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Original Article

Journal of Plastic Surgery and Transplantation
Volume 1 Number 2, July–December 2020

The Role LLLT in the Management of Skin Graft Donor Site

Nishad K[1], Ravi Kumar Chittoria[2], Chirra Likhitha Reddy[3], Padmalakshmi Bharathi Mohan[4], Imran Pathan[5], Shijina K[6], Neljo Thomas[7]

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Abstract

It is well known that LLLT has role in the wound ed preparation of ulcers, but the role of LLLT in healing delayed healing skin graft donor sites has very scanty data. In this article we sharing our experience of treating a skin graft donor site which was showing delay in healing.

Keywords: Skin grafting; Donor site; Delayed healing; LLLT.

Introduction

Adult wound healing comprises of three stages: the inflammatory phase, the proliferative phase, and the re-modelling phase. These 3 stages have to occur in sequentially to result in healing of wound. Any factors that hinder the progression of these phases can result in delay in the healing of any wound. The LLLT is a modality with known benefit in wound bed preparation of any ulcer. But the data about its role in the management of delayed healing skin graft donor site is scanty. The LLLT was applied in 4 sessions to a delayed healing skin graft donor site.

Materials and Methods

This study was conducted in the department of Plastic Surgery at tertiary care center after getting the departmental ethical committee approval. Informed written consent was taken from the patient. The details of the patient in study are as follows: A 36 years old female with no known co morbidities with h/o road traffic accident 8 months back and underwent right below knee amputation due to vascular injury and degloving injury of the left lower limb for which serial debridement and splint thickness grafting over the raw areas, she now has non-healing ulcers over the graft donor site (Fig. 1). It was being treated with conventional wound bed preparation methods, but as it was still not healing it was decided to give a course of LLLT therapy adjuvant with conventional treatments.

LLLT was given to the wound bed in four session sessions, once a week for a total of four session, after each session of wound inspection and dressing (Fig. 2). Gallium Arsenide (GaAs) diode red laser (wavelength 650 nm, frequency 10 kHz and output power 100 mW)was used as a source of LLLT. It is a continuous beam laser with an energy density of 4 J/cm2. Machine delivers laser in scanning mode (non-contact delivery) with 60 cm distance between laser source and wound. In each session, the wound was given laser therapy for duration of 125 second followed by non-adherent absorbent dressing.

Result

The skin graft donor site healed well after four sessions of LLLT with good stable scar (Fig. 3).

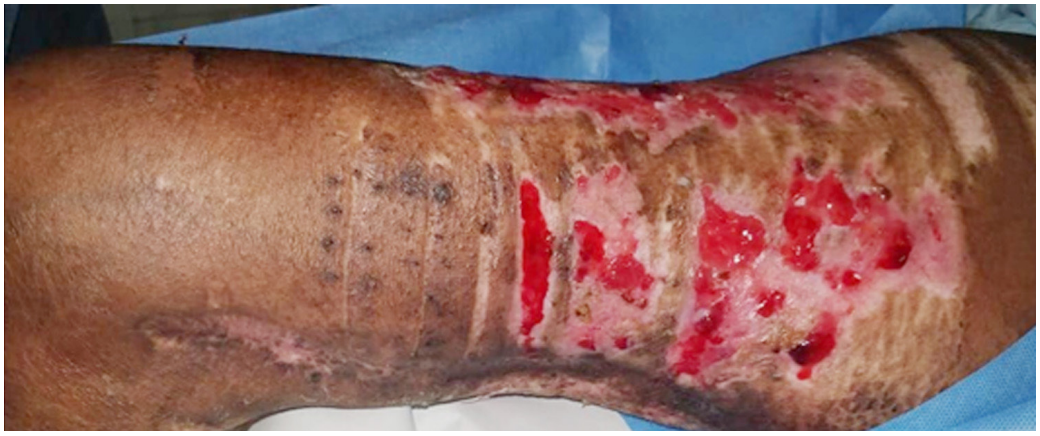

Fig. 1: Donor site with RAW areas.

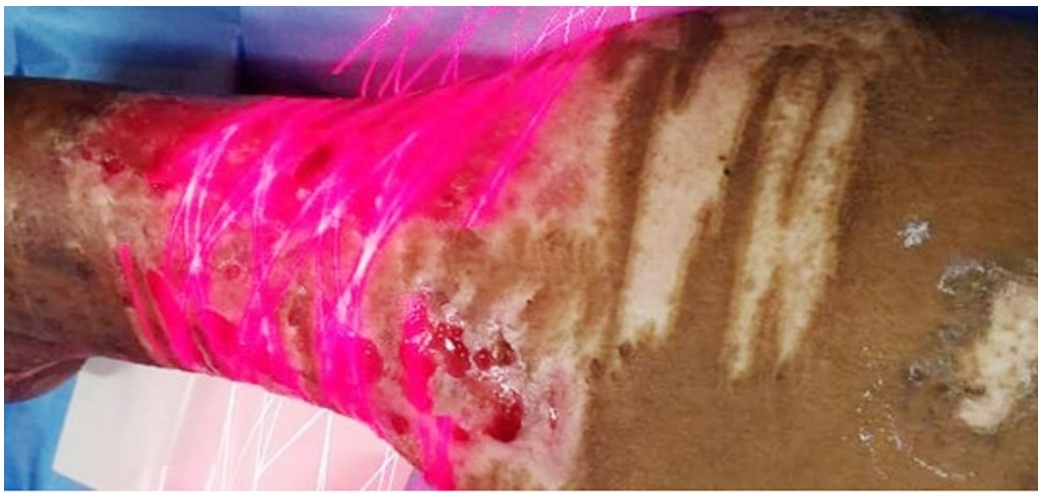

Fig. 2: DLLLT being applied.

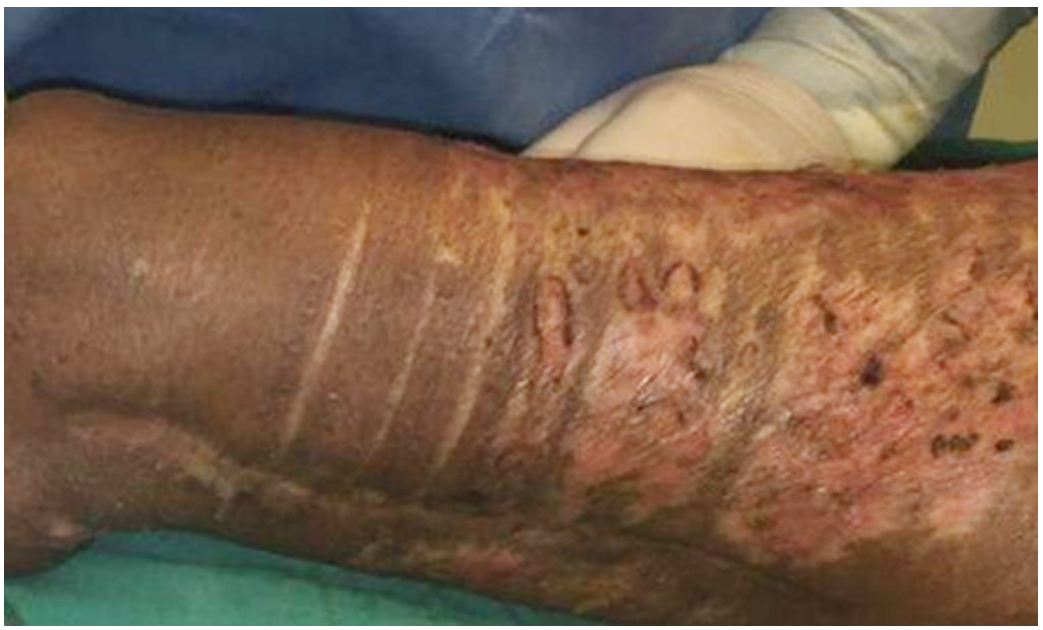

Fig. 3: Donor site healed completely

Discussion

LLLT means Low level Laser Therapy. Low level Laser uses energy much less than that is used for cutting, ablation therapy. By definition Low-level lasers are one with power density less than 500 mW/ cm2.[1,2] LLLT is used as an adjuvant to conventional therapy with promising results, in patients with ulcers.[3] LLLT is a form of phototherapy that use electromagnetic radiation. LLLT does not generate heatbut produces photochemical and photophysical effects, with the intention of re-establishing cell homeostasis. Essentially, light energy is delivered topically in a controlled, safe manner and it is absorbed by photo-absorbers (chromophores) that transform it into chemical energy.[4]

Positive effects of LLLT are: It accelerates tissue repair, increases the formation of granulation tissue, helps in wound contraction, decreases inflammation, modulation, and it also helps in pain reduction.[5]

According to the literature, low-energy photoemissions given at a wavelength range of 600nm to 900nm accelerates cell proliferation and wound healing processes.[6] Its action is thought to: Stimulate respiratory chain components such as flavin and cytochromes which increase adenosine triphosphate (ATP) synthesis,[7] thus enhancing the rate of mitoses and increasing fibroblast numbers[8-12], Stimulate collagen and elastin production, leadingto better reepithelialisation[13], Stimulate microcirculation and dilatation of the capillaries and neovascularisation to increase tissue oxygenation[14], Liberate mediator substances such as histamine, serotonin and bradykinin to influence macrophages, Regenerate lymphatic vessels.

Conclusion

It is well established fact that LLLT is beneficial in the management of ulcers. It is now found to have role in the management of donor site which was showing delay in healing. Butlimitation of the study is, it was done on a single patient and needs large randomized control trialsto draw a conclusive inference.

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Original Article

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Association Between Blood Group And Hypertrophic Scar

Padmalakshmi Bharathi Mohan[1], Ravi Kumar Chittoria[2], Chirra Likhitha Reddy[3], Imran Pathan[4], Shijina Koliyath[5]

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Abstract

Hypertrophic scar and keloids belong to the spectrum of abnormal wound healing. It has been a bothersome complication of scars. Various risk factors have been proposed to be in association with incidence of hypertrophic scars, the important one being familial predisposition and location of the scar. In this article we would like to put forth our experience in assessing the association between hypertrophic scar and blood group.

Keywords: Blood group; Hypertrophic scar.

Introduction

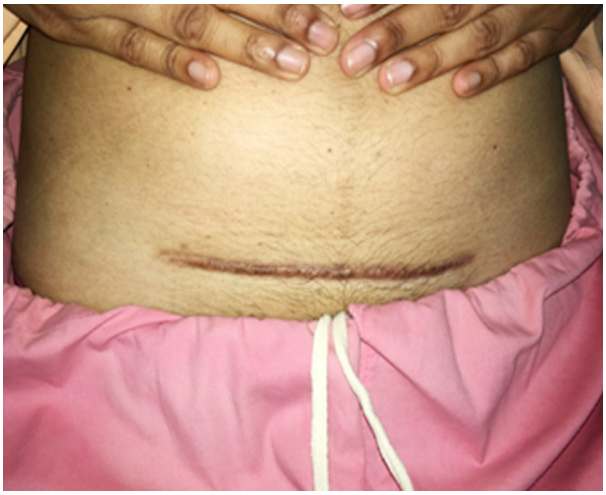
Scar, the word itself being derived from the latin word meaning cicatrix, is an end point of complex repair mechanism of human body.[1] The term scarring encompasses a wide clinical spectrum from normal fine lines to abnormal widespread, atrophic, hypertrophic and keloid scars and also scar contractures.[2] Scars are often considered trivial, but they can be disfiguring and aesthetically unpleasant and cause severe itching, tenderness, pain, sleep disturbance, anxiety, depression, and disruption of daily activities.[3] Various risk factors have been proposed for the occurrence of hypertrophic scar and keloid. They are young age, female gender, dark skin, neck or upper limb burns, multiple surgical procedures, greater than 3 weeks to healing, meshed skin graft use, and burn severity.[4] Among genetic factors specific types of HLA antigens and specific blood group have been linked to the occurrence of hypertrophic scars. In this article we would like to share our experience in associated blood groups with the occurrence of hypertrophic scars.

Materials and Methods

This study was conducted in the Department of Plastic surgery of a tertiary care center in Puducherry, during January 2020. A total of 10 patients who presented to the OPD with hypertrophic scars were included in the study. The scars were evaluated only with clinical photographs. All patients were instructed to get their blood group checked and the association of the same with hypertrophic scar was assessed.

Results

Out of the 10 patients who presented to us, 6 patients who had hypertrophic scar were A+ve. No statistical analysis done.



Patient No	Scar	Location	Blood group
1.	LSCS scar	Suprapubic	O +ve
2.	LSCS scar	Suprapubic	A +ve
3.	Post traumatic	Back	A +ve
4.	Post MRM	Right chest	A+ve
5.	Post Ear lobe piercing	Right Ear lobe	A+ve
6.	Post Ear lobe repair	Left ear lobe	O-ve
7.	Post traumatic	Left elbow	B+ve
8.	Post traumatic	Forehead	A+ve
9.	Post Sebaceous cyst excision	Suprapubic	AB-ve
10.	Post BCG scar	Left shoulder	A+ve

Discussion

Hypertrophic scar and keloids are defined as excessive scar formation due to abnormal response to injury. Both are manifestations of over exuberant scarring, although the upstream aetiology is probably different. Keloids and hypertrophic scar are differentiated by their clinical appearance of the former being extending beyond the scar margin, and the latter being confined to the scar margins. The disadvantage of them both are that, they are both associated with intense itching and they are cosmetically unacceptable. Hence a knowledge about the risk factors and predisposing conditions, will aid in taking precautions to prevent their occurrence.

Keloids are rare and are limited because of their genetic predisposition, being present in 6% of the entire population. It is primarily predominant in black and asian population.[5] Other risk factors that have been proposed in keloids and hypertrophic scars are position of the scar (Presternal, shoulder etc.,). HLA-DQA1*0104, DQB1*0501 and DQB1*0503 have been reported to be have an increased risk of developing keloid scarring.[7] Various studies have been described in linking the association of blood group with hypertrophic scar. People with Blood group A has been found to have increased incidence of keloid and hypertrophic scar due to the presence of red cell antigen A on the blood cells.[8] Ramakrishnan et al[8] did a study in Madras in 1974, in which he postulated that group A patients had a higher incidence of hypertrophic scar and keloids. Shaheen et al[9] also confirmed the association of keloids and blood group A.

Our article concurs with the above studies, in that blood group A patients had a higher incidence of hypertrophic scars and keloids. The main drawback of our study is that statistical analysis was not done and the sample size was small and a single centre study. Hence it is essential for a multicentric large volume randomized control study to establish the association between blood group A and hypertrophic scars & keloids.

Conclusion

Keloids and hypertrophic scar cause significant morbidity in terms of aesthetics as well as functional. Hence it is essential to take precautions to avoid the occurrence of the same. Identifying the risk factors helps in preventing the occurrence of the same. Blood group identification is one of the simpler methods. But a large multicentric randomized control study with statistical analysis is required to validate the study.

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Original Article

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Modified Limberg Flap for Sacrococcygeal Pilonidal Sinus: A Prospective Institutional Study

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Abstract

Background: Sacrococcygeal pilonidal sinus is an acquired disease commonly seen in young adults especially males in gluteal cleft and it is known for recurrence and affects the patient's quality of life. Rhomboid excision of sinus with Limberg rotation flap coverage is a well-known surgical modality for this. This prospective study is carried out to determine the effects of the Limberg flap rotation surgery especially for its feasibility in a General surgical unit for the sacrococcygeal pilonidal sinus patients, their compliance, outcomes of the surgery such as wound infection, postoperative pain relief, recurrence rates, and back to routine duration.

Patients and methods: This is a prospective study of 40 Limberg flaps done from 2017 January to 2018 December in general surgical unit by the same surgical team for both primary and recurrent Pilonidal sinuses, and patients who previous incision and drainage had done for the pilonidal abscess. The various demographic, clinical and surgical data are studied and compared to other studies.

Results: There were 34 (85%) male patients and 6 (15%) female patients and all patients successfully underwent surgery, with very minimal postoperative pain, stayed in hospital for average 10 days, returned to work after 3 weeks. The operative time, blood loss, hospital stay, surgeon's performance scale, wound hypothesia, wound cosmoses score, patient satisfaction score, and patient quality of life were studied. The Limberg flap surgery had better clinical results regarding frequency of seroma formation and time to drain removal, pain score and early return to normal works. Out of the 40 patients operated 1 (2.5%) developed superficial skin necrosis, 2 (5%) developed seroma, and 1(2.5%) type-1 diabetic female developed surgical site infection.

Conclusion: In this procedure of Limberg flap there are significant benefits in terms of postoperative pain, infection rates, less hospital stay and early return to work with almost nil recurrences.

Keywords: Flap; Limberg; Pilonidal; Rhomboid; Sinus; Sacrococcygeal.

Introduction

Sacrococcygeal pilonidal sinus is an acquired disease most commonly affects the young adults. Male are affected twice more than female and occurs both after puberty and before the age of 40 years .[1] Commonly the sinus is seen in the gluteal cleft, however in other sites such as the umbilical, axilla and inter digital especially in barbers and other areas also rarely it manifest.[2] The Pilonidal sinus is diagnosed by identifying the epithelialized follicular opening of the sinus. "*Pilonidal* "means "nest of hairs." in Latin. It causes significant

morbidity from both disease and surgery done for the same.

The epidemiological studies shows an estimated incidence of 26 per 1,00,000 population.[3,4] The pilonidal sinus normally presents as a cyst, abscess, or sinus tracts with or without discharge.[5] Mayo in 1833 first reported these cases and proposed the pathogenesis is due to congenital origin secondary to the persistent remnant of an epithelial lined tract from postcoccygeal epidermal cell rests or vestigial scent cells. However this theory is disputed as congenital tracts do not contain hair and are lined by cuboidal epithelium and the view is now shifted toward acquired theory.[6] It is now attributed to the persistent local irritations and resultant aberrations, poor hygiene, excessive hairiness and presence of deep anatomical natal cleft.[7] The presence of high quantity of hair, extreme force, and vulnerability to infection were the three cardinal factors for the development of this disease as per the study of Karydakis *et al*.[8]

The surgical treatment is the corner stone for this disease and various procedures like excision and packing and leaving it for secondary granulation and healing, excision and primary closure, marsupialization, and flap techniques have been suggested for the treatment.[9]

Recurrence following treatment is the major concern and it is reported regardless of the technique followed there is about 20 to 40% recurrence for this disease.[10] The causes of recurrence were widely studied and postulated as leaving behind some tracts, sutures in midline causing more trauma with repeated infection with accumulation of perspiration, and friction with tendency of the hair getting incorporated into the wound.[11] No technique is termed as gold standard treatment method at present. An ideal operation should be simple, with less hospital stay, low recurrence rate, with minimal pain, wound care and less the patient's time off-work and early return to works.[12]

Limberg in 1946 designed rhomboid flap for sacrococcygeal pilonidal sinus.[13] It is a technique of closing a 60° rhombus-shaped defect with a transposition flap. As this flap was easy to perform, with sutures away from the midline giving rise to a tensionless flap of unscarred skin in the midline, which helps in good hygiene maintenance, reducing sweating, maceration, erosions, and scar formation, it gained wide usage.

Literature study shows, In Limberg flap with wide rhomboid excision of the sinus and covering it with transposition flap, is much better than primary closure, or other flap coverage methods. It is also stated to be a safe and reliable method with low complications and recurrence for the treatment of sacrococcygeal pilonidal sinus.[14]

In our institution the primary excision of the sinus and through curetting followed by dressing to enhance granulation and secondary healing was followed. As this method postulated had much appreciated quicker relief we resorted to carry on this study in our setup to evaluate the usefulness of Limberg flap procedure in sacrococcygeal pilonidal sinus, patient compliance, complications, and long-term recurrence rates following the procedure.

Methods

The study was performed in the General surgical unit of Kanyakumari Government Medical college Hospital from January 2017 to December 2019 and total 40 patients (34 male and 6 female) were included in the study.

An informed written consent was obtained prior to surgery.

Inclusion criteria

- Sacrococcygeal pilonidal disease.
- Age between 16 and 50 years.
- Primary or recurrent disease.
- Willing for the study.

Exclusion criteria

- Unfit for surgery.
- Unwilling.
- Severe co morbidities and bleeding disorders.

All patients were prospectively evaluated for age, gender, indication of surgery, duration of symptoms, co morbidities, and location of sinus, operative time, postoperative stay and complications.

The study was approved for ethical clearance by the ethical committee of the Medical College.

Procedure

Patients who had pilonidal abscess were first managed by incision and drainage they later underwent definitive surgery. Surgery was performed under general or regional anaesthesia.

Patients were placed in prone jack-knife position with buttocks strapped for wide exposure.

After painting and draping, the area to be excised is marked and flap lines are marked so as to be able to excise all of the pits and sinuses enbloc. Care was also taken to leave minimum midline scar (Fig. 1).

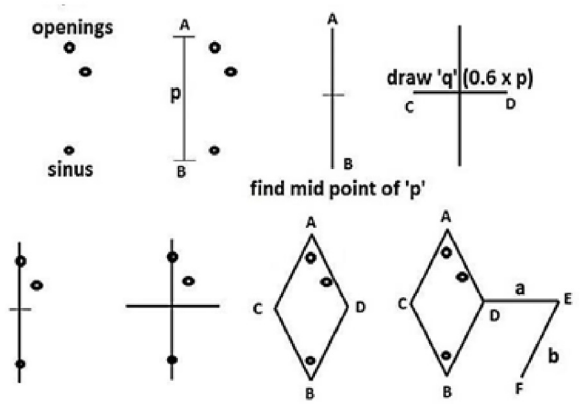

Fig. 1: General schematic of creating a limberg flap.

The long axis of the rhomboid in midline is marked as A–B, B being adjacent to peri anal skin, A and B are marked such that all diseased tissues can be included in the excision. The line C–D transects the midpoint of A–B at right angles and is 60% of its length. D–E is a direct continuation of the line C–D and is of equal length to the incision C –A, to which it will be sutured after rotation. E–F is parallel to D–B and of equal length. After rotation, it will suture to A–D. (Fig. 2).

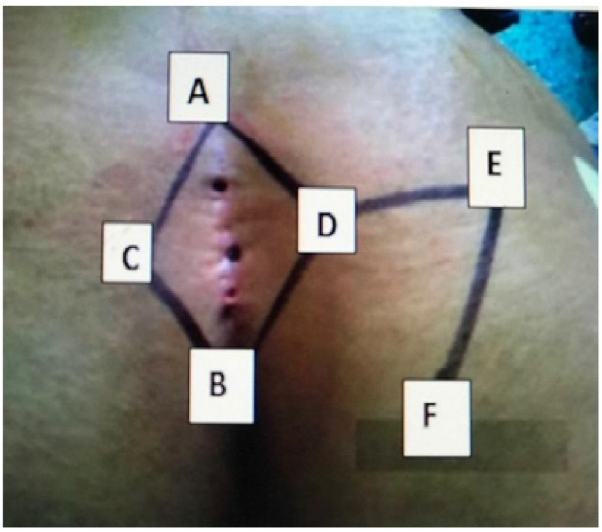

Fig. 2: Markings for creating Limberg flaps

The rhomboid incision with each side equal in length, includes the sinus, is made down to the presacral fascia. The flap is constructed by extending the incision laterally down to the fascia of the gluteus maximum muscle (Fig. 3).

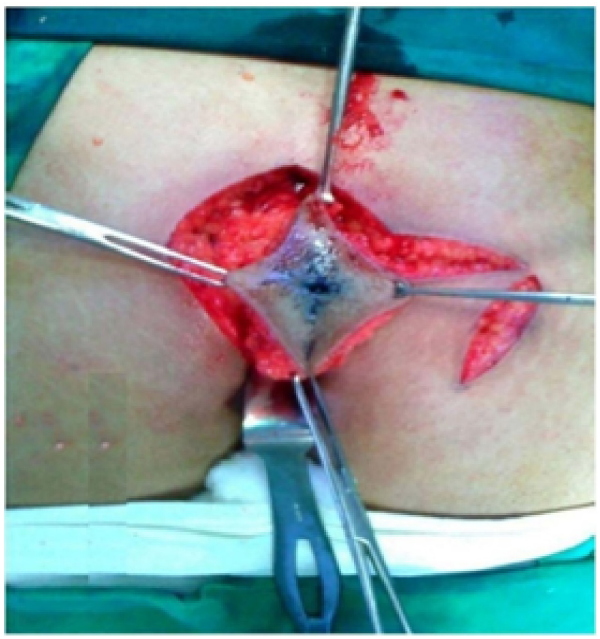

Fig. 3: Excision till deep fascia

After securing the haemosatasis the flap is transposed to the rhomboid defect created by excision of the sinus (Fig. 4).

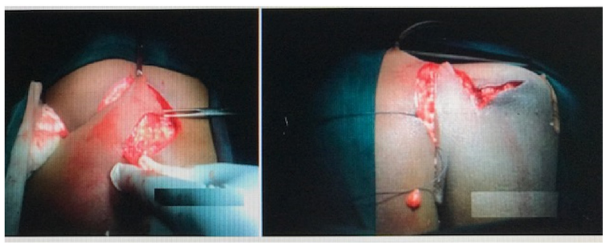

Fig. 4: Rising of flap and rotating over the defect

Subcutaneous tissue is approximated with interrupted vicryl 2-0 suture with a drain fixed. The skin is approximated with interrupted nylon 3-0 suture (Fig. 5).

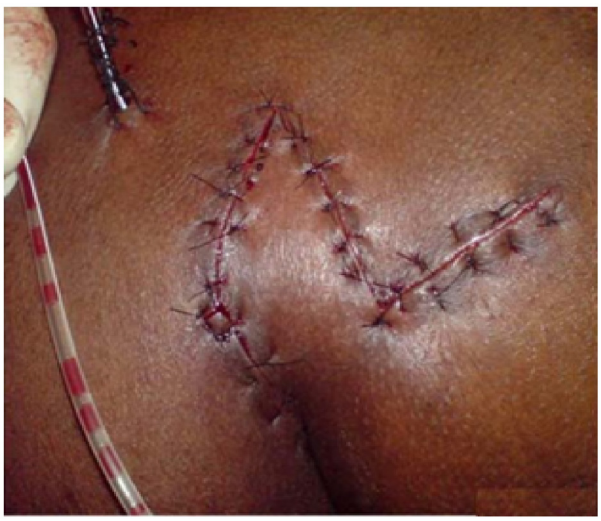

Fig. 5: Final outcome after suturing

Drain is removed after 48–72 hours. Alternate sutures are removed on 9th postoperative day (POD). Rests of the sutures are removed on the 10th day. Postoperatively patients' are advised to avoid prolonged sitting or exercise for two weeks. The general cleanliness and keeping the area dry and remove the dense hair if any for one month. Patients are followed up in OPD monthly for 6 months. Length of hospital stay, time taken for return to work, postoperative complications and recurrence were recorded.

Results

Forty patients were operated by rhomboid excision and Limberg flap reconstruction. Among them there were 34 males (85%) and 6 females (15%). The mean age of presentation was 28 years old (range 16–50 years old). Seven patients presented with recurrent sinus (17.5%). Twenty five patients (62.5%) presented with discharge, 10 patients (25%) presented with pain, four (10%) with infection and one with pilonidal abscess. The operative time ranged from 60 to 100 minutes. Hospital stay ranged from 10 to 12 days. The demographic profile and intraoperative details are tabulated in Table 1.

Out of the 40 cases that were operated, 1(2.5%) developed superficial skin necrosis at the tip of the rhomboid flap (<1 cm), 2 (5%) developed seroma postoperatively which resolved with conservative treatment, and 1 (2.5%) type-1 diabetic female developed wound infection which was treated by laying open of a single suture and allowing to heal by secondary intention. None of them required any surgical intervention. No recurrences were noted in the follow up period ranging from 12 months to 2 years. The complications noted in our study are tabulated in Table 2.

Table 1: General, demographic and clinical data

Variable	Value
Age	28 years (16-50)
Gender	
Male	34 (85.1%)
Female	6 (15%)
Number of sinuses	
Single midline	28 (70.8%)
Multiple midline	12 (30%)
Co morbidities	
Hirsute nature	23 (57.5%)
Obesity	1 (2.5%)
Smoking	4 (10%)
Symptoms	
infection	4 (10%)
Pain	10 (25%)
Discharge	25 (62.5%)
Duration of symptoms	6.52 months (2-13)
Operative time	67.05 min (60-90)
Post op stay	10.05 days (9-12)

Table 2: Complications

	Number	Percentage
Hematoma	0	0
Superficial skin necrosis	1	(2.5%)
Wound gaping	0	0
Flap edema	2	(5%)
Seroma	2	(5%)
SSI	1	0
Recurrence	0	(2.5%)

Table 3: Comparison of results with other studies

Author/s	Patients (no.)	Hospital stay (days)	Complication (%)	Recurrence (%)
Katsoulis et al. [23]	25	4.0	4 (16%)	1(4%)
Akin et al. [20]	411	1–10	15.75%	12 (2.91%)
Urhan et al. [25]	110	3-7	7%	5 (4.9%)
Mentes et al. [2]	353	2–19	11%	11 (3.1%)
Aslam et al. [24]	110	3.0	5%	1 (.9%)
El-khadrawy [21]	60	5–11	40%	6 (10%)
U Jethwani et al.	67	9-12	11.94%	1 (1.49%)
Current study Jayalal et al.	40	10-12	3 (7.5%)	0

Discussion

Pilonidal sinus diseases are caused by forces exerted on the midline of the natal cleft (tension = force/surface area) especially on the point of coccyx turning anteriorly[14], vacuum effect created between the buttocks, by virtue of it the anaerobic bacteria are gravitated to this point along with hair or debris[15], the ensuing friction movement of buttocks[16] in the presence of other risk factors such as obesity, hirsuteness, and bad hygiene.[17] An effective surgical technique will eliminate this shearing forces, vacuum effect, and friction movement.[18]

Excision of the diseased tissue down to the sacrococcygeal fascia is the standard prerequisite for an effective surgical treatment for this sinus. However the next step of what to do with defect is a matter of concern and debate. The patient compliance, postoperative pain, infection, recurrence rates, hospital stay, frequent wound dressings, and cosmetic outlook with preservation of the bottom are the main criteria which decide the surgical option.

Recurrence is the main problem associated with all modalities of surgeries used in the treatment for pilonidal sinus which ranged from 21.4% to 100% for incision and drainage, 5.5%–33% for excision and open packing, 8% for marsupilisation, 3.3%–11% for Z plasty.[19] Flap techniques have been associated with lower recurrence rates.

Limberg flap has many advantages as it is easy to perform, design and flattens the natal cleft with a large well-vascularised pedicle which is sutured without tension. Also it has the benefits of reducing midline dead space and midline scar is avoided. Limberg flaps are useful in recurrent pilonidal disease and reduce hospital stay and time to resume normal activities. The Lamberg flap procedure was found much better than simple excision and closure, marsupialization, or other postulated flap procedures such as Bescom and Karydakis.[8,15]

The review of various reported studies on this technique were compared with our study report and most of the factors are comparable. In our study, 40 patients with sacrococcygeal pilonidal disease were managed with rhomboid excision and Limberg flap reconstruction. No recurrence was noted in this study. Akin *et al*.[20] operated on 411 patients and reported recurrence rates of 2.91%. Superficial necrosis was seen in one patient (1.49%), which may be due to the design of the long flap or fault technique. El-khadrawy[21] operated on 40 patients and had superficial necrosis at the tip of the flap in four patients (10%). Time off-work in our study patients was 12–18 days. This was similar to that reported by Abu Galala et al.[22] Katsoulis had 25 patients, with 16 of them having complications with no recurrences.[23] Aslam had 110 patients, with 5 of them having complications and 1 recurrence.[24] The comparative table of various studies and reported complications are tabulated in (Table 3).

Conclusion

Sacrococcygeal pilonidal sinus is a treacherous disease for both the patient and the surgeon by virtue of its recurrent infection, persistent troublesome pain with discharge, and high recurrence rates inspite of good surgical procedures. Following Limberg flap reconstruction after excision of the pilonidal sinus, the resultant distortion and shape of the gluteal regions are averted and as there is no recurrence the agonizing continuous discharge of foul smelling pus are stopped.

The technique is easy to perform in quick time by the General surgeons and this procedure can be used in both primary and recurrent diseases, with very low complication rates. The advantages are obliteration of the midline natal cleft and scar pressure in the midline, quick healing time, short hospital stay, and early return to daily life. It is a feasible best option for the sacrococcygeal pilonidal sinuses.

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Original Article

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Efficacy of HBOT as Adjuvant in Burn Patient

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Abstract

Background: It a great challenge which requires great efforts to treat the patient with burn injury. Immediate treatment significantly improves mortality rates. Management of a burn case usually involve, appropriate fluid resuscitation, attainment of resuscitation targets using consensus formulas for initial fluid administration, topical agents to control pain, reduction of fluid loss as well to prevent bacterial growth.

Objective: our aim was to look for the evidence of effectiveness of HBOT and the patient's satisfaction improvement due to reduction in wound pain.

Study Design: Study carried out was prospective case control study.

Place of Study: Prana HBO Centre, located in the Northern parts of Mumbai, in India.

Methods: In group I in comprised of 22 patients with burn injury who got regular HBO therapy. HBO therapy was given with compressed with air at a pressure of 2.5 atmosphere absolute (ata). At this pressure the patient breathed 100% oxygen via facial mask. The HBO therapy protocol included 90 minutes oxygen breathing at 2.5 ata, twice daily over 6 days. 20 sessions were performed for each patient. In group II patients with burn injury were 21 who also received burn treatments in our setup but without HBO therapy.

Results and Discussion: The mean improvement in pain relief in group I was 4.9 ± 1.2 in comparison to group II which was 3.2 ± 0.85, comparatively improvement in pain score was significantly higher in group I and at par with group II. Hyperbaric Oxygen therapy can improve pain score and patient satisfaction in our study. However the possibility of cost effectiveness of the HBO therapy would need further discussion. Future, the clinical trials with large sample size and different types of burn injury shall be considered.

Conclusion: Findings shows the beneficial effects of HBO therapy, as well suggests that the HBO therapy has a significant improvement in the pain relieve and satisfaction improvement. Hence, HBO therapy, as an adjuvant treatment, could be helpful for pain control and satisfaction associated with burn injuries.

Keywords: Patients satisfaction; Pain relief; HBOT; Burn Injury.

Introduction

Damage to skin integrity depending upon depth, subcutaneous tissues or organs resulting due to high temperature, electricity, chemicals or radiations is termed as Burns.[1] The classifications of burns are based on depth expressed in degrees and their related corresponding symptoms. Burn causes skin barrier, which serves as protection from various external environmental factors, which is interrupted leading to homeostasis and

physiological disruption. In superficial burns damage of epidermis causes swelling and blister formation. In deep dermal full thickness burns it leads to loss of skin barrier causing loss of water by evaporation from wound, as well loss of thermoregulatory function and decrease in number of electrolytes and proteins.[2,3] Later due to progressive dehydration causes disruption of process of repair, cell damage as well it inhibits the regenerative changes in wound environment. Similarly, cell membrane damage, increase in vascular permeability leads to leakage of body fluids in intracellular spaces followed by gradual onset of swelling, as water leaks through the burn wound to the environment.[4,5]

In burn wounds, swelling affects development of hypoxia, adjacent tissues and leads to accumulation of harmful cellular metabolites, leading to formation of inflammation and necrotic tissues which ultimately delays the process of healing. Hence Necrosectomy is usually performed after five to seven days after the injury at the latest. By the end of fifth day after injury, microorganisms begin to colonize necrotic tissue, which serves as a good medium.[6] Hence in order to normalize patient physiological condition and to restore hemostasis, after surgical debridement of burn wound, its protection through application of autologous skin graft or skin substitutesshould be the priority.[7] As such Thermal burns are with maximum morbidity and mortality, they are complex and injury which involves both local and systemic consequences. It is seen if there is more than twenty percent of the total body surface area, severity increases.[8]

It a great challenge which requires great efforts to treat the patient with burn injury. Immediate treatment significantly improves mortality rates. Management of a burn case usually involve, appropriate fluid resuscitation, attainment of resuscitation targets using consensus formulas for initial fluid administration, topical agents to control pain, reduction of fluid loss as well to prevent bacterial growth. It is observed in past two decades that early closure of full thickness wounds had improved the outcome in extensive burn cases by preventing colonization and infection.[8]

To get a good outcome in cases with thermal burns, HBO therapy is used as adjuvant therapy and this and been well studied. HBOT is application of hundred percent oxygen at two or three times the atmospheric pressure at sea level, at environmental pressures between 1.4 and 3.0 atmosphere absolute (ATA), for periods between 60 and 120 min once or more daily.[9] It causes most of the physiological and therapeutic effects. This therapeutic procedure has a range of positive effects for the inhaling process and it is being prescribed along with other treatment in various other clinical situations.[10] The Undersea and Hyperbaric Medical Society recognizes 14 valid medical indications for hyperbaric oxygen therapy, commonly ate diabetic foot ulcer, radiation tissue injury, condition with acute ischemia which includes crush injuries as well in acute poisoning by carbon monoxide, acute occlusion of central retinal artery, diving accidents, severe anemia and burns.[11]

For acute thermal burn injury the undersea and hyperbaric medical society (UHMS) had approved and HBO therapy is an adjuvant treatment for burn patient and it specifically reduces the length of hospital stay of the patient and cost of care is also reduced.[12] In this study our aim was to look for the evidence of effectiveness of HBOT and the patient's satisfaction improvement due to reduction in wound pain.

Patients and Methods

Study setting

The study was carried out at the Prana HBO Centre, which is owned by the Investigator and located in the Northern parts of Mumbai, in India. The center has one Sechrist Monoplace hyperbaric chamber and a TCOM machine with 3 electrodes. The oxygen gas supply is from oxygen cylinders of 7000 liters' capacity each. The center has all the requisite certifications and registrations as required by the local authority in Mumbai. Study was conducted over a period of 2 years and patient with Burn injury referred to the Hyperbaric Unit at Prana HBO center. Center took care in a specialized form and provided care to patients with burns and critical soft tissues conditions and was responsible for caring for all patients. Written informed consent was obtained from the patient and patient's relative.

Study Design

Study carried out was prospective case control study.

Study Population

In our study total 43 patients with burn injury were included which were referred to our Prana hyperbaric center Mumbai over a period of two years. Furthermore, all the patients were screened for eligibility to be included in the study and

they had no previous or current history of pain disorders and no known neurologic, rheumatologic or psychiatric clinical features in association with chronic pain.

Inclusion Criteria

Burn injury patients referred to Prana Hyperbaric center, without a history of chronic pain and any further treatment of burn received were included in the study.

Exclusion criteria

All of the following patients who died during the treatment, with excessive comorbidities, burn injury area more than 60% of the total body surface area, patient suffering with septic shock or showing unstable vital signs were excluded from the study.

Ethics review

This study was performed within the scope of international ethical guidelines and legislation. Ethics review and approval was provided by Stellenbosch University (number: U16/06/015) and the ethics committee of the Hyperbaric Society in India.

Procedure

In our study the selected patients were divided into two groups and both group received regular wound dressing and surgery as per requirements. In group I in comprised of 22 patients with burn injury who got regular HBO therapy. HBO therapy was given with compressed with air at a pressure of 2.5 atmosphere absolute (ata). At this pressure the patient breathed 100% oxygen via facial mask. The HBO therapy protocol included 90 minutes oxygen breathing at 2.5 ata. 20 sessions were performed for each patient. In group II patients with burn injury were 21 who also received burn treatments in our setup but without HBO therapy. Selection of the patients was random. In our study all patients received burn wound treatments which includes dressing, pain control, infection control and if required surgical intervention in the form of debridement and skin grafts was given. During the study all of the following parameters such as HBO sessions given to the patients of group I, age, sex, inhalation injury status, total body surface area, hospital stay duration, and location of scars with its characteristics were all documented meticulously. Vancouver Scar scale was used to evaluate the condition of scar and very well documented. Visual analog Scale was used to score and assess pain. Patients satisfaction was documented by the principal investigator of the study, patients were asked to mark the satisfaction score about the current health status on a scale of one to ten, before and after the whole course of therapy and the differences in subjective score was graded accordingly.

Statistical Analysis

A descriptive table prepared to present the distribution of HBO and non HBO group of therapy. The graphical presentation was used to present the improvement after burn injury treatment by patient's satisfaction. The small sample t-test was used to compare the difference between mean of TBSA and scare improvement. The odds ratio was used to determine the relative risk. The Chi-square test was used to test the association between age and pain relief score. The complete statistical analysis was done by MS-Excel software.

Results

Total 43 patients with burn injury were enrolled in our study, of which 22 in group I and 21 in Group II were included. In or study patient s burn wound were mostly on the extremities, group I consist of 18 males were as in group II it comprised of males. The mean age of Group I is 28 and for group II is 26 with an average of 39.7 and 41.84 respectively in both group. The mean TBSA of wounds in group I was 23.8 ± 9.7 in group I and 26.3 ± 10.9 in group II which did not showed up significant difference. The mean improvement in pain relief in group I was 4.9 ± 1.2 in comparison to group II which was 3.2 ± 0.85, comparatively improvement in pain score was significantly higher in group I and at par with group II. The mean debridement time in group was 1.4 ± 0.4 as compared to that of 0.9 ± 0.7 in group II, which reflected not much significant differences. The mean skin graft times in group I was 3.1 ± 1.2 and in group II 1.9 ± 1.4 which also reflected that there is not much significant differences. The mean length of hospital stay of the patients in group I showed 31.5 ± 8.9 days and in Group II was 34.8 ± 10.1 days, it also had no significant differences. In group I significant improvement in patient's satisfaction was 90.9% in comparison to group II where it was 66.7%.

Relative risk estimation: Odds Ratio = 5 (Total no. of cases is 43)

At 95% Confidence interval is, The Lower value

Table 1: Descriptive analysis of baseline parameters

Parameters		Group - I HBO (n = 22)	Group - II Non-HBO (n = 21)	Total
Age	Min. Age	28	26	26
	Average	39.7	41.84	40.
	Max. Age	56	59	59
Sex Ratio (Male : Female)		18 : 4	16 : 5	34 : 9
TBSA		23.8 ± 9.7	26.3 ± 10.9	25.7 ± 10.4
Pain Relief		4.9 ± 1.2	3.2 ± 0.85	4.2 ± 0.96

Table 2: Result of different characteristics in HBO and Non HBO groups

Parameter score	HBO (n = 22)	Non- HBO (n = 21)
Debridement times	1.4 ± 0.4	0.9 ± 0.7
Skin graft times	3.1 ± 1.2	1.9 ± 1.4
Patients stay (in days)	31.5 ± 8.9	34.8 ± 10.1
Development in scar	0.8 ± 1.1	1.7 ± 1.4
Infection rate (in %)	34%	49%

Table 3: Satisfaction improvement between HBO and Non-HBO groups by Odds ratio

Improvement		HBO (n = 22)	Non - HBO (n = 21)	Total
Significant improvement of satisfaction	No. of Patients	20	14	35
	Percentage (%)	90.9%	66.7%	81.4%
No Significant improvement of satisfaction	No. of Patients	02	07	8
	Percentage (%)	9.1%	33.33%	18.6%
Total	No. of Patients	22	21	43
	Percentage (%)	100%	100%	100%

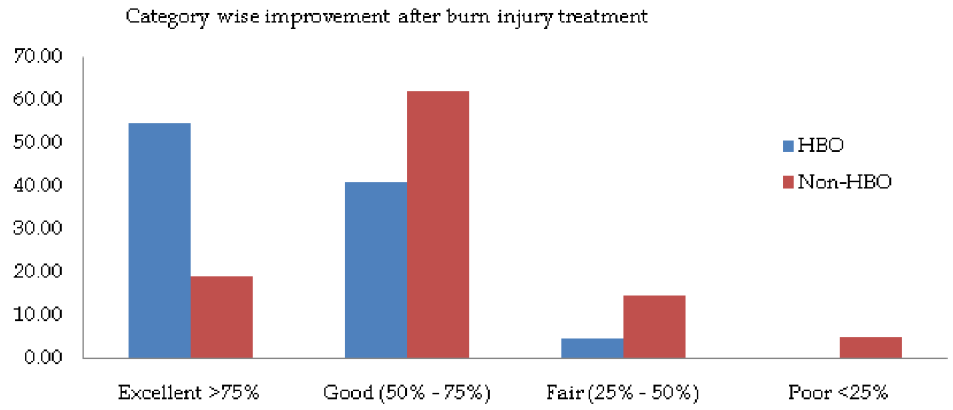

Fig. 1: Category wise Improvement after treatment

= 3.21 & The Upper value = 6.79 of odds ratio is recorded.

To compare the mean value of TBSA of wounds between HBO and Non-HBO groups by using small sample t-test, at 5% level of significance the p-value is 0.2893 which is greater than α=0.05, It means there is no significant difference between them.

Similarly to compare the scar improvement between HBO & non-HBO groups.

The p-value is 0.0837 > 0.05 which showed there is no significant difference of scar score between two groups.

Discussion

The tissue damage in burn injury is due to multiple factors which include the failure of surrounding tissue to supply borderline cells with oxygen and nutrients which are necessary to sustain

viability.[13] Impediment of the circulation below the injury results in desiccation of the burn wound, as fluid cannot be supplied through the thrombosed or obstructed capillaries. As such topical agents and dressings may reduce but they cannot prevent the desiccation of the burn wound and inexorable progression of deeper layers. Altered permeability is not caused by heat injury all alone; even oxidants and other mediators like prostaglandins, kinnins and histamines all of them contribute to vascular permeability.[14] Neutrophils are a major source of oxidants and injury in the ischemia or reperfusion mechanism, they may be complex but favorablyaffected by several interventions. Therapy is focused on the reduction of dermal ischemia, reduction of edema and prevention of infection. During the period of early hemodynamic instability edema reduction has a markedly beneficial effect as well as modulating later wound conversion from partial to full thickness injury.[15]

Infection remains the leading overall cause of death in case of burn injury cases, infection susceptibility is tremendously increased due to loss of the integumentary barrier to bacterial invasion, ideal substrate in the burn wound and the compromised or obstructed microvasculature that prevents humoral and cellular elements from reaching the injured tissue, along with additionally immune system is seriously affected, which demonstrate levels of immunoglobulin's and serious perturbations of polymorph nuclear leukocyte functions[16,17], that includes disorders of chemo taxis, phagocytosis and diminished killing ability. These functions greatly increase morbidity and mortality. Progressive ischemic process can be potentiated by poor tissue perfusion, experimental data significantly support the adjuvant use of hyperbaric oxygen therapy in burn patients, it is evident that this improves microcirculation of the wounded area whereas it decreases wound depth and size.

Several investigators clearly pointed out that hyperbaric oxygen therapy promotes wound healing, by direct increase in fibroblast replication, collagen synthesis as well neovascularization. Giving oxygen at the cellular level will increase leukocyte bactericidal activity and gives direct lethal effect on anaerobic organisms.[18]

Korn et al. presented second degree burn wounds heal faster when treated with HBO_2.[19] Research on epithelial tissue pointed that it can survive without oxygen, but cells cannot divide or migrate.[20] Enough oxygen in tissue to enable epithelial cells to migrate and divide is required to wound healing.[21] Epithelisation process is dependent on the total cell population which survives initial and subsequent later injury as well as mitosis and migration. HBO_2 surely had an affect the process by allowing minimum wound desiccation and destruction as well increasing oxygenation of hypoxic, thermally damaged cells which may not survive otherwise.[22] Perrins et al. reported that there is no effect of HBO_2 in a pig scald model.[23] Niccole et al. also highlighted that there is no advantage in wound healing achieved by HBO_2 when the modality was compared to topical antibiotics.[24] They pointed and made a proposal that HBO2 alone acted just as a mild antiseptic.

Cianci, 2004[25] reported that the WBC that fight the infection in the ulcer use twenty times more oxygen when they are killing bacteria. Also it is proposed that the more oxygen the more efficiently the repair of the connective tissues. New capillaries mean that more blood gets to the site of the ulcer, which spreads healing. High oxygen levels also make RBC cells more flexible so they can get through the twists and turns of the capillaries and get to where are needed.

The Hyperbaric Oxygen therapy has a treatment modality for around a broad range of ailments, which includes chronic pain, and reduces pain in animal models. Clinical research had indicated that the HBO therapy is useful to modulate human pain. A research carried out by Katznelson et al. highlighted a reduction in pain, swelling, and allodynia and an improvement in skin color and range of motion in patients with complex regional pain syndrome after completionof three weeks of HBO therapy.[26]

Our research reflected that the HBO group had better pain relieve and satisfaction improvement, it may be probably only due to the gratification of receiving HBO therapy. However, we cannot exclude the possibility of few complications for HBO therapy such as barotrauma, sinus or tooth squeeze, all such conditions will affect satisfaction; further more meticulous studies with more number of patients and parameters need to be done. In our study we excluded persons with excessive comorbidities; if the patient had excess comorbidities, it may loss to followup during the course of study likely chance as well even after well explaining the risk for HBO therapy, many patients with excess comorbidities did not tolerate and refused the management. Hyperbaric Oxygen therapy can improve pain score and patient satisfaction in our study. However, the possibility of cost effectiveness of the HBO therapy would

need further discussion. Future, the clinical trials with large sample size and different types of burn injury shall be considered.

Conclusion

In this study to conclude the impact of hyperbaric oxygen therapy in burn injury patients, outcome is favorable to Burn injury patients. Our findings shows the beneficial effects of HBO therapy, as well suggests that the HBO therapy has a significant improvement in the pain relieve and satisfaction improvement. Hence, HBO therapy, as an adjuvant treatment, could be helpful for pain control and satisfaction associated with burn injuries. Consequently, when pairing the clinical experiences and laboratory data, justification for using HBOT as an adjunct for managing Burn injuries is strong. Despite these encouraging results further research is needed to more clearly define the mechanism and potential role of HBOT following Burn injury. However, in no situation should HBOT be used as a substitute for indicated surgical and medical interventions.

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Conflict of Interest: The author declares no conflict of interest for this study.

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Original Article

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Role of Bates-Jenson Wound Assessment Tool (BJWAT) in Wound Management

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Abstract

Wound management is an integral part of surgical specialties. The process of wound healing has been studied in detail and the management of wound and its myriad treatment options have been evolving since the advent of scientific advancements. Proper wound assessment is an important part of wound management. Here we share our experience with the use of Bates-Jenson Wound Assessment Tool in the assessment of wounds.

Keywords: Bates Jenson Wound Assessment Tool (BJWAT); Wound assessment; Management.

Introduction

From the time of injury body initiates a process of tissue repair and wound healing. Wound healing is a dynamic process involving cellular, humoral and molecular mechanisms and consists of phases such as inflammation, proliferation and wound remodeling. Wound healing is a multifactorial process; hence both local and systemic factors should be included for effective assessment of wound. Appropriate assessment enables interventions at the right time. An adequate assessment is essential for making treatment and recognizing and preventing wound possible complications. Various wound assessment tools are described in literature. Here we describe our experience regarding decisions and management of healing process which involves monitoring t and recognizing and preventing wound possible complications. Various wound assessment tools are described in literature. Here we describe our experience regarding the use of Bates- Jansen wound assessment tool in assessment of wounds and thus further management.

Materials and Methods

This study was conducted in the department of plastic surgery in a tertiary care center during the period January 2019-March 2019. Informed consent was taken from all participants included in the study. Here we studied the use of Bates-Jenson Wound Assessment Tool in the management of wounds. A total of 10 patients were included in the study who were admitted and treated in the plastic surgery ward. Three patients were cases of

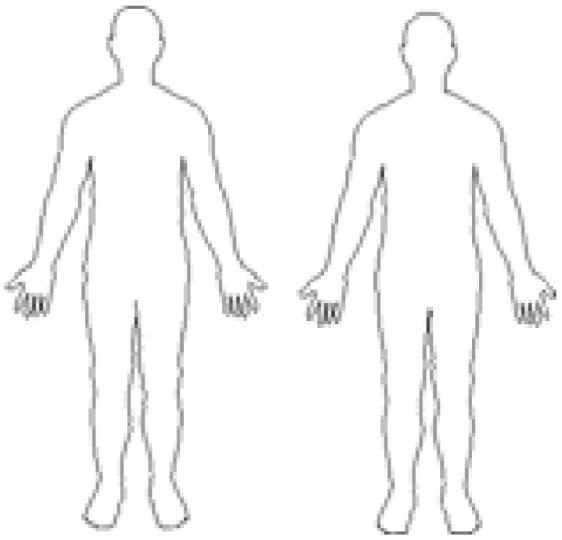
posttraumatic raw area, 4 cases were of diabetic ulcer, 2 were of postsurgical raw area following surgical site infection and one was a case of Fournier's gangrene. Wound assessment was done using BJWAT Chart on admission and weekly after start of therapy for 4 weeks. Following are the details and guidelines followed while using BJWAT Chart:[3]

Bates-Jensen Wound Assessment Tool

Name

Complete the rating sheet to assess wound status. Evaluate each item by picking the response that best describes the wound and entering the score in the item score column for the appropriate date.

Location: Anatomic site. Circle, identify right (R) or left (L) and use "X" to mark site on body diagrams:



Sacrum & coccyx	Lateral ankle	
Trochanter	Medial ankle	
Ischial tuberosity	Heel	Other Site

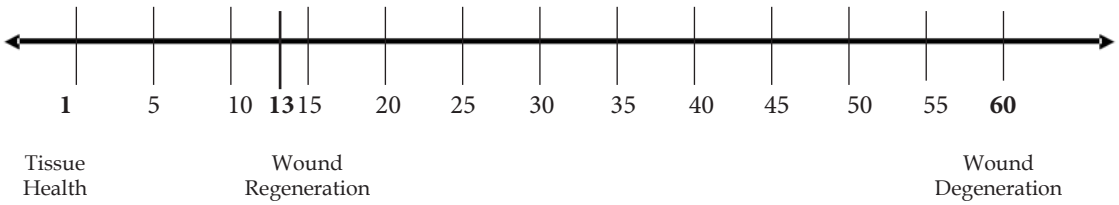
Shape: Overall wound pattern; assess by observing perimeter and depth.

Circle and date appropriate description:		
Irregular	Linear or elongated	
Round/oval	Bowl/boat	
Square/rectangle	Butterfly	Other Shape

Item		**Assessment**	**Date Score**	**Date Score**	**Date Score**
1. Size	1	= Length x width <4 sq cm			
	2	= Length x width 4--<16 sq cm			
	3	= Length x width 16.1--<36 sq cm			
	4	= Length x width 36.1--<80 sq cm			
	5	= Length x width >80 sq cm			
2. Depth	1	= Non-blanchable erythema on intact skin			
	2	= Partial thickness skin loss involving epidermis &/or dermis			
	3	= Full thickness skin loss involving damage or necrosis of subcutaneous tissue; may extend down to but not through underlying fascia; &/or mixed partial & full thickness &/or tissue layers obscured by granulation tissue			
	4	= Obscured by necrosis			
	5	= Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle, bone or supporting structures			
3. Edges	1	= Indistinct, diffuse, none clearly visible			
	2	= Distinct, outline clearly visible, attached, even with wound base			
	3	= Well-defined, not attached to wound base			
	4	= Well-defined, not attached to base, rolled under, thickened			
	5	= Well-defined, fibrotic, scarred or hyperkeratotic			
4. Under-mining	1	= None present			
	2	=Undermining < 2 cm in any area			
	3	= Undermining 2-4 cm involving < 50% wound margins			
	4	= Undermining 2-4 cm involving > 50% wound margins			
	5	= Undermining > 4 cm or Tunneling in any area			
5. Necrotic	1	= None visible			
Tissue	2	= White/grey non-viable tissue &/or non-adherent yellow slough			

Type	3	= Loosely adherent yellow slough
	4	= Adherent, soft, black eschar
	5	= Firmly adherent, hard, black eschar
6. Necrotic	1	= None visible
Tissue	2	= < 25% of wound bed covered
Amount	3	= 25% to 50% of wound covered
	4	= > 50% and < 75% of wound covered
	5	= 75% to 100% of wound covered
7. Exudate	1	= None
Type	2	= Bloody
	3	= Serosanguineous: thin, watery, pale red/pink
	4	= Serous: thin, watery, clear
	5	= Purulent: thin or thick, opaque, tan/yellow, with or without odor
8. Exudate Amount	1	= None, dry wound
	2	= Scant, wound moist but no observable exudate
	3	= Small
	4	= Moderate
	5	= Large
9. Skin	1	= Pink or normal for ethnic group
Color	2	= Bright red &/or blanches to touch
Sur-	3	= White or grey pallor or hypopigmented
Rounding	4	= Dark red or purple &/or non-blanchable
Wound	5	= Black or hyperpigmented
10. Peripheral	1	= No swelling or edema
Tissue	2	= Non-pitting edema extends <4 cm around wound
Edema	3	= Non-pitting edema extends >4 cm around wound
	4	= Pitting edema extends < 4 cm around wound
	5	= Crepitus and/or pitting edema extends >4 cm around wound
11. Peripheral	1	= None present
Tissue	2	= Induration, < 2 cm around wound
Induration	3	= Induration 2-4 cm extending < 50% around wound
	4	= Induration 2-4 cm extending > 50% around wound
	5	= Induration > 4 cm in any area around wound
12. Granu-	1	= Skin intact or partial thickness wound
Lation Tissue	2	= Bright, beefy red; 75% to 100% of wound filled &/or tissue Overgrowth
	3	= Bright, beefy red; < 75% &> 25% of wound filled
	4	= Pink, &/or dull, dusky red &/or fills < 25% of wound
	5	= No granulation tissue present
13. Epithelialization	1	= 100% wound covered, surface intact
	2	= 75% to <100% wound covered &/or epithelial tissue extends >0.5 cm into wound bed
	3	= 50% to <75% wound covered &/or epithelial tissue extends to <0.5 cm into wound bed
	4	= 25% to < 50% wound covered
	5	= < 25% wound covered
	Total Score	
	Signature	

Wound Status Continuum



Plot the total score on the Wound Status Continuum by putting an **"X"** on the line and the date beneath the line. Plot multiple scores with their dates to see-at-a-glance regeneration or degeneration of the wound.

BJWAT was used and scores were calculated every week whenever the wound was debrided and wound bed preparation was done (Figs. 1-3). The assessment tool was used by 5 Plastic surgery trainees on their patients. Feedbacks were collected from them at the end of the study on the basis of which it was concluded whether B JWAT was helpful in their treatment protocol for their patients.

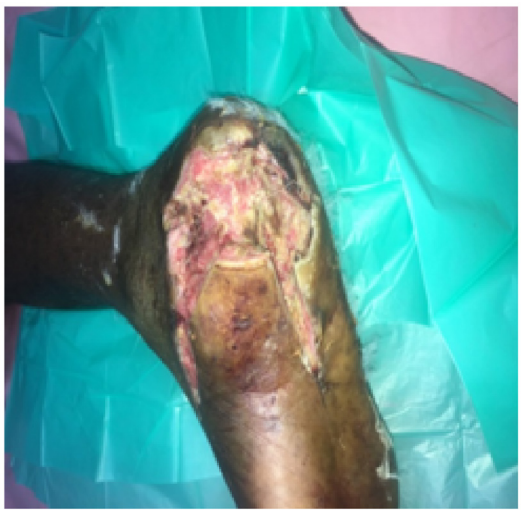


Fig. 1: Wound with BJWAT Score 45 at admission

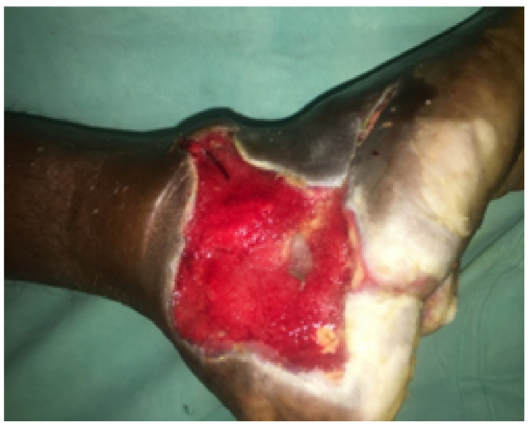


Fig. 2: Wound with BJWAT score 25 after Wound Bed Preparation (WBP)

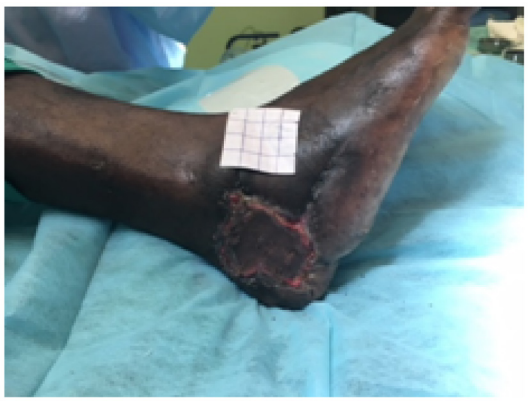


Fig. 3: BJWAT Score 13 after treatment (skin grafting)

Results

BJWAT was used in 10 patients by 5 Plastic Surgery trainees and scores were calculated over a period of 4 weeks. The scores decreased from high to low during the period of 4 weeks, signifying wound regeneration. The assessment scores helped in decision making and planning further management in addition to evaluating efficacy of the ongoing therapy. Based on the scores surgeons were able to plan their appropriate interventions for the desired results. It was found that BJWAT was useful in wound assessment but 2 surgeons felt that it required modifications since it did not consider systemic factors affecting wound healing such as diabetes mellitus, anemia, hypoalbuminemia, smoking etc.

Table 1: BJWAT Scores

S.N.	Week 1	Week 2	Week 3	Week 4
1.	55	35	20	13
2.	50	25	15	15
3.	55	43	20	14
4.	45	22	16	15
5.	40	20	18	13
6.	35	23	15	13
7.	30	21	18	13
8.	50	33	20	15
9.	45	25	17	14
10.	35	23	18	13

Table 2: Questionnaire

Questions	Participants				
	1	2	3	4	5
Is the assessment tool easy to use and comprehend?	Yes	Yes	Yes	Yes	Yes
Were you able to assess the wound condition and able to plan the management?	Yes	Yes	Yes	Yes	Yes
Were you able to correlate the wound condition with the changing score?	Yes	Yes	Yes	Yes	Yes
Were you able to make changes in your management approach based on the score?	Yes	Yes	Yes	Yes	Yes
Do you think modifications are needed in the score?	No	No	Yes	Yes	No

Discussion

Wound assessment is an important aspect in efficient and effective management of wounds. Choosing a proper wound assessment tool becomes imperative in this set up. It is essential in deciding topical treatment based on wound

status and for recognition of healing and deterioration requiring other interventions.[1] The process of wound assessment should be simple according to Doughty.[2] According to Harris C, wound assessment is a complex process requiring substantial visual and physical assessment skills, combined with clinical judgement and experience.[3] Kobza and Scheurich attribute a significant portion of increased costs associated with wound care to inadequate or variable assessment and inconsistent documentation.[4] One method of improving this process is the use of standardised instrument designed to guide clinicians through a systematic and consistent assessment and documentation.[5] Various wound assessment tools are used in medical practice including PUSH (Pressure ulcer scale for healing), BJWAT (Bates Jensen Wound Assessment Tool), DESIGN (Depth, Exudate, Size, Infection/Inflammation, Granulation tissue, Necrotic Tissue), DESIGN-R (Depth, Exudate, Size, Infection/Inflammation, Granulation tissue, Necrotic Tissue, Rating), PUHP (Pressure ulcer healing process), Wound bed Sore (WBS), Diabetic foot ulcer assessment scale (DFUAS). Most of the assessment tools are based on wound parameters like size, area, volume, depth, exudate, tissue type, signs of infection and inflammation.

Bates-Jenson wound assessment tool is one of the most prevalent wound assessment tools. Originally developed in 1990 as the Pressure Sore Status Tool (PSST), it was redesigned in 2001 and renamed by Barbara Bates-Jenson.[4,6]

Although developed initially for assessment of pressure sores, BJWAT has been used to assess healing of chronic wounds of different etiologies and acute wounds as well. BJWAT assesses 13 wound characteristics with a numerical rating scale and rates from best (1) to worst (5). Total score ranges from 13 (skin closed) to 65 (profound tissue degeneration) (Table 3). Lower scores indicate a better healing index. It is imperative to watch the total score to note whether wound is healing or not. BJWAT has evolved to include measuring and predicting wound healing. Average content validity is 0.62.[6] Validation studies indicate that in addition to having good content validity, BJWAT has excellent intra-and interrater reliability when used by experienced wound care clinicians.[7] There are very detailed instructions for using the BJWAT and Harris and colleagues gave a pictorial guide to help novice clinicians.[3] BJWAT assesses 13 parameters including size, depth, edges, undermining, necrotic tissue type, necrotic tissue amount, exudate type, exudate amount, skin colour surrounding wound, peripheral tissue oedema, peripheral tissue induration, granulation tissue, epithelisation. Higher scores indicate tissue degeneration and lower scores indicate tissue regeneration. A descriptive tool like BJWAT is not set out to be an outcome measure but rather used for initial assessment.

Conclusion

This is a preliminary study to assess the use of BJWAT in wound management in a limited setting with limited number of cases. The assessment tool doesn't consider systemic factors of the patient which also plays an important role in wound healing. A positive effect was found but a large multicentric, double blinded control study with statistical analysis is required to substantiate the results.

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Review Article

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Plastic Surgery Training In India – Past, Present And Future

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Abstract

Plastic surgery training in India traces its roots back to 600 B.C when Sushrutha laid the foundations of this speciality. Today almost 65 years after the first plastic surgical unit was established in India, the speciality has expanded and evolved rapidly but facesmany challenges as it grows further. This article aims to highlight the strengths and weaknesses of plastic surgical training in India compared with the rest of the world. It also suggests improvements in the existing training curriculum so that the future residents would be better equipped to deal with the rigours and demands of modern-day plastic surgery. There must be adequate funding to set up centres of excellence of teaching and research and incentives to attract the brightest minds as faculty to lead this process of change.Standardisation of plastic surgery training curricula and frequent interaction between centers of different countries would help ensure that the speciality would grow further and provide a firm foundation for the future.

Keywords: Plastic surgery; Ttraining in India.

Introduction

Plastic surgery training in India has its origins many centuries ago when Sushrutha (600 B.C) began laying the building blocks of what we now know as the speciality of Plastic and Reconstructive Surgery. He lived 150 years before Hippocrates and is described as the Father of Plastic surgery. He published his treatise known as 'Sushruta Samhita'in 600 B.C which is probably the oldest textbook of surgery in the world. In this book, he describes 120 surgical instruments, 300 surgical procedures and classifies human surgery into 8 categories. The pupils who trained under him were called 'Saushrutas' and the duration of this training was a minimum of 6 years. Before they began their training they had to undertake a solemn oath (similar to the present day Hippocratic oath). Surgical skills were taught to the 'Saushrutas' by assisting in live surgeries and practising on experimental modules like making skin incisions on vegetables (watermelon, bitter gourd), probing in worm-eaten wood and various other models (Fig. 1).[1]

Fig. 1: Figure shows 'Saushrutas', trainee surgeons engaged in simulation surgical exercises.

Sushrutha described various surgical techniques like thecheek flap, repair of the torn earlobe, piercing of earlobe, repair of accidental lip injuries and congenitalcleft lip, skin grafting, classification of burns, wound care and wound healing. He also described the cheek flap for nasal reconstruction which is sometimes also known as "Indian rhinoplasty", he used a leaf as a template for the nasal defect. Then he would incise the and raise the cheek flap and inset over the defect, the flap division would be done a few weeks later.[1,2]

Later, classical cheek flap rhinoplasty of Sushruta was modified to the forehead flap in the 14th century. This was then popularized by TribhovandasMotichand Shah who published it in 1889. He described more than a hundred cases treated by him in 4 years and gave minute operative details and discussed the advantages of Indian forehead rhinoplasty.[2,3]

The modern-day plastic surgery training in India traces its origin to the 1950s when Dr C Balakrishnan setup the first plastic surgery unit in Nagpur. Since then, the speciality has had a tremendous growth but the present-day training has not evolved to keep pace with the challenges that lie ahead. The integrative approach to training in plastic surgery is increasingly being adopted worldwide as this entails a more focused approach towards training in plastic surgery and allows maximum exposure towards all the sub-specialities of plastic surgery. Hence, this had led to a change in the educational goals of the training programmes throughout the world.[4] The present training in plastic surgery in India is in a stage of flux and must be more in sync with the demands and aspirations of the current crop of residents and teachers. This article aims to highlight the deficiencies in plastic surgery training in India and hopes to provide some solutions that may positively impact the trainees and the faculty.

Discussion

Plastic surgery in modern India owes its development to Sir Harold Gillies, Eric Peet and B.K. Rank who helped set up the first maxillofacial unit in India in 1945. Dr C. Balakrsihnan was the first plastic surgery trainee in India and in 1947 he was sent to the U.K for higher training. He was trained by none other than, Sir Harold Gillies (Father of Modern Plastic surgery) and Professor T. P. Kilner. In 1950, Dr C. Balakrishnan returned to India and joined Government medical college, Nagpur. However, it was only in 1958, the first plastic surgery unit in India was established at Nagpur with Dr C. Balakrishnan as the head of the department. Sir Gillies contributed in the development and growth of these units by conducting live surgical demonstrations, lectures and in 1957, he inaugurated the first meeting of the association of plastic surgeons of India (APSI).[2,5] Another plastic surgery unit was established at the Armed.

Forces Military Hospital in Pune by Maj. BR Sukh who along with Dr C. Balakrishnan was the first plastic surgery trainees in India.[6]

In 1964, N. H. Antiaset up another plastic surgery unit at J.J. Hospital, Mumbai. Antia and Buch performed the world's first microvascular free flap when they transferred a superficial inferior epigastric artery free flap for a facial defect.[7] Subsequently, more units were established all over India and today the field has made giant leaps such that each state has at least two-three plastic surgery units all over the country. Today the speciality has grown by leaps and bounds such that there are more than two thousand board-certified plastic surgeons in the country.

In India, to get into a career of plastic surgery the minimum requirement is a bachelor of medicine and surgery (MBBS). There are two pathways to enter into plastic surgery training – Independent programme and the Integrated programme. The independent programme is of three years duration and on completion, M. Ch degree (Magister Chirurgiae or Master of Surgery) is awarded. The candidate who desires to obtain an M. Ch degree in plastic surgery must have completed an M.S or DNB degree in general surgery. The other pathway – an integrated programme is started soon after completion of MBBS and is conducted by the national board of examinations (NBE). This is a sixyear programme - the first three months are spent in the parent plastic surgical unit to know the basics of plastic surgery. The next twelve months are to be spent in general surgery to learn the basics of surgery. In the second year of this programme, the candidate then rotates in the various subspecialities of surgery for 9-12 months. After the completion of his rotations, he returns to the parent plastic surgery unit to finish his training there for another four years. The syllabus for plastic surgery training in India includes the following areas -Principles and Basic Sciences, Aesthetic surgery, Breast surgery, Pediatric Plastic Surgery, Head and Neck, Trunk and Lower Extremity, Hand Surgery and Burns. The course curriculum includes –weekly case presentations & discussions, seminars, journal club and grand round presentation. A clinical audit is

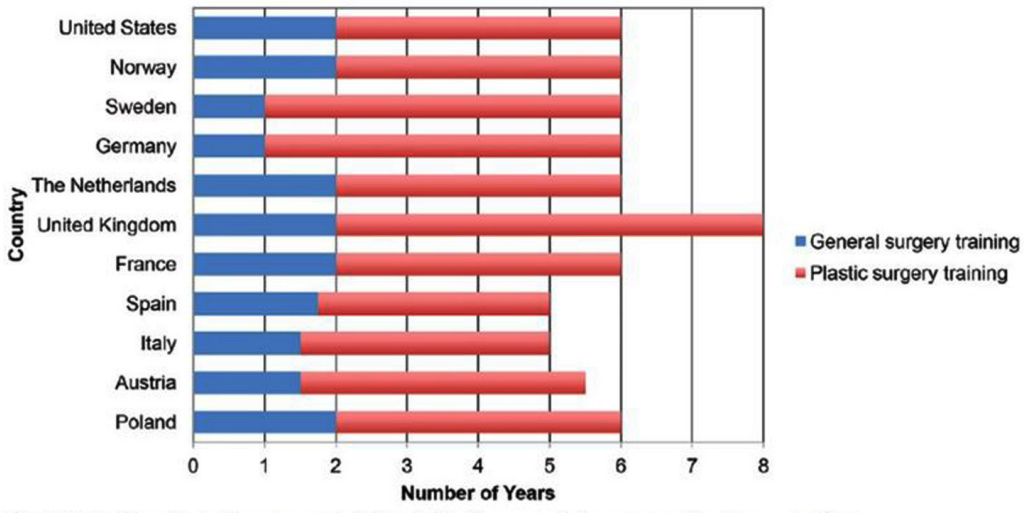

Fig. 2: Figure shows the duration of plastic surgery training in India and the rest of the world. Courtesy of 'Kamali P, van Paridon MW, Ibrahim AM, Paul MA, Winters HA, Martinot-Duquennoy V, Noah EM, Pallua N, Lin SJ. Plastic Surgery Training Worldwide: Part 1. The United States and Europe. PlastReconstr Surg Glob Open. 2016 Mar 17;4(3):e641'.

conducted once in a month. All candidates enrolled in MCh or DNB plastic surgery course have to maintain a surgical logbook and submit a thesis at the end of their course which will be evaluated. Trainees are also encouraged to attend at least one national conference and present at least one paper and poster at a national or state level conference. Trainees are also given guidance to submit at least one journal paper publication. Besides this, trainees are encouraged to attend a microsurgical anastomosis course.[8]

After completing training in plastic surgery, what are the further options available? Nowadays in this era of super-specialisation of the medical field, it would be prudent for the freshly passed out plastic surgeon to focus his interest into one or two core areas of plastic surgery. There are many fellowships available in India and abroad depending on individual interest. In India, the coveted fellowships include – Hand and microsurgery fellowship in Ganga Hospital, Coimbatore, Oncoplastic fellowship in TATA memorial hospital, Mumbai and Aesthetic surgery fellowship by Maharashtra University of Health Sciences (MUHS). Besides this, fresh pass-outs can join the government or private medical colleges as faculty, private clinics or hospitals and can even start their private practice or group practice.

When we compare plastic surgery training in India with the rest of the world – the average duration of plastic surgery training in the world is six years (including general surgery training) which is the same as in India (Fig. 2). The average age at which a trainee starts his plastic surgery residency in the world is 24-30 years of age which is similar to that in India. The duration of work hours per week for plastic surgery trainees averages 40-80 hours in the world which compares with the Indian working hours.[9]

Plastic surgery training in India is at a crossroads, with increasing sub-specialisation and expansion of our field coupled with encroachments from other specialities. As it evolves and expands further, numerous challenges must be addressed if it is to remain relevant. The current training programmes in India is heavily biased towards trauma and reconstruction with little or no exposure to cosmetic surgery. Most plastic surgeon rookies who enter into private practice or work in corporate hospital face an increasing demand for aesthetic surgeries which not only are income-generating but also add a touch of glamour and sheen to the hospital. A study conducted in 2010-2013 found that cosmetic surgery would grow at a compound annual growth rate of 31%.[10]

A study by Khare et al found that most trainees and fresh pass-outs would like to focus on the following core areas for their future practice – aesthetic surgery (38.7%) and microsurgery (32.6%). Only 9.1% of the respondents (fresh pass-outs in plastic surgery) felt the current training system is adequate in producing plastic surgeons with enough skills. An overwhelming 81.8% felt that their training programme in plastic surgery was inadequate.[10] In this study, suggestions put forward to improve the current state of affairs included – an interdepartmentalexchange of students, the involvement of senior accomplished

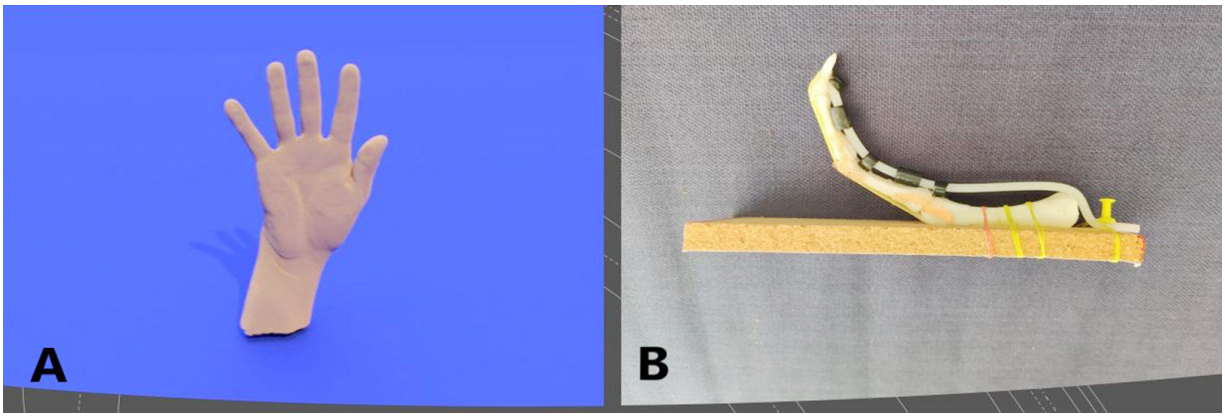

Fig. 3: (A) - 3D printed hand model. (B) - 3D printed hand model for flexor tendon surgical repair.

private practitioners in the training and teaching process. This would allow adequate exposure to all the sub-specialities of plastic surgery, especially in aesthetic surgery. Another suggestion put forward is to structure the selection process of plastic surgery trainees, to attract the best, brightest, scientific minds from medical schools. But, to accomplish this, plastic surgery education must be introduced into the undergraduate curriculum so that medicos would learn the basics of wound healing, suturing skills, wound repair techniques (flaps and grafts). This would inculcate in them an inherent desire and interest to pursue plastic surgery as a career.[10,11,12]

There is a worldwide trend towards the integrated programme of plastic surgery training. This would involve a reduced broad speciality general surgery training duration (12-18 months) and followed by 4-5 years of focused plastic surgery training. In the initial years, the trainees must be encouraged to acquire skills in microsurgery and clinical lab research skills. Towards the last two years of the programme, there must be consolidation and development of surgical acumen in all the core areas of plastic surgery hand and microsurgery, craniofacial, paediatric, lower extremity, breast reconstruction and cosmetic surgery.[12]

Another area that must be reformed is the standard of teaching, the concept of "training the trainers" must be implemented through periodic workshops, seminars and evaluation of trainers by a central or state regulatory plastic surgery body. The teaching of trainees must be supportive, nurturing and should encourage constructive criticisms and feedback.[13]

There must be an overhaul in the current evaluation system of plastic surgery trainees which is mainly theoretical and knowledge based. It should be both competence and knowledge based evaluation. The optimal course curriculum in plastic surgery should include exposure to principles and practices of plastic surgery, impart theoretical knowledge, promote surgical skill acquisition and enhancement. The final evaluation must include knowledge based tests and competency-based tests through the performance of index procedures which will add more credibility to these exams and enhance the confidence of the trainees and the trainers.[13]

The speciality of plastic surgery must be autonomously regulated, with adequate government and private funding to attract the best talent as faculty to train the trainees and setup wellequipped laboratories to promote research. The future training programmes can also include a 'back to the dissection lab' concept whereby trainees are encouraged to go to anatomy dissection labs to refresh their anatomical knowledge and at the same time simulate flap harvest techniques on cadavers. The use of 3D printed models as training simulation aids for the trainees would help them in acquiring surgical skill and mastery (Figure – 3). Microsurgery labs must be made mandatory in every accredited department for plastic surgery training.

Conclusion

The current state of plastic surgery training in India needs to be in sync with the hope and aspirations of the trainees so that they may be better equipped to handle challenges and demands of the rapidly expanding health sector. There is much scope for improvement in training so that the trainee will have an all-round exposure to all sub-specialities of plastic surgery, in addition to focused training in one or two core areas of his/her interest. The integrated approach to training with added focus in plastic surgery is now being adopted worldwide.

Acknowledgement: *None*

Conflict of Interest: *None*

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Standard abbreviations should be used and be spelt out when first used in the text. Abbreviations should not be used in the title or abstract.

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