ablative lasers. CO₂ and Erbium: YAG lasers are highly absorbed by water, as water in the skin is the chromophore for these lasers. The chromophore absorbs the thermal energy and gets heated up. This causes thermal change on the skin surface. On reaching a certain temperature, the skin surface layer is vaporized and looks as if it is abraded like in dermabrasion. Following reepithelialization it leads to *skin resurfacing*.

Erbium: YAG laser gets absorbed in water ten times more than by CO₂ laser. Hence, it removes a very thin layer of the skin surface in one pass or in one layer treatment. This laser does not heat the surrounding tissue. CO₂ laser ablates or vaporizes a layer thicker than Erb:YAG and it disperses the heat to the surrounding tissue, heating the collagen of the dermis. It causes the skin to shrink, due to the shrinkage of the collagen and laying of neocollagen. The CO₂ laser in a continuous mode can cut the tissue like a knife, when it is focused to a point, but Erb:YAG laser cannot do this as it cannot be used in a continuous mode. The CO₂ laser coagulates a blood vessel of diameter of 0.5mm, and therefore, in deep

resurfacing of the skin by CO₂ laser there is no bleeding. While deep resurfacing by Erb:YAG laser leads to bleeding from the deeper layers. During ablation the *plume* (gaseous material) comes out and has to be sucked to avoid inhalation by the surgeon and the patient. The ash remaining on the surface of the skin has to be wiped with wet saline gauze or a pad. During resurfacing by Erb:YAG laser the ash is thrown in the plume by the optical blast of the laser. The plume of the Erb:YAG would contain more of the toxic material hence the suction should be more powerful.

The effect of heat on the skin surface is as on any living tissue. The tissue vaporizes at 100° C. If the laser pass is repeated at the same place without removing the ash, the temperature rises in the ash and the tissue is charred black. If the energy is adjusted in such a way that the temperature on the skin surface reaches between 40° and 50° C, the collagen of the skin is heated up, which may be reversible, and cause collagen shrinkage.

NON ABLATIVE LASERS

The non ablative lasers do not affect the epidermis in normal course. There is a so called dermal window between 400 - 1400 nm wavelengths. At these wavelengths the lasers can pass through the skin and affect the dermal structures. The epidermis is saved by surface cooling. The wavelength around 700 nm has affinity for black pigment and those between 480-600nm are better absorbed by red pigment. The heat of the lasers if dissipated, non-specifically, affects dermal collagen and can rejuvenate the photo-damaged skin. There are various lasers in this range which have been used for rejuvenation of the skin. Intense Pulse Light (IPL) has also been widely used in this regard. In addition to the wave length, the mode and dose of the intense light or that of the laser is important.

These lasers can perform *various functions* can be beneficia in.

- Hair removal by targeting the hair root structures.
- Treatment of pigmentary lesions of the skin by selectively affecting the melanosomes and melanocytes. Lasers can also target any other pigment like the colours of tattoos.
- Treatment of vascular lesions of the skin like portwine stains, telangiectasis etc.
- Facial Rejuvenation by collagen shrinkage.
- Management of acute acne by targeting the bacteria P. acnes.
- Tissue welding.
- Photodynamic therapy.
- Limited role in hypertrophic scars and keloids.

Intense Pulsed Light (IPL)

The intense pulsed light is essentially a non ablative light working like a laser. It has wavelengths between 500-1200nm. The required wavelength is obtained by an appropriate filter. The tissue effect behaves in a manner following the theory of *selective photothermolysis*. Hence, it has to be used in the pulsed mode. The pulses are divided into two or three pulses with a delay time in between. This delay helps in reducing the heat transfer to the skin and takes precaution against any probable complications of the epidermo-dermal component.

The continuous energy of the flash lamp and the wavelength is computer controlled. The longer wavelengths have deeper penetration than the shorter wavelengths. An appropriate filter is used at the tip of the hand-piece. This is rectangular in shape and of various sizes. The use of a cool gel helps in cooling the skin. Division into multiple pulses also helps in saving the skin. The ability to pulse the IPL within the thermal relaxation time of the chromophore accumulates adequate heat in the target to destroy it. The larger size of the tip of the hand-piece helps to treat a larger area at a time and also has a deeper penetration.

Various companies have limited the range of wavelengths of these machines. The machine with 400nm wavelength is used only in cases of acute acne. Sittings are given twice a week for about sixteen weeks or till remission occurs. This may be repeated if the acne becomes acute again. Longer wave lengths are available in Vasculight Plus of Lumenis (formerly ESC). This is a high output device. It specifies an 'SR mode' for photorejuvenation, 'VL mode' for vascular lesions, 'PL mode' for pigmented lesions, and 'DL mode' for deeper blood vessels. It also has a mode for hair removal. The computer gives the pulse duration, the number of pulses and the fluence for the type of skin. Necessary filters are used to cut off unnecessary wave lengths. A cool gel is applied on the surface of the skin before pulsing the target.

It is claimed that there are no short term or long term adverse effects of IPL therapy. There may be transient erythema, oedema and pigmentary changes after the treatment. There are no serious long term complications like blistering, scarring and pigmentary dyschromias in Fitzpatrick's skin type III, IV, V and VI.

Nester et al define the skin changes broadly as Type I and II.

Type I: Include pigmentary changes like lentigenes, post inflammatory hyper-pigmentation, and vascular abnormalities like telangiectasia and persistent erythema.

Type II: Includes solar elastosis, collagen damage, such as loss of texture and dilated facial pores, laxity and rhytids. These are changes of the ageing face. Histologically, there are tangled masses of degraded elastic fibers, decreased collagen fibers, increased ground substance such as glycosaminoglycans and proteoglycans, and some cutaneous changes due to sun damage.

In case of Vasculite Plus of Lumenis, cut off filters used are of 560 nm, 590 nm and 640 nm. Total fluence is 20 to 30 joules. Pulse mode is double or triple. The pulse duration is (2.5- 4.0 / 4.0-5.0 msec). These parameters are set according to the skin type and extent of photo damaged skin. Emla / Prilox cream is applied two hours before treatment to anesthetize the skin. A chilled gel is spread on the surface of the skin. The sapphire hand piece is gently placed on the skin without making contact with it. The shot of the pulse is felt like the snapping of a rubber band. This treatment is repeated at three weeks interval for 4 to 6 sessions. The results are short term and long term, though not permanent.

There are a variety of machines in the market and the frequency of treatment to photodamaged or aged skin of the face depends on the power of the machine, the dosage and the number of pulses per shot. The effect also lasts for a variable period.

CUTANEOUS PIGMENTED LESIONS

Laser treatment should be undertaken only in case of benign pigmented lesions. In case of any doubt, a prior histopathological study must be done. These lesions may be:

A: *Superficial or epidermal*. (Lentigenes, epilides, nevi spilus, café-au-lait, seborrheic keratosis, and may include some junctional nevi).

B: *Deep or dermal*. (Nevi of Ota, nevi of Ito and tattoos).

C: *Dermo-epidermal, involving both epidermis and dermis*. (Compound nevi, Becker's nevi, melasma, post-inflammatory and post-traumatic pigmentations).

The melanin of the skin can regenerate and the ultraviolet rays of the sunlight stimulate it. Therefore, human races of the tropics are the coloured races. Ablative lasers can remove melanin of the epidermis in lentigenes. The pigment of the melanosomes (pigment granules) can only come out if the cell wall bursts. The thermal relaxation time of melanosomes is unknown and is probably in the range of 250-1000 nanoseconds. The rupture of melanosomes is independent of the pulse duration below 100 nanoseconds- occurring even in picosecond and

femtosecond pulses. Therefore, most of the Q-switched lasers in the market provide pulses in 2-8 or 15 nanoseconds. The immediate effect of the Q-switched laser on the pigmented skin is whitening. Deeper whitening occurs in case of tattoos which have intracellular pigments.

Epidermal lesions

They are amenable to many modalities as almost all injuries confined to the epidermis heal without scarring. The CO₂ laser can efficiently resurface most of the epidermal lesions. However, for lesions not elevated above the surface Q switched Nd:YAG 532 nm laser (5-10nsec) clears many of these in a single treatment. There may be transient hypopigmentation after the treatment. The pulsed dye laser 510 nm has been shown to be effective in lentiginos. Epelides (freckles) respond to sunscreens and sun avoidance. Alfa hydroxy acids and tretinoin application also helps. The Q switched lasers also do well. The same is true for café au lait macules. Nevus spilus is a lesion where if malignant degeneration is suspected, a biopsy should be obtained.

Dermal – epidermal lesions

Becker's nevi show elongation of rete ridges and basal cell hyperpigmentation. Melanocytes appear to be increased and dermal thickening is present. The pulsed dye, Q switched Nd:YAG, Ruby or Alexandrite lasers offer good clearance, but recurrence is common.

Melasma is of two types: *Epidermal* - where melanin is mostly in basilar and suprabasilar areas and melanocytes contain highly melanized melanosomes; and the *dermal* - which has melanophages in the superficial and deep dermis, in addition to the epidermal pigmentation. Examination under a Wood's lamp shows enhancement of pigmentation in the epidermal type. Epidermal ones also have sharp borders. Repigmentation after any clearance by lasers is very common due to a failure in stopping the etiologic mechanism for hypermelanosis. Theoretically, pretreatment and post-treatment with hydroquinones should effectively prevent repigmentation, particularly when combined with tretinoin. Q switched Nd:YAG laser, 532nm for superficial and 1064nm for deep melasma provide good clearance at low fluences and the result has to be maintained by creams, along with avoidance of sunlight. Post-inflammatory hyperpigmentation can also be treated with a similar regime but with lasting results.

Dermal lesions

Commonly acquired nevi appear after 6-12 months of age and are sun sensitive, with a higher number in sun exposed areas. Smaller nevi respond better to all Q switched Nd:YAG lasers but many respond partially or recur. Congenital nevocellular nevi are present since birth, with a lifetime risk of 6.3% for development of melanoma in large nevi. Acquired nevi show better results than congenital ones. Because congenital ones extend into deepest reticular dermis, full clearance with pigment lasers is often not possible (fig.6)

Nevus of Ota is a bluish grey macular lesion limited to first and second divisions of the trigeminal nerve, often associated with ocular pigmentation and has a strong predilection for females. The edge of the nevus is not sharply demarcated. Histology shows long dermal melanocytes in the upper half of dermis. Along with the nevus of Ito they respond well to the Q switched lasers (fig.7). Optimal interval between sittings is 6-8 weeks. Superficial lesions respond to shorter wavelengths (510nm, 532nm and even 694nm) whereas deeper lesions respond well to 694nm, 755nm and 1064nm). Larger spot sizes increase penetration depth.

Tattoos

Tattoos are pigmented lesions. The pigment is forced into the skin either by trauma or for decoration. Pigment is found in the keratinocytes, phagocytes and mast cells. Tattoo removal is done after they are 9-12 months old, and the pigment is set in cells, otherwise the color may run at the edges. Earlier, they were treated by dermabrasion etc. and also by non selective lasers. These destructive modalities resulted in scarring. The Q-switched (1064nm) Nd:YAG lasers are effective in removing the blue and black pigment in multiple sessions. In our experience they are especially useful in darker skin (fig.8). The



Fig.6 Profile view of a patient with giant hairy nevus in right temple and malar areas which was partly treated with serial excision & laser (top left- untreated nevus, centre - partial excision, bottom right- treated by 6 sittings of Q-switched, 1064nm, Nd:YAG laser).



Fig.7a A patient with nevus of Ota in the left malar and cheek areas.



Fig.7b Showing significant clearing of pigment after four sittings of Q-switched, 1064nm, Nd:YAG laser treatment.

hypopigmentation seen after treatment is transient. Frequency doubled (FD) Q-switched Nd:YAG (532nm) laser is able to target the red and orange colours. The yellow colour in tattoos responds poorly. The blue and green colours also respond poorly and are better treated with a Q-switched Ruby laser. Purple, orange and yellow colours can be treated with a flash lamp pumped dye laser in a few sessions.

Amateur tattoos do better than professional tattoos as the pigment volume and depth is more in the latter. Treatments should be spaced 6-8 weeks apart and it may require 2-20 treatments for clearance. The desired endpoint for both nevi and tattoos (with Q switched Nd:YAG laser) is whitening, and punctate bleeding means higher fluences are being used. A 3 or 4 mm spot size is used, and one should start with lower fluences and work upwards. The rate is adjusted as per convenience from 0.5-10 Hz. Post-operatively, an antibiotic cream with steroid is used till completely healed. Bleaching creams or keratolytic creams are advised rarely after the healing of the laser wound. They may be used in some cases under supervision and followed up every week or 10 days.



Fig.8a A patient with a decorative professional tattoo on the flexor aspect of left wrist after two sittings of treatment with Q-switched, 1064nm, Nd:YAG laser.



Fig.8b More improvement and color fading can be seen in the tattoo after another three sittings with same laser. The result shown is at one year after the last sitting.

CUTANEOUS VASCULAR LESIONS

The haemangiomas and vascular malformations must be investigated regarding their extent, depth and whether there is any venous communication (arterio-venous malformation). The presence of a murmur or a bruit is noted. Other investigations which are useful are CT scan, MRI, colour doppler studies and a CT or MRI angiography. If there are any deeper connections the case may be sent for embolization to an interventional radiologist. The concept of selective photothermolysis has opened the door to the dermal window in the visible spectrum. The oxyhaemoglobin in blood vessels is targeted by the appropriate laser to heat up and destroy the endothelium.

In 1988, Mulliken, classified the vascular birthmarks as; haemangiomas and vascular malformations.

Haemangiomas have endothelial dilatation and hyperplasia. These may be superficial (capillary) or deep (cavernous). The colour of the overlying skin suggests whether it is superficial or deep. Haemangiomas appear a few months after birth, and they proliferate with time and with the age of the child. Majority of them regress or involute as the child grows.

Vascular malformations are abnormalities of the vascular channels with more or less normal endothelium. They may be; capillary, arterial, venous or lymphatic depending on the vessels involved. It may be a combination of these vessels. They are usually present at birth or, may manifest later in young age. The low flow lesions are capillary (port wine stain) or venous and the high flow lesions are arterial and lymphatic. The high flow lesions are treated by embolization and surgical excision.

Port wine stains are capillary malformations. They do not regress with the growth of the child and should be differentiated from nevus flammeus neonatorum which is a faint 'salmon patch' and it disappears or fades in a few months of life. These lesions may be associated with other medical problems like glaucoma, other vascular abnormalities or neurological disorders, which should be investigated if necessary. They may be associated with crusting, oozing or dermatitis. The superficial lesions are pink in colour, but the deeper lesions are darker with bigger vessels with thicker walls. They become thicker as the child grows older. Hence, the response to treatment is better in a younger age. The flash lamp pulsed dye laser (FLPDL) was specifically designed to treat small vessels in childhood. In general, children under 4 years of age had better results than those over 4 years. Some advocate beginning the treatment as early as 7-14 days of age so that 3 treatments can be completed by the time the child is 6 months old. This can lead to a 50% improvement in three sittings. Very superficial lesions clear much quicker than deeper ones, latter needing up to 10 treatments or more (fig.9). Also, darker skin patients require more sittings. Goldman and Fitzpatrick recommend fluences of 5.75 – 7.75 J/cm² with a 5mm spot, and correspondingly lower fluences of 4-5 J/cm² for larger spot sizes of 10 mm. The KTP laser (532 nm) has also been used. At our centre, using the 532 nm(KTP) wide pulse laser in darker skinned patients, the energy (fluence and pulse duration) is adjusted depending on the diameter being used, the contact time being 50 milliseconds. For superficial vessels the contact time is reduced gradually to 35, 25 and 15 milliseconds, in subsequent sittings. Sometimes in the same lesion, the darker portion is treated with longer contact time than the lighter part of the lesion. The treatment is always done after application of Prilox or Emla cream for topical anaesthesia. Usually some cooling is added by using ice packs or air cooling. The end point to be noted is a whitish or grayish white appearance. The purpuric or dark grey end point is not very desirable and it indicates that too high an energy has been chosen. The penetration of the non ablative lasers in white skin is more with lasers between 400 to 900 nm wavelength. Above 900 nm the absorption is more or less the same across



Fig.9b Showing improvement after six sittings of treatment with KTP 532nm laser. Sittings were carried out at six to eight weeks interval.



Fig.9a Portwine stain in left lower cheek region in a 20 year lady.

all skin types. This may be the reason why there are better results in the vascular lesions in lighter skin. A newer laser called LBO (Lithium Triborate) 532nm with pulse duration in milliseconds, has recently been reported as a vascular laser with better results.

Venous malformations may be seen in mucus membranes of the mouth, the eyelids or any part of the body and they usually appear as bluish swellings. They respond to oral prednisolone (2-3 mg / kg) but a relapse is more likely. The prednisolone is usually given for 3 weeks but can be continued for 6 months under supervision. We have successfully used long pulse Nd:YAG laser to treat these lesions simultaneously with prednisolone medication, however, a dye laser is probably more effective. Intense pulse light is also effective in these cases.

Besides these other vascular lesions include; angiomas and pyogenic granulomas.

Angiomas are cherry coloured, spider like, and are seen in children. In spider angiomas, the dye laser or 532nm wide pulse laser is likely to benefit. These lesions are rarely seen in our country.

Pyogenic granulomas are acquired lesions with a pedicle. Their endothelium shows proliferation. If it is removed with CO₂ laser, the site of the pedicle must be resurfaced with a very mild pass, using 50 to 100 µs contact time.

LASER HAIR REMOVAL

The need for a rapid, permanent and 'no scarring' method for hair removal has led to the development of various lasers and light sources. These include ruby, alexandrite, diode, and Nd:YAG lasers, and IPL.

Relevant hair anatomy

Each hair has 3 distinct components, ie, the bulb (the extended lower portion of the follicle), the isthmus, and the infundibulum. The bulge is an area near the insertion of the erector pili muscle. Pluripotential cells in the bulb and bulge areas cause growth of the hair follicle. Melanocytes are present in these areas. For most people, the terminal hair bulb is approximately 4 mm (2-7 mm) beneath the surface of the skin in anagen phase, thus requiring considerable laser penetration depth for removal. In contrast, vellus hair bulb extends about 1 mm or less into the dermis.

Hair cycles

Hair grows in cyclic phases: Anagen is the active growth phase; catagen, the transition or shrivelled phase and telogen, the resting phase. The duration of the anagen phase governs the length of hair at different body sites. Scalp hair has a longer anagen phase and can last upto 6 years,

the telogen phase lasting only about 3 months. Hair from other body sites like eyebrows, cheeks, ears, arms, legs have much shorter anagen phases i.e. 4 - 7 months, and longer telogen phases. Catagen phase is fairly constant at about 3 - 4 weeks.

The laser is effective only in the anagen phase, during which time hair matrix cells divide rapidly and migrate outward from the shaft, and the melanin load is at its highest. During the catagen phase, mitosis ceases, the hair matrix regresses, the papilla retracts to a place near the bulge, and capillary nourishment diminishes. In the telogen phase, the follicle detaches from the papillae and contracts to a third of its original depth, eventually falling out. The ratio of anagen / telogen follicles varies with body location. Since not all hairs are in anagen phase at any one time, laser treatment must be repeated to capture new hairs coming into anagen. This is fundamental in understanding the need for repetitive hair-removal sessions to completely destroy hair follicles.

Etiology of excessive hair

Hirsutism is defined as the excessive growth of thick dark (terminal) hair in locations where hair growth in women usually is minimal or absent. Such male-pattern growth of terminal body hair usually occurs in androgen-stimulated locations, such as the face, chest, and areolae. *Hypertrichosis* refers to excess hair (terminal or vellus) in areas that are not predominantly androgen dependent. Whether a patient is hirsute often is difficult to judge because hair growth varies among individual women and across ethnic groups. What is considered hirsutism in one culture may be considered typical in another. For example, women from the Mediterranean and the Indian subcontinent have more facial and body hair than do women from East Asia, sub-Saharan Africa, and northern Europe. Given the subjectiveness of this perception, a scoring scale has been developed in which nine body areas are used to grade hair growth on a scale of 0-4. The scores are added for the nine body parts, and a score of eight or more defines hirsutism.

Hirsutism can be caused by abnormally high androgen levels or by hair follicles that are more sensitive than usual to normal androgen levels. Therefore, increased hair growth often is observed in patients with endocrine disorders characterized by *hyperandrogenism*. The disorders may be caused by abnormalities of the ovaries or adrenal glands. Serum levels of free testosterone, the biologically active androgen that causes hair growth, are regulated by sex hormone-binding globulin (SHBG). Lower levels of SHBG increase the availability of free testosterone. SHBG levels decrease in response to the following: Exogenous androgen administration (anabolic steroids, testosterone), in certain disorders that affect androgen levels like polycystic ovarian syndrome (PCOS, ovarian tumors), congenital or delayed-onset adrenal hyperplasia, Cushing syndrome, obesity, hyperinsulinemia, hyperprolactinemia, increased growth hormone levels. SHBG levels increase with higher estrogen levels, such as the levels that occur during oral contraceptive therapy. The resultant increased SHBG levels lower the activity of circulating testosterone. The *idiopathic* category is probably caused by subtle forms of ovarian or adrenal hypersecretion, alterations in serum androgen-binding proteins or androgen metabolism, or most likely, excessive genetic sensitivity of hair follicles to normal androgen levels.

LABORATORY INVESTIGATIONS

After familial and drug-induced causes for hirsutism have been excluded, hirsutism is considered resulting from androgen excess. The clinical picture should guide the evaluation.

Serum testosterone and DHEA-S levels are estimated. Initial screening for total or free testosterone and DHEA-S often determines if further testing is necessary. Whether total testosterone is a better screening test than free testosterone is controversial. The evaluation of simple hirsutism

requires only DHEA-S and testosterone levels. If the level of one is abnormal, further testing may be warranted. Complicated hirsutism or virilism requires additional testing to better define a source of hyperandrogenism. No direct correlation exists between the levels of testosterone and the degree of hirsutism, since hirsutism is caused by the action of dihydrotestosterone, which is the more potent testosterone metabolite. Elevated free serum testosterone levels (>80 ng/dl) are found in most women with anovulation and hirsutism. In most patients in whom the total testosterone level is greater than 200 ng/dl (>100 ng/dl in postmenopausal women), a tumor workup is indicated. This workup includes a pelvic examination and ultrasound, which usually are adequate to diagnose PCOS. If the test results are negative, an adrenal computed tomography scan is performed. Serum DHEA-S determinations are used as a marker of adrenal androgen output, since serum concentrations vary less than do DHEA-S levels with diurnal serum cortisol levels. Moderate elevations suggest an adrenal origin for the hirsutism. Tumor workup is indicated in most patients in whom the DHEA-S level is greater than 700 mg/dl (400 mg/dl in postmenopausal women). An increase of this magnitude usually results from adrenal hyperplasia rather than the extremely rare adrenal carcinomas.

Test for androstenedione: Androstenedione can originate in the adrenal glands or in the ovaries and often is elevated in patients with hyperandrogenism. A serum androstenedione level greater than 100 ng/dl suggests an ovarian or adrenal neoplasm.

Test for luteinizing hormone and follicle-stimulating hormone: Often, in women with PCOS, luteinizing hormone (LH) levels are elevated and follicle-stimulating hormone (FSH) levels are depressed, which results in elevated LH/FSH ratios (>2 is common). Women with late-onset congenital adrenal hyperplasia (CAH) usually have a normal LH/FSH ratio.

Test for 17-hydroxyprogesterone: The screening test for late-onset CAH is measurement of morning 17-hydroxyprogesterone levels. DHEA-S and 17-ketosteroids levels are normal or moderately elevated. Testosterone and precursors of cortisol levels are elevated. Urinary 17-ketosteroids also are elevated slightly in patients with PCOS.

In patients with late-onset CAH, 17-hydroxyprogesterone levels should be less than 200 ng/dl. A 17-hydroxyprogesterone level greater than 800 ng/dl is diagnostic for 21-hydroxylase deficiency, the most common defect associated with late-onset CAH. An intermediate 17-hydroxyprogesterone level (200-800 ng/dl) should also have a dexamethasone suppression test. Women with late-onset CAH usually have normal dexamethasone suppression test results. If a patient is oligomenorrheic, LH, FSH, prolactin, and thyroid-stimulating hormone levels may be useful in the diagnosis.

Perform a 24-hour urinary cortisol or an overnight dexamethasone suppression test if Cushing syndrome is suspected.

Imaging Studies

In patients with suspected PCOS or a possible adrenal or ovarian neoplasm, imaging studies of these organs may be required. Consult an endocrinologist or gynecologist for guidance

Terminology in hair removal

Temporary hair reduction is defined as a delay in hair growth, which usually lasts 1-3 months, consistent with the induction of telogen phase. *A permanent hair reduction* refers to a significant reduction in the number of terminal hairs after a given treatment, which is stable for a period of time longer than the complete growth cycle of hair follicles at the given body site. It has recently been suggested to add another 6 months (i.e. 1 year from date of last sitting) to this post treatment observation time (i.e., the time necessary for a damaged follicle to recover from the laser injury and reenter a normal growth cycle). A distinction needs to be

made between permanent and complete hair loss. *Complete hair loss* refers to a lack of regrowing hairs (i.e. a significant reduction in the number of regrowing hairs to zero). Complete hair loss may be either temporary or permanent. Laser treatment usually produces complete but temporary hair loss for 1-3 months, followed by partial but permanent hair loss. Histological observations show damage predominantly in hair follicles with large, pigmented shafts, while hair follicles with small (<25 mm), hypopigmented shafts do not demonstrate any morphological change.

Immediately after laser treatment, the hair shaft shows fragmentation with focal rupture and thermal damage to the surrounding follicular epithelium (fig.10). The extent of thermal damage is dependent on the pulse width but retains confinement on the spatial scale of the follicle itself. One month later, most follicles are in telogen phase while others are being replaced by fibrosis and a foreign body giant cell reaction with phagocytosis of melanin. At one year, most follicles are replaced by miniaturized hair follicles (dominant mechanism), and some are replaced by a fibrotic remnants. Both of these histological findings produce permanent clinical reduction in hair.

Indications and Contraindication

The indication for hair removal is mostly subjective. A desire for hair removal is the only criterion for laser surgery. Relative contraindications are white, gray or blonde hair.

Prelaser Workup

It is essential to differentiate between hypertrichosis and hirsutism. Record a detailed personal and family history (if pertinent) regarding the amount and distribution of excessive hair growth, date of onset, previous treatments, and drug history. Menstrual irregularities, nipple discharge, difficulty in conceiving, scalp hair loss or cystic acne etc. should be reviewed exhaustively. A detailed medical history to exclude photosensitizing disorders, collagen vascular disease, or medications (Accutane, immunosuppression etc.) needs to be recorded. The patient should avoid waxing or plucking the treated area for 4-6 weeks, ideally,



Fig.10 Showing immediate changes in the chin region of a patient treated with long pulse, 1064nm, Nd:YAG(40ms,30J) laser for hair removal. Note the perifollicular edema and popping out hair which is hallmark of adequate fluence and pulse width.

prior to laser treatment. Shaving hairs is acceptable. If used earlier, all bleach effect should have weathered off before laser treatment. When treating the bikini area or perioral area a history of herpes simplex infection should be enquired. Still, the patient is administered antiviral medications perioperatively for prophylaxis (eg. acyclovir 400 mg, t.i.d for five days). Patients should avoid sun tanning for at least 4-6 weeks prior to laser hair removal. Check for history of post-inflammatory hyperpigmentation, scarring or keloid formation after any skin injury. One needs to be careful while treating skin darker than Fitzpatrick IV phototype. Obtain a detailed and informed consent. Elements of this consent form should include past laser treatments (if any), availability of alternative treatment options, rationale for treatment, expected results, requirement of multiple treatment sessions, goal of hair reduction (not

complete hair removal), potential side effects or complications (crusting, blister formation, burns, dyspigmentation), chances of recurrence in endocrine disorders and the exclusion criteria.

Mechanism of hair removal and chromophores

With earlier lasers at fluences affecting hair follicles the epidermis was severely damaged. The theory of selective photothermolysis has revolutionized laser hair removal and the market has exploded with numerous hair-removing lasers and light sources.

Initial laser systems, such as the Q-switched Nd:YAG (1064 nm, soft light system, Thermolase Corp, California), used a carbon mineral oil suspension to penetrate the hair follicle and act as an energy-absorbing chromophore. An optically filtered xenon flash lamp (Epi Light and ESC Luxar, Energy Systems Corp, Massachusetts) uses filters to select operating wavelengths of light at a cutoff of 690 nm, thus allowing light above this wavelength to pass through to affect hair removal. The long-pulse Ruby laser (694 nm, Epi Laser, Palomar Technologies, Massachusetts and Epi Touch, Sharplan Laser, NJ) uses the principle of selective photothermolysis, in which melanin acts as the target chromophore. The long-pulse Alexandrite laser (755 nm, Photo Genica LPIR, Cynosure Inc, Massachusetts) uses the principle of thermokinetic selectivity to target melanin in the hair follicle. In this way, the epidermis is allowed to cool more efficiently, while the melanin in the hair follicle is heated. Coherent Medical (California) and Palomar (Lexington, Massachusetts) have introduced the Light Sheer, a diode laser operating at 800 nm that has longer pulse durations (up to 30 milliseconds). This technology minimizes laser machine size by eliminating the laser tube in place of a solid-state diode circuitry. Several long-pulsed Nd:YAG lasers, e.g. Fotona (Dualis XP, XP Plus; Slovenia), Laser Scope (Depilase, California), that deliver pulses in the millisecond domain have been approved by the US FDA for hair removal on all skin types. The long pulses (50 milliseconds) are also capable of inducing long-term hair loss, however, high energy is needed to compensate for the lower melanin absorption. One distinct advantage of these systems is their ability to safely treat individuals with dark skin tones.

Hair follicles are destroyed by lasers or by light by three mechanisms; *photo-thermal* (due to local heating), *photo-mechanical* (due to shock waves or violent cavitation), or *photo-chemical* (due to generation of toxic mediators like singlet oxygen or free radicals). Lasers and noncoherent light sources have recently been introduced to induce selective damage to hair follicles based on the principles of selective *photo-thermolysis*. Selective thermal damage of a pigmented target structure will result when sufficient fluence at a wavelength, preferentially absorbed by the target, is delivered during a time equal to or less than the thermal relaxation time of the target. In the visible to near-infrared region, melanin is the natural chromophore for targeting hair follicles. Lasers or light sources that operate in the red or near-infrared wavelength region (694-nm ruby laser, 755-nm alexandrite laser, 800-nm diode laser, 1064-nm Nd:YAG laser, and noncoherent light sources with cut-off filters) all lie in an optical window of the spectrum in which selective absorption by melanin is combined with deep penetration into the dermis. Therefore, deep and selective heating of the hair shaft, the hair follicle epithelium, and the heavily pigmented matrix is possible in the 600-1100nm region. However, melanin in the epidermis presents a competing site for absorption. Selective cooling of the epidermis has been shown to minimize epidermal injury. Cooling can be achieved by various means including ice, a cooled gel layer, a cooled glass chamber or sapphire window, a pulsed cryogen spray, or cooled airflow. Laser pulse width also appears to play an important role as suggested by the thermal transfer theory. Thermal conduction from the melanin-rich shaft and matrix heats surrounding follicular structures. To obtain confinement of thermal

damage, the pulse duration should be shorter or equal to the thermal relaxation time of the hair follicle. Thermal relaxation of human terminal hair follicles has never been measured but it is estimated to be approximately 10-100 milliseconds, depending on size. Therefore, devices for hair removal have pulse durations in the millisecond region. The normal mode 694nm ruby, normal mode 755nm alexandrite, 800nm pulsed diode lasers, long-pulsed Nd:YAG lasers (fig.11), and filtered flash lamp technology all use this mechanism. The *concept of thermal damage time* has recently been launched in the case of the hair follicle. The melanin-rich hair shaft and matrix cells occupy a relatively small volume, and propagation of the thermal damage front through the entire volume takes 3-20 times longer than the thermal relaxation time of the hair follicle. Super-long pulse heating (>100 milliseconds) appears to allow for long-term hair removal. *Photo-mechanical* destruction of hair has been attempted with very short nanosecond pulses by Q-switched 1064nm Nd:YAG lasers, with and without carbon suspension,



Fig.11a A 30 year lady with polycystic ovarian disease (PCOD) showing prominent hirsutism of chin and neck region.



Fig.11b The same patient at six months post treatment after five sittings with long pulse Nd:YAG, 1064nm laser.

however, when these very short pulses are used to target hair follicles, extremely rapid heating of the chromophore (melanin) occurs. This generates photo-acoustic shock waves that cause focal photo-mechanical disruption of the melanocytes but not complete follicular disruption. Therefore, the Q-switched Nd:YAG lasers are not likely to produce long-term hair removal. *Photo-chemical* destruction of hair follicles is the use of light and a photo-sensitizer to produce therapeutic effects.

Hair removal with topical aminolevulinic acid has been reported in a pilot study. Aminolevulinic acid (ALA) is a precursor in porphyrin synthesis and is rapidly and selectively converted to protoporphyrin IX by cells derived from the epidermis and follicular epithelium. Aminolevulinic acid or one of other related drugs is unlikely to prove useful for hair removal.

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JIMSA News

JIMSA CHAPTER ACTIVITIES - July to Sept. 2006

Tamil Nadu Chapter

09-07-06: Dr. R. Thara, “*Over view of Psychiatric Disorders*”
 13-08-06: Dr. V. Jayanthi, “*Portal hypertension*”
 10-09-06: Dr. R.Ravikumar, “*Robotic Surgery from concept to reality*”

Delhi Chapter

17-08-06 : Dr. Achal Dhir, “*Good Health & Aging – by Choice and not by Chance*”
 : Dr. S.K.Mishra, “*Biological Aspects of Aging*”

Rural CME T.N. Chapter

16-07-06 : Dr. Thiagarajan, “*Therapeutic Options in common skin conditions*”
 : Dr. A. Govindan, “*Recent Developments in Radiology and Imaging*”
 20-08-06 : Dr. R.Kandiah, “*Common Ophthalmic problems in general practice and current concept*”
 : Dr. A. Thiagarajan, “*Therapeutic Options in Common Skin conditions*”

Bihar Chapter

10-09-06 : Dr. Sheo Kumar Prasad, “*ENT & Genetics*”
 : Dr. Dori’s Desouza, “*Evolution of Genetics*”
 : Dr. Rajiv Ranjen, “*Medical Genetics Update*”
 : Dr. Gopal Prasad Sinha, “*Clinical Application of Genetics*”

JIMSACON 2006 at Lahore, Pakistan

Dr. Shaheena Asif, Organising Secretary of the conference has intimated that she has been directed to inform the participants of the conference that they can now apply for visa to Pakistan High Commission in India. As such the persons intending to participate in the conference, may apply for visa to the Pakistan High Commission in India under intimation to JIMSA HQ at New Delhi.

JIMSACON 2007 at Manipal

JIMSA is pleased to inform its Fellows and Members that Annual Conference “JIMSACON 2007” will be held at Manipal on 3,4,5 November, 2007. Manipal Academy of Higher Education (MAHE) (Deemed University) will organize the conference. Dr. Ramdas M. Pai, President of the MAHE and Trustee of JIMSA will be the Patron.

HONOUR

Dr. R.R. Thukral, Vice President, JIMSA, ENT specialist, has been awarded ‘**Best Worker**’ by the Delhi Medical Association (DMA) in its 92nd Foundation Day Function held on 14th August 2006 at New Delhi.

Dr. R. R. Thukral, Vice President JIMSA has been conferred “**Lifetime Achievement**” Award by *His Highness Dr. A.P.J. Abdul Kalam, President of India* on the occasion of “**World Congress on Clinical and Preventive Cardiology**” (WCCPC 2006) organized by Cardiology Society of India, at New Delhi.

Dr. H.K.Chopra, Secretary General, JIMSA has been conferred “**Lifetime Achievement**” Award by *His Highness Dr. A.P.J. Abdul Kalam, President of India* on the occasion of “**World Congress on Clinical and Preventive Cardiology**” (WCCPC 2006) organized by Cardiology Society of India, at New Delhi.

Fellows and Members elected during the quarter July-Sept. 2006

Dr. Vatsla Dadhwal	New Delhi	Dr. Satish Kumar Gupta	Rajasthan
Dr. (Mrs) Sneha Agarwal	New Delhi	Dr. Satyanarayan Mishra	Annamalai Nagar (T.N.)
Dr. Satish Sachdeva	Patiala ((Punjab)	Dr. D.P. Manchanda	U.P.
Dr. Neeraj Malik	New Delhi	Dr. Anup Mohta	Delhi
Dr. (Mrs) Ramesh Arora	Noida (UP.)	Dr. Mamatha Ballal	Manipal (Karnataka)
Dr. Tapan Ghose	New Delhi	Dr. Bikash Medhi	Chandigarh.
Dr. Satish Kumar Sharma	Gurgaon (Haryana)	Dr. Basheer Ahmed	Srinagar (Kashmir)
Dr. Vanita Arora	New Delhi	Dr. Surinder Salwan	Amritsar (Punjab)
Dr. Shiv Charan	Amritsar (Punjab)		

GUIDELINES FOR AUTHORS

The Journal of the International Medical Sciences Academy (JIMSA) is published quarterly, and serves as a medium for publication of work done by Fellows/Members of the Academy. The authors should provide a written undertaking signed by the senior author that *article submitted has neither been published elsewhere nor sent for publication at the time of submission.*

The Editorial Board reserves the right to modify articles so as to conform to the Journal style and standard. The views expressed in the articles will, however, remain the opinion of the author, and the Editorial Board accepts no responsibility for these.

The manuscript of article should be submitted in triplicate, typed double-spaced on standard bond paper with a 3 cm margin all round and should be sent to the Editor, JIMSA, 2nd Floor, National Medical Library Building, Ring Road, Ansari Nagar, New Delhi-110029. Update/Review article. Original article should not exceed 10 typewritten pages: case report, brief communication, procedure, current drug therapy - 6 pages. The article should be preceded by summary not exceeding 150 words; key words, where ever relevant should be listed. The manuscript should be arranged in the following sequence: Title page, with address for Correspondence, summary, introduction, material and methods, results (or case report), tables, legends to figures.

REFERENCES : Number should not exceed 15 for original articles, 8 for brief communication, case report, procedure and current drug therapy and 3 for letter to the Editor (correspondence). The names of all authors should be mentioned up to three; if more than three, the first three

names should be mentioned, followed by et al. The front and punctuations in *References* should be as follows.

Mathur, SM, Bhaskar, K. patel, BD, Krishnadas, J, Bronchoalveolar Lavage, J. Assoc. Physicians India 1984, 32:974-984.

Chapter from a book : Fulplus SW, charecterisation, isolation and purification of chollnergicreceptors in motor Innervation of muscle: edited by Sloff, S, Academic press London 1976; page 1-29.

Tables, if any should be at the end of manuscript.

ILLUSTRATIONS : These should be on glossy paper and submitted in triplicate. The figure number, article title and top of illustration should be indicated on the back of photograph alongwith details of the individual illustration. Upto 4 illustrations will be printed free of cost, additional figures and colour prints will be charged to the authors at prevalent rates.

CORRESPONDENCE : Letter to the Editor may comment on articles published in the Journal or may provide original date or information. Letters commenting on a Journal article should be received within six weeks of the article's publication, such letters will be forwarded to the senior author of the article, reply is expected within six weeks. In the absence of a reply the letter will be published with a note stating so.

REPRINTS : Five reprints of published articles will be supplied free of cost. Extra reprints will be supplied at additional cost. No such request will be entertained after the article's publication.