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CONTENTS

ORIGINAL ARTICLE

A Study on the Surgical Management of Mandibular Fractures by Different Treatment Modalities

Muhammad Anwar, Tariq Iqbal, Saleem A. Malik

Abstract: **Background**: Treatment of mandibular fractures is basic to the treatment of maxillofacial trauma. As the principles of internal fixation and compression osteosynthesis were adopted by maxillofacial surgeons during recent years the time-honoured methods of intermaxillary fixation and transosseous wiring has gradually become less favoured method of treatment in most of the cases.

Objectives: The objectives of this study was to evaluate the results achieved in the surgical treatment of mandibular fractures by different techniques with respect to restoration of the pre-existing anatomical form, functional occlusion of the dentition, facial esthetics and to propose a simple, efficient, and cost-effective technique for mandibular fractures.

Materials and Methods: This cross-sectional study was conducted in the plastic surgery department of Pakistan Institute of Medical Sciences (PIMS) Islamabad during 1½-year period from 1st July 1999 to 31st December 2000. 105 cases of mandibular fractures were included in this study and a total of 174 fractures were treated by different surgical techniques. The mean age was 27.3 years and male to female ratio of 6:1. The patients were assigned into three groups according to the type of surgical technique used: 35 patients had closed reduction plus intermaxillary fixation (CR+IMF); 20 patients had non-rigid osteosynthesis; 50 patients had rigid/semi-rigid osteosynthesis. Outcome was measured by preoperative variables (age, gender, mechanism of fracture, site and number of fractures, nerve function, associated injuries and delay in treatment) and postoperative variables (duration of intermaxillary fixation (IMF), duration of admission, malunion, nonunion, infection, and nerve function), which were assessed during the follow up period.

Results: The results showed that the preoperative variables and demographic features were similar in all groups. All the three treatment modalities were successful in restoring functional occlusion. Ten patients required reoperation or readmission and a total of 25 complications were noted. These complications were observed in fractures treated by CR+IMF (6), non-rigid osteosynthesis (6), rigid osteosynthesis (13), and included 05 soft tissue infection (4.8%), 09 malocclusion (8.5%), 04 malunion (3.8%), 05 mental nerve dysfunction (4.7%), and 02 cases of facial nerve (mandibular branch) damage (1.9%). There was no incidence of non-union or osteomyelitis. Bone healing was satisfactory in 100% of cases. The rigid osteosynthesis avoided the use of IMF better than the non-rigid group. There was a higher incidence of malunion in CR+IMF (5.7%) compared with non-rigid (5%), and rigid (3.8%) groups, but 8.5% patients of the open reduction and internal fixation (ORIF) group developed mental nerve paresthesia and 4% facial nerve weakness.

Conclusion: Based on the results of this study we concluded that a brief period of intermaxillary fixation (IMF) helps to stabilize the occlusion, allows reattachment of the soft tissue drape and promotes initial primary bone healing, and overall CR+IMF with 2.7-mm cortical bone screws is the simplest, less invasive, efficient, and cost-effective technique.

Key words: Mandible, Fracture, Occlusion, IMF, Osteosynthesis, Open Reduction and Internal Fixation (ORIF).

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Introduction

Treatment of mandibular fractures is basic to the treatment of maxillofacial trauma. The prominent position and configuration of the mandible are such that it is one of the most frequent facial bones to be fractured.[1] Because of the mandible's contribution to speech, mastication, deglutition, and to the form of the lower portion of the face, fractures of this structure must receive careful consideration.[2] Successful treatment of mandibular fractures results in an anatomic bony union with restoration of normal occlusion and function. Maxillofacial trauma, especially the mandibular fractures, remains the major part of workload at plastic surgery unit of Pakistan Institute of Medical Sciences, Islamabad. The rapid mechanization of our society in recent years along with miserable conditions of the roads and noncompliance with the traffic rules has resulted in an increased incidence of maxillofacial trauma.[3,4] The most common causes of mandibular fractures are road traffic accidents, falls, missile injuries, assault and sporting accidents.[5,6] A clear understanding of the etiology and extent of all the maxillofacial injuries will be useful in planning to prevent or to reduce the number and severity of such injuries. These data will also be useful in assessing the current requirements of maxillofacial service in our hospital and for better future planning to handle the increasing number of patients with maxillofacial trauma. The fractures of the mandible require early diagnosis, rapid and proper treatment and possible rehabilitation for optimum results. Unfortunately these fractures still remain maltreated due to nonavailability of specialty service even in the tertiary care hospitals. This ultimately leads to delay in the definitive treatment. Reduction and immobilization is the accepted universal principle to treat a bony fracture and this goal can be achieved with a variety of treatment modalities.[7]

In simplest terms, treatment may be categorized as closed reduction plus intermaxillary fixation (CR + IMF), open reduction with internal fixation (ORIF), or external pin fixation (EPF). Open reduction with internal fixation may be accomplished with transosseous wires or with bone plates & screws, performed intraorally, extraorally, or percutaneously. Open reduction with internal fixation with bone plates may be further subdivided into rigid internal fixation (RIF) with dynamic compression plates (DCP) or semirigid internal fixation with miniplates.[7] Previously the most popular method for mandibular fracture treatment was CR+IMF and ORIF with wire osteosynthesis, necessitating an average of 6 weeks of IMF for satisfactory healing. However, in recent years open reduction and internal fixation is the preferred treatment method of mandibular fractures but at the same time it is very expensive and needs an experienced surgeon to get the optimum results.[8] With this in mind, the author has conducted this prospective study to achieve the objectives of restoration of pre-existing anatomical form, functional occlusion and facial esthetics with the simplest treatment modality.

Materials And Methods

This cross-sectional study was conducted in the plastic surgery department of Pakistan Institute of Medical Sciences (PIMS), Islamabad. All the patients, regardless of age and sex, with maxillofacial trauma who had well documented fractures of the mandible, admitted through emergency or out-patient department (OPD) and who were treated surgically were included in this study. One hundred and ten patients participated in this clinical study during 1 ½ -year period from 1st July 1999 to 31st December 2000. Five patients had an insufficient postoperative review time (less than 6wks) therefore these patients were omitted, leaving 105 patient's data to be analyzed. 85.7% of patients were male; the mean age was 27.3 years with an age range of 4-75 years.

Fractures of the mandible were diagnosed on the bases of history, clinical examination, and radiographs. Anteroposterior, lateral, and orthopantogram (OPG) were the standard radiographs used to diagnose the fractures. The clinical data of each patient was recorded on a performa. The preoperative patient variables of age, sex, mechanism of injury, site and number of fractures, dentition, presence of teeth in the fracture site, nerve function, associated injuries, and delay in treatment were recorded. Any relevant medical history notably drug use, diabetes mellitus, hypertension, ischemic heart disease was also noted. Patients were allocated to three groups according to the surgical technique used.

Group I: 35 patients CR+IMF using 2.7-mm cortical bone crews, arch bars, and Ivy loops.

Group II: 20 patients Non-rigid osteosynthesis using Transosseous Wire (TOW), Kirschner wire (K- wire), and external pin fixation (EPF)

Group III: 50 patients Rigid/Semi-rigid osteosynthesis using bone plates and screws.

The following postoperative variables were assessed and analyzed in each patient in the follow-up period.

Duration of admission
Duration of intermaxillary fixation (IMF)
Malunion
Infection
Nonunion
Mental nerve function, and
Facial nerve damage

Operative Technique

Eighty-nine patients (84.8%) were operated under general anesthesia and 16 patients (15.2%) were treated under local or regional anesthesia. In 98.9% of patients general anesthesia was administered through nasotracheal intubation and a nasogestric feeding tube was routinely passed at induction of anesthesia and secured with a silk suture to the membranous nasal septum along with the nasotracheal tube. Vasoconstrictive solution, lignocaine with adrenaline (1:200,000) was routinely infiltrated into the incision line preoperatively. Hydrogen peroxide mouth washes and antibiotic cover (500 mg cephradine and 500 mg of metronidazole 8 hourly intravenously) were administered preoperatively and continued for a minimum of 24 hours postoperatively.

Temporary IMF was applied in open reduction and internal fixation (ORIF) cases for aiding occlusion. The fracture site was exposed via a labial or buccal mucoperiosteal flap. In ORIF group 67.2% of cases were operated by an oral approach, 15.7% by an extra-oral approach, and 17.1% of cases required a combined approach. In combined approach fracture sites were exposed intra-orally and small skin incisions were used for percutaneous placement of screws to facilitate fixation of bone plates. In extra-oral approach a 4-5 cm submandibular incision was used to expose the mandible and a great care was taken to preserve the mandibular branch of the facial nerve.

Standard techniques of fixation (Spiessl[9] and the AO/ASIF[10] -Association for Osteosynthesis/Association for the Study of Internal Fixation) were used to place hardware in group III patients. Teeth present in fracture line were removed at the time of surgery. Dislocated condylar fractures were treated by ORIF via pre-auricular incision extending into the temporal hair-bearing region, preserving the facial nerve and its branches.

Inter-maxillary fixation (IMF) was maintained postoperatively for all groups for various periods of time (1-6 wks) dependent on the method of osteosynthesis and presence of concomitant non-fixed fractures. Patients

were given dietary and oral hygiene advice postoperatively.

Patients were followed up every 1-2 weeks time for a minimum period of 2 months. The period of follow up was extended if there were complications. A senior resident or consultant assessed postoperative patient variables clinically. Anteroposterior or OPG radiographs were used only where deemed necessary. Clinical review continued for at least 2 weeks post removal of IMF, at which time screws, arch bars, or Ivy loops were removed. Soft diet was recommended for 2- 4 additional weeks. Fixation removal was performed as indicated due to clinical factors such as, patient request, persistent pain, and infection. Routine removal of implant was not carried out.

The data was analyzed on SPSS statistical package by a statistician. The descriptive variables were analyzed using a Chi-square test. The measurement variables were tested with one-way analysis of variance. A 'P' value <0.05 was considered to be significant.

Results

The results were reported on a total of 105 patients with 174 mandibular fractures, of which 91 were fixed with bone plates and screws, 29 were treated with non-rigid osteosynthesis techniques, and 54 fractures were treated with CR+IMF (Fig I).

The mean age of patients was 27.3 years with an age range of 4-75 years. 85.7% of the 105 patients were male, with male to female ratio of 6:1. There was an average of 1.6 fractures per mandible. The etiology of mandibular fractures was divided into seven categories (Table I). In 60.9% of cases, road traffic accidents (RTA) were the etiology, followed by fall and missile injuries. Regarding fracture location, parasymphyseal fractures were most prevalent (29.3%), followed by body (20.1%), angle (16.1%), condylar (11.5%), symphysis (10.4%), ramus (8.6%), and dentoalveolar (4%) fractures (Fig II). The coronoid fractures were not diagnosed in any of the 105 patients. 43.8% of patients had single mandibular fractures, 47.6% had double fractures and the most common site for these were a parasymphyseal fracture with a contralateral angle fracture (16.2%), followed by symphyseal or parasymphyseal fracture with a contralateral condylar fracture (10.5%). 16% of fractures in the rigid, 15% in the non-rigid, and 11.4% in the IMF groups were compound extra-orally. Comminuted fractures were seen in 12% of rigid and 10% of the non-rigid groups.

Sixteen patients (15.2%) had a head injury, 17.2% had an orthopedic injury, 10.5% a simultaneous maxillary fracture, and 8.6% of the patients had panfacial fractures. One patient had diabetes mellitus, 2 were hypertensive, and two had ischemic heart disease. None of the patients was found to be drug or alcohol addict. 95.2% of the patients were dentate.

Regarding treatment modalities, out of 75 fractures in the rigid group that were fixed, 33 reconstruction plates (RP), 12 dynamic compression plates (DCP), 10 mini-plates (MP), and 20 lag screws were used. In the non-rigid group, out of 29 fractures, 10 were fixed with K-wires, 17 with TOW, and 2 were managed with external pin fixation (EPF). In the CR+IMF group, 20 patients were treated with bicortical intermaxillary fixation screws, 10 patients with arch bars, and 5 patients were treated with Ivy loop indirect interdental wiring. 16 concomitant undisplaced fractures in group III were not fixed and managed with IMF. These were mainly subcondylar, ramus, and angle fractures. Only 25% of the condylar fractures were treated with open reduction and internal fixation. 52.4% of patients were treated within one weak following trauma. Only 9.5% of patients were treated within 24 hours after injury. In rest of the patients the treatment delay was more than 1 week.

Age, gender, etiology, fracture site distribution, mental nerve function, and delay in treatment were all similar for the three groups. One preoperative variable (comminuted fractures) was not statistically similar. Group II and III had a higher number of comminuted fractures as compared to group I.

Comparision of Postoperative Variables (Table II)

Occlusion was assessed postoperatively in all the patients by the consultant or by senior resident. Analysis of treatment outcome showed that in 90% of patients, functional occlusion was restored. Rigid fixation (Group III) resulted in malocclusion in 4 (8%) of the patients in comparison to 2 (10%) in the non-rigid (Group II), and 3 (8.6%) in the CR+IMF group. There was no significant difference between the three groups (P = 0.24). None of these patients required further surgery to correct this malocclusion. Most of these patients had associated condylar fractures. Only 5 patients (4.7%) required corrective occlusal adjustments with rubber elastic bands, the remainder resolved at later review.

Infection was seen in 4.8% of patients occurring 1-6 weeks following operation. It was mainly soft tissue infection, manifested by abscess formation or discharging sinus. Frank osteomyelitis was not recorded in any of the cases. Only 1 case of infection (2.8%) recorded in IMF group, 2 (10%) in the non-rigid, and 2 (4%) in the rigid groups. The difference was significant statistically (P=0.012). None of the two infected cases in the rigid group required removal of implant. In the non-rigid group one patient required removal of wires. Rest of the cases was treated conservatively.

Delayed union (excessive mobility of the fracture site 4 weeks post treatment) occurred overall in 4.8% of patients. All progressed to satisfactory union without further surgical intervention. Malunion occurred in 2 patients (5.7%) in group I, 1 (5%) in group II, and 1 (2%) in group III. These 4 patients had multiple fractures and undisplaced fractures were treated conservatively. Only 1 patient in the rigid group (III) was re-operated for malunion. No case of non-union was recorded. There was satisfactory bone healing in 100% of cases. This difference of malunion was not significant statistically (P=0.26).

Mental nerve function was routinely assessed in the follow-up period. Five patients (4.7%) had persistent mental nerve paresthesia, 1 (5%) in group II, 4 (8%) in group III, and none of the patients in group I. A significantly higher incidence (8%) of iatrogenic nerve damage occurred in group III (P = 0.007).

Weakness of the marginal mandibular branch of the facial (VII) nerve was significantly higher (4%) in the rigid group (P = 0.0001). None of the non-rigid group (II) had this complication. It was usually associated with an extra-oral approach.

IMF was used in 58% of patients of group III, and 80% of group II. In group III this was necessary for concomitant non-fixed fractures, or when fracture was treated with semi-rigid fixation technique. 85.7% of patients of group I had 4 weeks or more IMF as compared to group II (75%), and group III (40%). The duration of IMF was significantly shorter for group III (P = 0.002). Hospital stay was over 3 days in 40% of group I, 90% of group II, and 88% in group III. Duration of admission was significantly shorter (P = 0.001) for group I.

Fixation (plate or wire) removal was not undertaken routinely. Eight plates in 5 patients were removed in the rigid group, and three K-wires in 3 patients were removed in the non-rigid group. Ten patients (9.5%) required re-admission, 8 for fixation removal, 1 for malunion, and 1 patient was admitted for soft tissue infection. Overall the complication rate was low of group I.

Discussion

In the management of facial injuries and fractures it is the obligation of the physician to return the patient to his normal function and appearance, or as near to the normal as possible. In most of the cases function as well as appearance and esthetics has to be considered. In a competitive society economic and sociologic factors make it necessary that an aggressive and expedient program be adapted to return the patient to an active, productive life as soon as possible with minimal cosmetic and functional disability.

There are many ways to implement the principles of reduction and fixation.[10] Methods vary considerably with the patient and with the training and skill of the surgeon. Generally, the method of choice should be one that offers the simplest direct approach to successful reduction and fixation[11]. Most of the fractures can be treated adequately by CR + IMF, but in our experience superior results have been achieved in more serious injuries by open reduction and internal fixation[8].

The method of IMF for treating mandibular fractures is simple, easy to learn, and still widely practiced in most of the maxillofacial surgery units.[12] The method of IMF employed in our department has changed over the years. Currently IMF utilizing intraoral cortical bone screws is the preferred method over arch bar and Ivy loop techniques.[13] The reason is that it is very easy to apply and remove the screws. The operating time is significantly reduced from 45 minutes for IMF with arch bars or Ivy loops to 10 minutes for IMF with screws. Moreover, it is equally applicable in patients with teeth and those without teeth with increased patient comfort and tolerance, and the surgeon is less exposed to infectious diseases by skin punctures as compared with arch-bar and wire techniques of IMF. On the other hand difficulties associated with prolonged period of immobilization include airway problems, poor nutrition, weight loss, poor oral hygiene, difficulty in speaking, social inconvenience, patient discomfort, work loss, and difficulty in recovering normal range of jaw function.[14]

Recently the trend is towards open reduction and rigid/semi-rigid internal fixation.[8,15] The rigid internal fixation (RIF) is highly technique sensitive and demanding. A lot of experience and skill is required to apply the plates properly.[16] Errors in fixation will result in permanent malocclusion. At the same time, the advantages of the RIF include early mobilization, and restoration of jaw function, airway control, improved nutrition and speech, better oral hygiene, great patient comfort, and an earlier return to the workplace.[17]

Principles and techniques of RIF were developed and popularized as a result of research conducted by the AO/ASIF[10] in Europe in the 1970s. The basic principles of the AO were outlined by Spiessl.[9] RIF leads to primary bone healing which occurs when axial compression yields tight approximation of the fragments at the fracture site, promoting direct extension of osteocytes across the small bone gap.[18] This type of primary bone healing occurs without formation of any intermediate callus, thereby shortening the time period for remodeling and consolidation. When extra-oral approach is used the method of ORIF, however, is associated with increased operating time, risk of facial nerve damage, and hypertrophic scar formation.[16]

The concept of adaptive or semirigid fixation was developed by Michelet et al[19] and Champy et al[20] in France again in 1970s. In this type of fixation a small gap between the bone ends exists which means that a limited amount of primary callus forms. In this type of fixation miniplates are applied close to the tension zone (near the teeth) of the mandible. Monocortical screws are used to avoid injury to the roots of the teeth and alveolar nerve. However, a variable period of IMF is required with this type of fixation.

Lag screw is another form of compression osteosynthesis, which has been commonly practiced in our unit. This technique was introduced to maxillofacial surgery by Brons and Boering[21] in 1970. The major advantage of this technique is that lag screws permit more rapid application of fixation than bone plates without diminishing the rigidity of the fracture reduction. Lag screws, when applied perpendicular to the fracture, even provide more rigidity than do bone plates.[22] This is also a cost effective technique since the screws cost little as compared to the cost of a bone plate. This technique is useful only for anterior mandibular fractures.

Non-rigid osteosynthesis utilizing intra-osseous wires, K-wires or EPF has not been practiced commonly in our unit. The number of patients treated by this technique is less as compared to IMF or RIF techniques. A prolonged period of IMF is required. Wire osteosynthesis is associated with higher complication rate as compared to IMF or RIF. The reported rate of infection of mandibular fracture treated with conventional methods is between 4.4 and 17%. We recorded 10% infection rate with wire osteosynthesis compared with 2.8% with IMF and 4% with bone plates. This compares favorably with other studies (Table II).

In our study the rate of malocclusion with CR + IMF is 8.6%. This is not significant statistically between the three groups (P = 0.24). However, the rate of infection (10%) is significantly higher in the group II (P = 0.012). Predisposing factor for infection in this group is the comminuted and contaminated fractures treated with TOW and K-wires with increased mobility at fracture site.[23] Mezitis et al[7] reported an infection rate of 2.5%, and malocclusion of 3.5% with IMF. The higher malocclusion rate in our study may be due to the fact that we treated multiple significantly displaced fractures with IMF in patients with poor socioeconomic status.

The infection rate with bone plates (RIF) has been reported to be between 6 and 32%. Iizuka et al[24] reported a postoperative infection rate leading to plate removal of 6.1%, and primary bone healing of 93.9% without IMF. Kearns et al[16] reported an infection rate of 6.2%, and a primary bone healing rate of 93.8% with a week of IMF. Ellis et al[22] have reported an infection rate of 13% with lag screws, 17% with wire osteosynthesis plus IMF, and 7.5% infection rate with an AO reconstruction plate without IMF. He concludes that the interfragmentary compression generated by DCP causes bone devitalization and subsequent necrosis. He advocates the use of AO reconstruction plates in comminuted and infected fractures. In our study the rate of infection, and of other complications of RIF, is comparable with other international studies (Table III), except numbness of the inferior alveolar nerve, which is higher (8%) than other studies. The incidence of facial nerve damage (4%) in this study was in agreement with the reported incidence of 0-12% in the literature.[7]

In this study males, between age group 21-30, accounted for most of the cases. Road traffic accidents (RTA) were the cause of fracture in 60.9% of cases and out of these 50% were motorcyclist. A significant number of patients, particularly females and children, suffered from RTA while crossing the road. These findings are constant with locally and internationally reported facts except etiology of fracture. In the western world compulsory use of seat belt and helmet by law have resulted decrease in severe injury, particularly, of facial region. In our country the legislation regarding compulsory use of seat belt, wearing of helmet, and implementation of traffic laws in general has been ineffective. In the European countries interpersonal violence (assault) is the leading cause of mandibular fractures.[25]

Analysis of treatment outcome showed that in 90% of cases functional occlusion was restored. Overall RIF, although it is an

expensive and time-consuming method to learn and apply, is of great benefit to patients as they can use their mouths normally after operation and return to their jobs quickly. RIF is more reliable in avoiding postoperative use of IMF than semi- or non-rigid osteosynthesis. However, postoperative malocclusion is more difficult to correct in RIF.

Conclusion

Based on the results of this study we concluded that a brief period of IMF helps to stabilize the occlusion by immobilizing fracture segments, allows reattachment of the soft tissue drape and promotes initial bone healing. All the three surgical techniques were successful in restoring functional occlusion. Rigid internal fixation with lag screws is reliable, efficient, and cost-effective technique for anterior mandibular fractures. In experienced hands RIF is the method of choice, particularly, for grossly displaced or comminuted fractures with or without bone loss. Overall CR+IMF with 2.7-mm cortical bone screws is the simplest, less invasive, efficient and cost-effective technique in treating most of the mandibular fractures. Ultimately the plan must be individualized according to the fracture, the patient, and the preference of the surgeon to maximize success rate while minimizing complications that may be physically and psychologically devastating to the patient.

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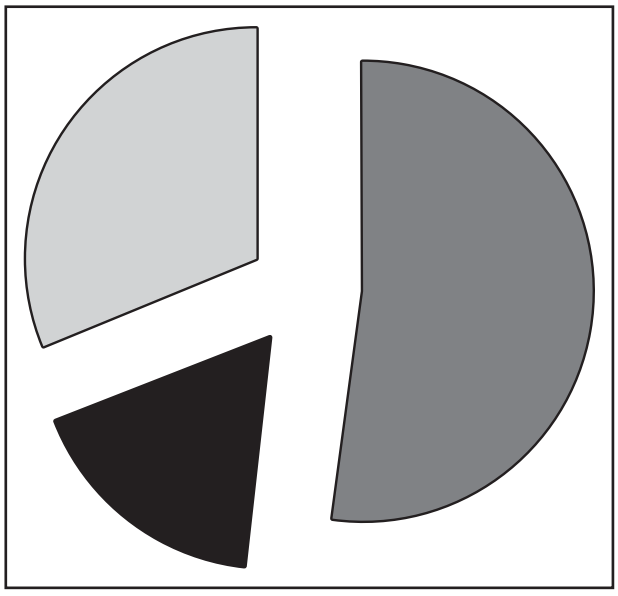
Figure I. Distribution of Fractures in Treatment Groups (data in percentages)



CR+IMF 31%

Rigid fixation 52%

Non-rigid fixation 17%

CR= Closed Reduction, IMF= Intermaxillaey Fixation

Table I. Etiology of Injury

Etiology	No. of patients	%
RTA	64	60.9
Fall	15	14.3
FAI	8	7.6
Assault	5	4.8
Industrial	8	4.8
Sports	4	3.8
Others	4	3.8

No = Number, RTA = Road Traffic Accident, FAI = Firearm Injury

Figure II. Site Distribution of Fractures (data in percentages)

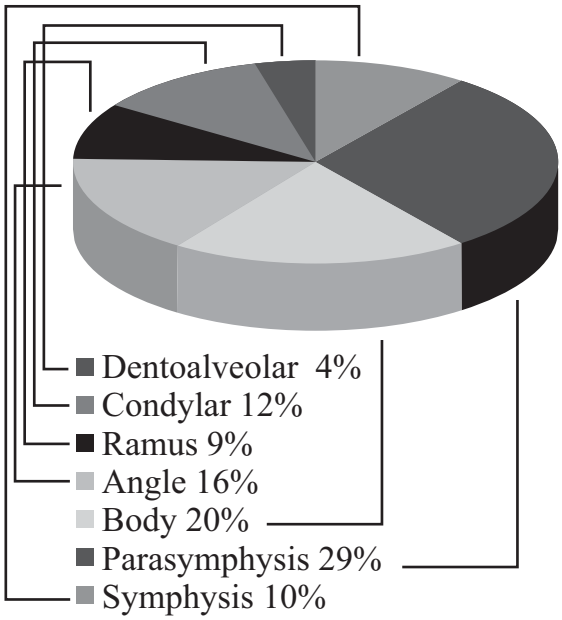


Table II. Comparison of Postoperative Variables

	CR+IMF no = 35	Non-rigid Osteosynthesis no = 20	Rigid Osteosynthesis no = 50	Total 105	%
Infection	1 (2.8%)	2 (10%)	2 (4%)	5	4.8
Malocclusion	3 (8.6%)	2 (10%)	4 (8%)	9	8.6
Malunion	2 (5.7%)	1 (5%)	1 (2%)	4	3.8
Mental Nerve Dysfunction	0	1 (5%)	4 (8%)	5	4.7
VII N Damage	0	0	2 (4%)	2	1.9
IMF>4wks	30(85.7%)	15 (75%)	20 (40%)	65	61.9
Inpatient >3 days	14 (40%)	18 (90%)	44 (88%)	76	72.4

no = Number, CR = Closed Reduction, IMF = Intermaxillary Fixation, VII N= Facial Nerve

Table III. Comparison of RIF Results with Other RIF Studies (Data in % of patients)

Study	Year	No	Infect-ion	Malocclusion	Malunion/ Nonunion	MN damage	VII N damage
Mezitiset al[7]	1996	443	3.4	3.4	1.5	0.5	3.5
Fardyc et al[17]	1996	88	2.3	4.7	-	-	7.9
Ellis[22]	1997	315	13	4	1	-	-
Lazow[11]	1997	155	3.9	-	1	-	0
Abbas et al[3]	2000	14	0	0	0	0	0
Anwar et al	2001	50	2	4	1	4	2

RIF = Rigid Internal Fixation, No = Number, MN = Mental Nerve, VII N = Facial Nerve

ORIGINAL ARTICLE

Reconstructive Rhinoplasty: new technique of central cartilaginous support

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Dr Sadia Mughese (MBBS), **Dr Tayyaba** (FCPS General Surgery), **Dr Muhammad Sajid** (MBBS)

Abstract: Honour amputation is a common cause of nose amputation in Pakistan, especially in Bahawalpur region. Skeletal support is always a problem in major nasal amputations. It needs multiple delays and extra support later on, with all traditional techniques.

We used sliding septal technique to reconstruct the central cartilaginous support of the nose. In this technique we used the remaining septum as a free graft. Ten patients were treated with this technique with excellent results. Nasal lining was provided either with septal artery mucosal flap or with nasolabial flap. Forehead flap was the only flap to provide external cover. Nostril rim were grafted with trimmed choncial cartilage primarily. In three patients debulking procedures were done later on , but no skeletal procedures.

In conclusion, this technique has given an excellent skeletal support and a nice tip projection with no delays or extra support later on. Patient satisfaction rate was 100%.

Key Words: Rhinoplasty, Reconstruction, Skeletal Support and Septum

History:

Honour amputation of nose and other body parts is a common problem in Pakistan and the most common cause of nasal amputation. Reconstructing skeletal support is a difficult and challenging problem. It needs to be delayed before reconstructing the final nose with most of the traditional procedures.

Nasal reconstruction constitutes external skin cover, inner lining and midline skeletal support.

Midline skeletal support of Reconstructive nose prevents tip, collapse makes the nose protrude adequately from the face with a naturally high tip.

At first external metallic platforms were fixed with in nasal cavity with a projecting framework shaped as desired[1]. In 1864 Ollier tried autogenous bone grafting[2]. In 1887 a forehead flap with a stent of ulna was used by Israel[3]. Wolkowitsch[4] in 1902 used little finger and in 1908 Mandry used clavicle[5]. Von Mangold in 1900, was the first to describe transplantation of costal cartilage of nasal support[6] . In 1925, Blair's comprehensive review gave the forehead flap priority for nasal cover with local flaps for lining and cartilage for frame work[7].

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Gillies in 1920 introduced the technique of L-strut[8]. It consists of a longitudinal piece of bone or cartilage that is placed on the radix and extended along the dorsum to the tip, where it is bent to rest on the anterior nasal spine. Chait and co-workers prefer a costal osteochondral graft from the fifth rib[9]. (Diagram no. 1)

Millard described hinged septal flap in 1973[10]. It is a L-shaped flap of septum hinged superiorly to augment the nasal angle, from the depths of the nose hole. Its limitations are that it does not provide adequate support and later it needs extra support. Secondly, it needs to be delayed.

(Diagram no. 2)

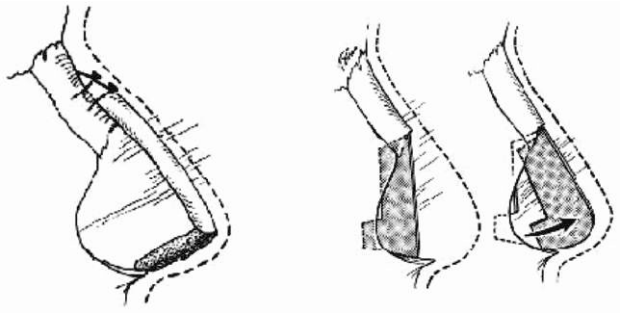


Diagram no 1 & 2:

L- strut and Millard hinged septal flap (diagrams from Grabb and Smiths Plastic Surgery, Fifth Edition)

Septal pivot flap was an expanded version of sir Gillies concept to bring some skeletal support simultaneously with lining as a composite flap of septum pivoting anteriorly[11]. This flap has got its limitations of delaying the flap, a large perforation in the septum and cases in which the septal artery is lost due to upper lip amputation this technique cannot be used. Diagram No.3

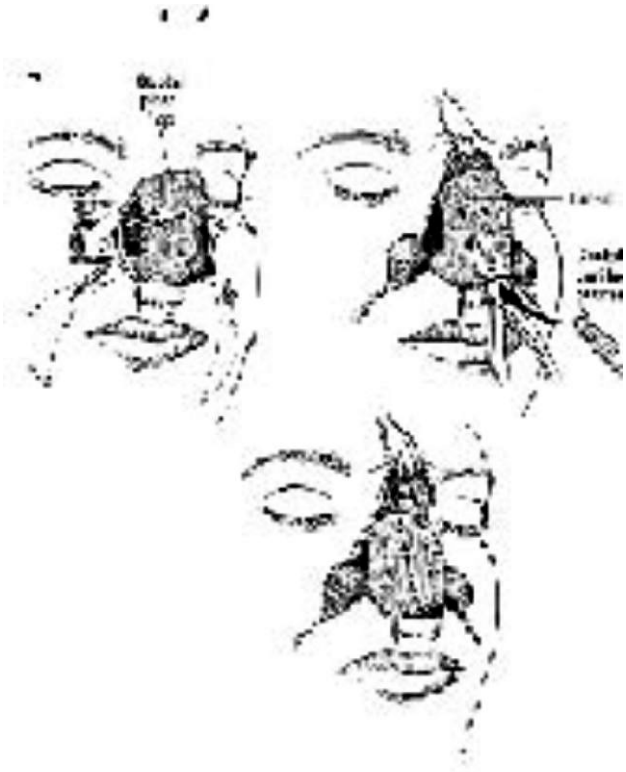


Diagram no. 3:

Septal Pivot flap (diagrams from Grabb and Smiths Plastic Surgery , Fifth Edition)

Then Converse and Millard experimented with **cantilever bone graft** for midline nasal support. The technique consists of a strong, longitudinal piece of bone that is affixed to the nasal radix and extends along the dorsum down to the tip, It does not need to be further supported up from below. (Diagram.No 4)

Diagram no. 4:

Cantilever Graft

Technique:

Sliding septal technique is an easy and effective method to reconstruct the central skeletal support with no septal perforation and the extra cartilage can be used to make the lower lateral cartilages. Normal external nose consists of bony vault, upper lateral cartilages and lower lateral cartilages. In homicidal nasal amputation usually the lower lateral and the upper lateral cartilages are cut but the bony vault is preserved.

(Diagram no. 5 and 6)

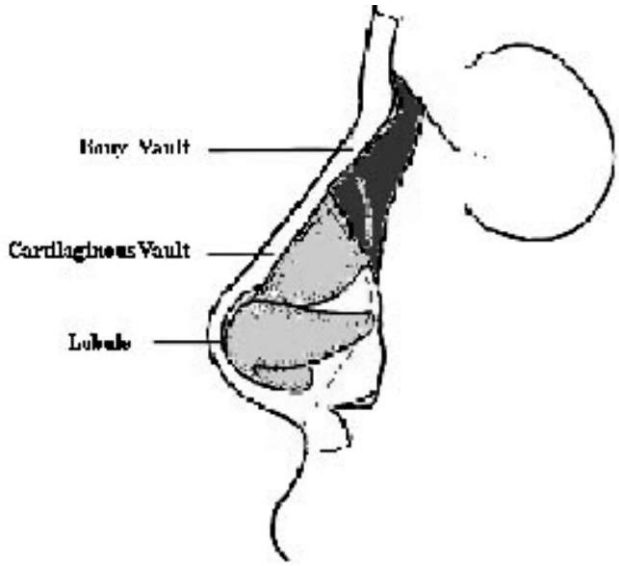


Diagram no. 5: Normal external nose

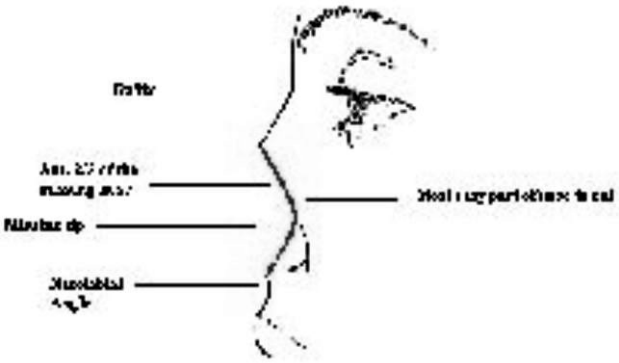


Diagram no.6: Amputated nose

The normal septum consists of the quadrangular cartilage, the perpendicular plate of ethmoid and vomer. In nasal amputation, one third to one half of the quadrangular cartilage is lost. (Diagram no. 7 & 8)

Diagram no. 7: Normal septum

Diagram no. 8: Amputated septum

Procedure:

Normal saline with adrenaline was injected in the septal mucosa and ballooned it up to separate the mucoperichondrium from the remaining septum. Septum was cut through and through in the shape of a rectangle with an osteotome (diagram no. 9) and slided forward. When reached to the desired location it was fixed at the anterior nasal spine and at the dorsum of the bony vault with prolene or wire sutures.

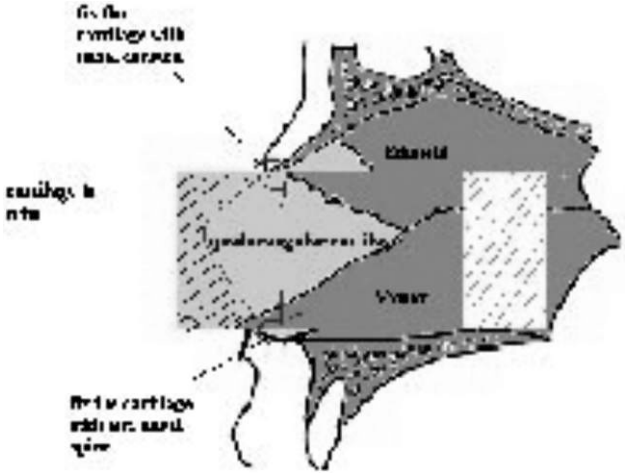


Diagram no. 9: Mucoperichondrial flaps are raised, septum is cut in a rectangle and slided forward and fixed with anterior nasal spine and dorsal bony vault.
Then excess cartilage was trimmed.

(Diagram no.10)

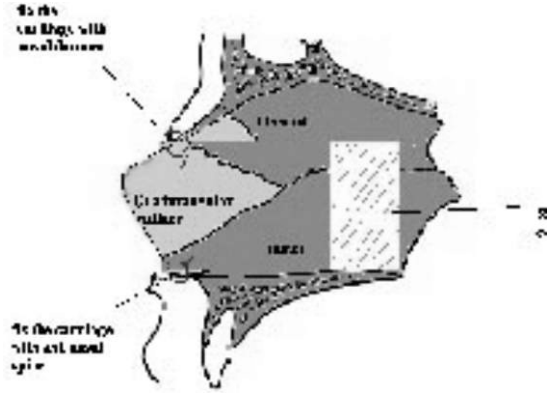
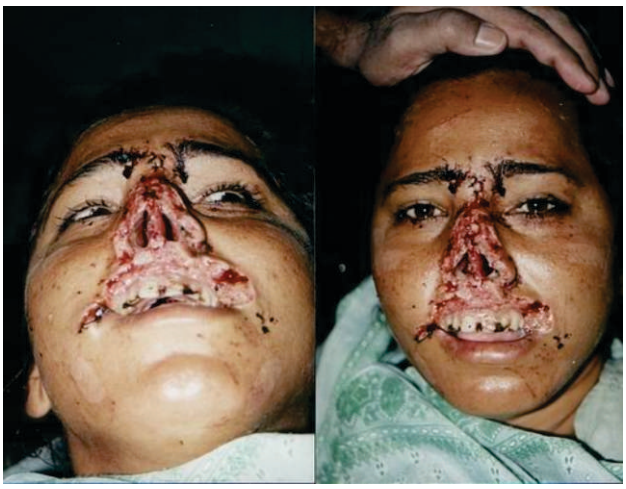
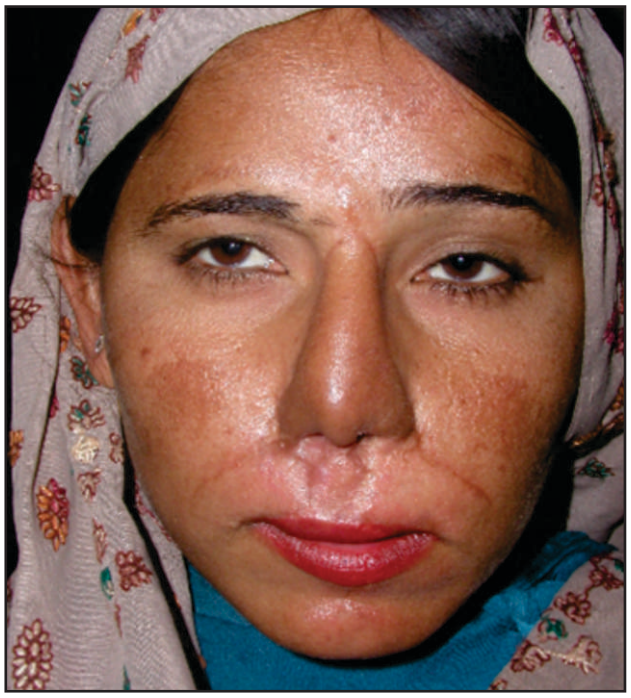


Diagram no 10: cartilage is trimmed and fixed with the anterior nasal spine and the dorsum of the nose.
Inner lining of the nose can be made with septal artery flaps if the septal artery is intact otherwise bilateral nasolabial flaps or forehead flap have to be used for the lining. Fore head flap is the workhorse for the external skin cover. Alar rims can be fortified with the remnant cartilage from septum.

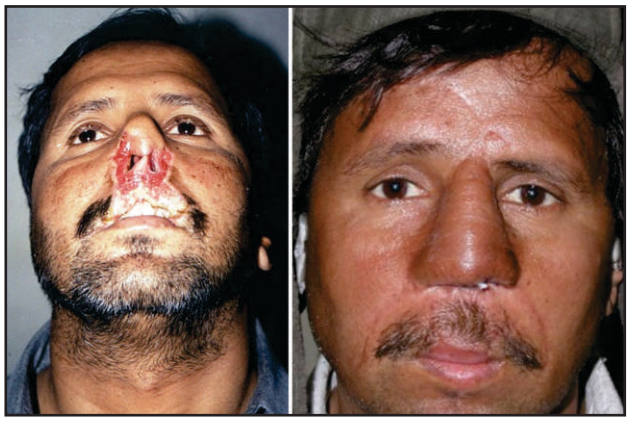
Cases:

Case no 1: A young unmarried lady presented in emergency with subtotal amputation of nose and total upper lip amputation with a sharp instrument. Her nose was reconstructed first with forehead flap for external cover, nasal mucosal flaps for the lining and central support with sliding septal technique.Alar rims were grafted with conchial carlitages.Pedicle of the forehead flaps was divided after 15 days. Upper lip as reconstructed with bilateral full thickness inferiorly based nasolabilal flaps and abbe flp.Some lip revision and nose debulikng was done a couple of months late.**Pic (1)** preoperative lateral, and frontal views.**Pic (2)** post operative frontal and lateral views after a couple of months. Some lip revision will be done after 3 months. (She married recently

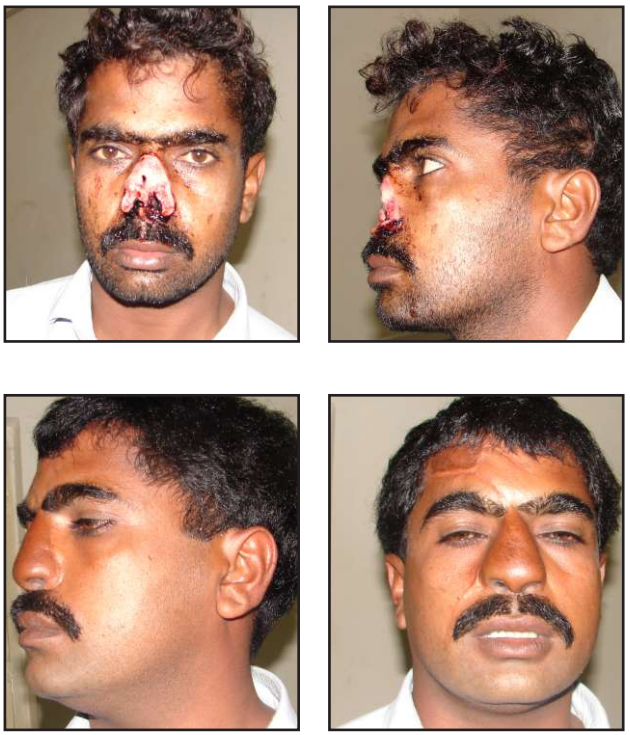




Case No. 2:
A middle aged man presented in emergency with subtotal nasal , near total upper lip and bilateral ear amputation. Upper lip was reconstructed with lower lip abbe and bilateral inferiory based full thickness nasolabial flaps. Nose was reconstructed with forehead flap, sliding septal technique for the central cartilaginous support, and nasolabial flaps for the inner lining. Planning to reconstructed the ears with ribs on a later date. Some nose debulking was done after 3 months.Pic (3) pre operative frontal and lateral views.Pic (4) early post operative view.Pic (5) post operative frontal and lateral views after 3 months.



Case no 3:
30 years old male, got his nose amputated by his cousin over a small dispute.Pic (6) pre operative basal and lateral views.pic (7) early post operative lateral view.Pic (8) post operative view after 1 year , lateral and basal.



Discussion.
The normal nose is made up of thin vascular lining, sculptured alar tip cartilages, bone and cartilages braces that buttress the dorsum and side walls and thin external skin.
In normal nose nasal bones and the septum provide dorsal support. Upper lateral cartilages and nasal bones make the lateral wall support.
In honour amputation of the nose, the septum is usually left flushed with the maxilla, down in the pyriform opening.(fig2).There must be some way to bring the remaining septum out for the support.
Millard[10] used L-shaped composite chondromucosal flap of full thickness of septum, by basing it above and fixing it on the anterior nasal spine.

Then wait for three weeks so that blood supply and fixation is established and the rest of the nose can be constructed later on. It is a three staged nasal reconstruction, plus it leaves a big septal perforation as well. And some time we cannot get the desired nasal tip augmentation and we have to add on to the tip in an other procedure.

Composite septal pivot flap as described by burgets, g.c,and Menick,.F.J[11] is a versatile and reliable technique in cases where septal artery is preserved. In this part of the word upper lip is mostly amputated with nose, so there is no septal artery (branch of superior labial artery).So the sliding septal technique works wells in these patients. Secondly, composite pivot flap is a multiple stage procedure, where septal sliding technique is a single procedure.

Cantilever bone graft and other substitutes like primary rib grafting are difficult options in the first instance with very poor and unreliable results.

Conclusion:

In this part of the world people are very poor and illiterate. Homicidal honour amputation of the nose is a common phenomenon. Pakistan is poor country and health care system does not provide any free health care facilities. So the patients cannot afford the expenses of multiple stage procedures.

Sliding septal technique is a very reliables, cost affective technique. It provides an excellent tip support in a single procedure, without sacrificing other precious material like rib or bone.

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ORIGINAL ARTICLE

Use of foam Dressing for Exudative Wounds and Graft Recipient area as Compared to Gauze Dressing

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ABSTRACT

Backdround: Traditional dressing on dirty wounds was cotton and gauze pads. Due to high cotton fibers and loose threads and low absorption rates we were struggling with this dressing. Secondly preparing these dressings also need lots of labor and resources. OBJECTIVES: The comparative study was conducted to compare foam dressing and conventional gauze dressing with reference to healing time and chances of infection in exudative wounds and on skin graft. MATERIALS AND METHODS: One hundred patients were included in the study, from Plastic Surgery Ward, Bahawal Victoria Hospital (BVH) during twelve months, from 1st November 2012 to 31st October 2013. Fifty patients with exudative wounds had foam dressings while fifty had gauze dressings, which were observed over time. RESULTS: Results showed that granulation with foam dressing is almost 7 days as compared to gauze dressing, which on average takes 12 days to heal. Whereas chances of infection with foam dressing also reduces two times as that from gauze dressing. CONCLUSION: In conclusion foam dressing is recommended for dirty exudative wounds because of its high absorptive nature, a kind of low negative suction effect, easy to prepare and low cost.

Key Words:

INTRODUCTION

It was noticed that foam dressings produced good results in wards, when used over infected wounds. So the study was designed to observe how foam dressing is better than conventional gauze dressing. It is believed that the foam dressing is highly absorbent and provides both weight support and pressure relief. The dressing is equally effective with varying amounts and flow rates of wound exudates. Says Chirag B. Shah, PH.D, Hansen P. BS; Brian J Dowd, MBA (Covidien, Basingstroke, UK).

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One hundred patients , from Plastic Surgery Ward, Bahawal Victoria Hospital, Bahawalpur, were studied for over a year, i.e.: from 1st, November,2012 to 31st,October, 2013. Out of 100, fifty patients had foam dressing whereas other half (fifty) were dressed with cotton gauze dressing.

The aim was to record a difference in healing time provided with foam dressing as compared to gauze for exudative wounds and areas where grafts were placed. Also to look the persistence of any infection with the use of both types of dressings.

All patients were observed during their stay at the hospital and the follow up visits. Changes in wound were recorded in text as well as captured in camera. Every wound was dressed daily. Foam being cost effective never played hindrance in a process. Wounds were washed with an antiseptic where required. Téot L, MD and Faure C,

(Burns and Plastic Unit, Hôpital Lapeyronie, Montpellier, France) said that Antiseptics act at the wound dressing interface, with some limitations – negative side effects on the fibroblasts and keratinocytes are well described. All care givers should know that these antiseptics should not be used at each dressing change, the flora being restored very quickly after elimination of germs by local application of povidine iodine or chlorhexidine . Therefore antibiotic course was also provided to the patients. All the dirty wounds as well as tidy wounds after grafts were under observation simultaneously.

MATERIAL AND METHOD

Wound was washed with antiseptic solutions and if required dead tissue was removed for all cases. Half inch 4×6 ft polyurethane foam autoclave able sheets were autoclaved and impregnated in pyodine solution and applied over the wound directly or over sofra tulle and was again covered by a dry polyurethane foam sheet and a compressive crepe bandage was done over it. In skin grafts we routinely changed 1st dressing after 5-6 days.

In gauze dressing, gauze pads were prepared by cutting cotton pads, and gauze sheets (fig.d). All pads were wrapped and then autoclaved. The gauze pads were also impregnated in pyodine solution and applied over wound , covered by dry gauze and then compressive crepe dressing was done. In skin grafts we routinely changed dressing after 4-5 days due to soakage.

Dressings were changed on daily basis in both cases but in foam cases, we often changed dressing on alternate days due to high absorption rates.

We did not use foam dressing on skin graft donor site due to its high adhesive nature.

RESULTS

Out of 50 patients who got foam dressing, 3 patients (6%) got infection in wound, whereas 9 out of 50 patients, (18%) with gauze dressing showed infection. fig.1 and fig.2

Healing time for wounds with foam dressing, on average was 7 days; however gauze dressed wounds healed in 12 days on average. Fig.3

Percentage of patients persisted wound infection after foam dressing

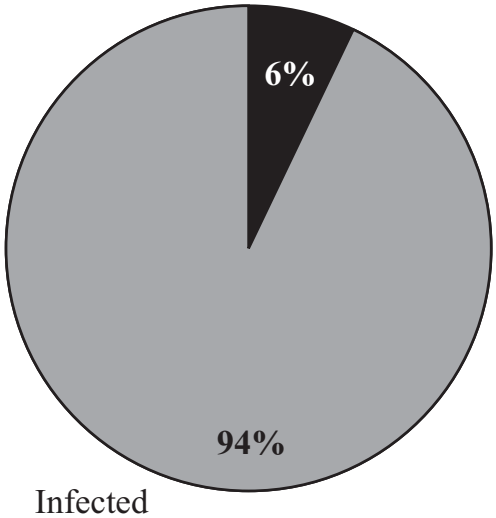

Fig.1

Percentage of gauze dressing patients who showed wound infection

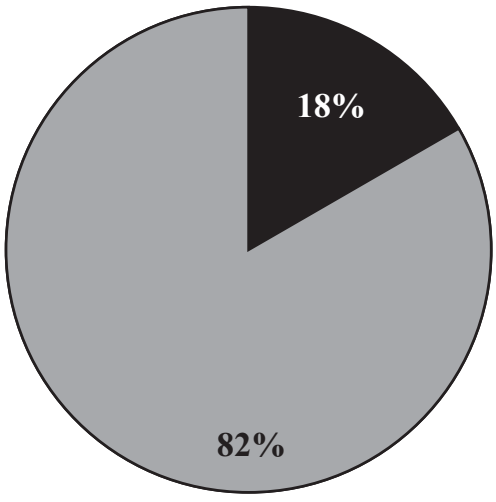

Fig.2

Healing time taken with foam and gauze dressings

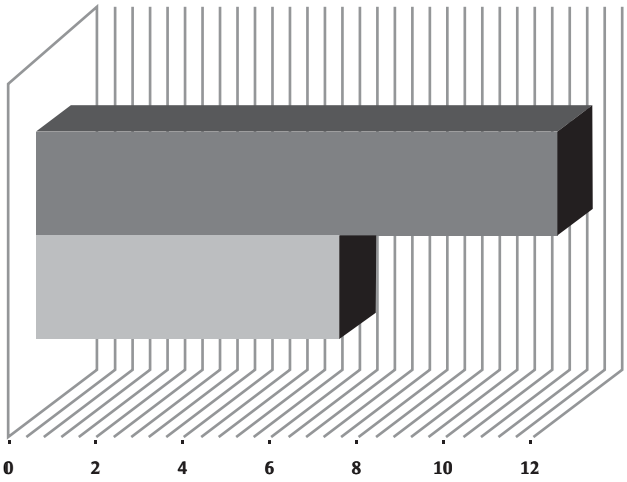

Fig.3

CASE 1:

A 20 year old male was shifted to plastic surgery ward from orthopedic depatment, he had a rod placed in his leg due to crush injury of tibia in a road traffic accident, one month before he was shifted. Wound area was infected when received and there was not a proper granulation tissue over it, We planned to prepare area before placing a graft over it.

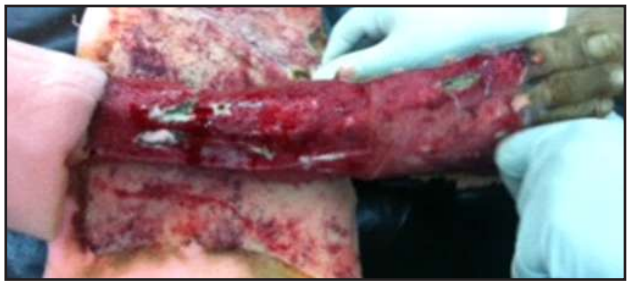

Figure a

For that purpose antibiotic course was started along with proper foam dressing. Foam dressing was changed daily (fig. a) after being washed and cleaned properly. New foam was placed over wound. Primary dressing was wet foam soaked in povidine iodine whereas secondary dressing was dry autoclaved foam (fig. b) . which was finaly wraped with a crape bandage.

Figure b

It was continued for almost 10 days when proper granulation tissue was obtained and infection was gone from the site. Split thickness skin graft was placed over the area and again foam dressing was done over it. When foam dressing was changed after 5 days of surgery (fig. c) a well placed and healthy graft was achieved.

Figure c

Gauze dressing preparation requires a lot of labor, space and material (fig. d) . gauze dressing are prepared when cotton sheet is packed between two layers of gauze sheet, cut into appropriate size and then autoclaved.

Figure d

Whenever gauze dressing is opened, it creates a lot of mess and is usually adherent to the wound. Cotton fibers, most of the time gets into wound area, acting as a foreign body . (fig.e) shows displaced graft area which was dressed with cotton gauze.

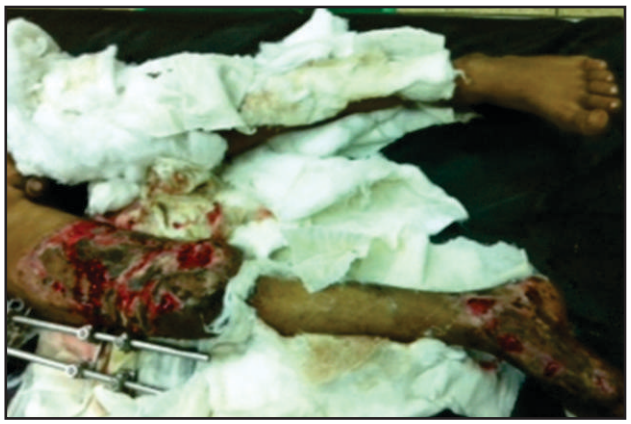

Figure b

DISCUSSION

The study was designed after general observation of using foam over exudative wounds, it was expected that foam dressing would show the better results regarding healing of a wound and minimizing infection. Results came out to be not very surprising. This one year work showed that foam dressing has better results over common gauze dressing. The infection is very well controlled by foam, as it provides environment to absorb maximum exudate, Téot L, MD, PhD and Faure C, PhD said that the foam itself, with its specific porosity and the capacity to allow fluids to circulate freely from one side to the other (open pore polyurethane foam), present some changes observed immediately after application of negative pressure. The pores, initially round, become oval when submitted to negative pressure and hamper bacterial growth locally, which helps in healing wound efficiently. Also it takes off slough from the bed like a debridement of a wound whenever the dressing is changed. It gives excellent results when used with oral or i/v antibiotic therapy. Healing time was also observed to be minimized with the use of foam, as it controls the infection and provides minimum exposure to external environment. Chirag B. Shah, PH.D, Hansen P. BS; Brian J Dowd, MBA (Covidien, Basingstroke, UK) said that the balance of moisture maintenance and prevention of infection in chronic wound management is a challenge and an ideal dressing addresses both issues may aid in healing of chronic wounds. Foam is also being more cost effective as half inch is bought in a meter sheet, whereas gauze pad needs cotton and gauze rolls which are comparatively expensive. The preparation time for gauze dressing is far more than that of foam. Cotton is layered between gauze sheets, then is cut to the size and is autoclaved after words, whereas foam is rolled as such and autoclaved and is ready to be used.

Helen Shaw and Rachael Matheson of conva tech wound therapeutics studied the role of aquacel foam dressing in stage 1 pressure ulcers prognosis. They inferred that foam dressing protects against skin breakdown caused by excess moisture, friction or shear force and also provides a waterproof, viral and bacterial barrier to protect the skin from excess moisture and incontinence episodes.

Gee TC, Xing N, Chen J, Zhou JJ, Su GL, Shi JW and Zheng YS from

Burn Institute of Rui'an, the Third Affiliated Hospital of Wenzhou Medical College, Rui'an 325200, China did the Comparison among several foam dressings in the properties of water-absorption, water-locking and air permeability. They concluded that among the three kinds of foam dressings, Allevyn performs best in water-absorbing rate, water-locking capacity, and air permeability, while Mepilex and Biatain perform best in water-absorbing speed. For selecting foam dressing in Clinic, the properties of foam dressings and wound characteristics should be considered at the same time.

In another study Payne JL and Ambrosio AM. Of Global R&D, Kinetic Concepts, Inc., San Antonio, Texas, USA. Said that The V.A.C. Therapy System (KCI, San Antonio, TX) is

an integrated wound management system that creates an environment that promotes wound healing which is comparable to the polyurethane foam dressing which is also reticulated. VAC therapy system is quite expensive as compared to simple foam, so it is not being used, as most of the patients cannot afford.

Rahmanian-Schwarz A, Willkomm LM, Gonser P, Hirt B and Schaller HE. From the Department of Plastic, Reconstructive, Hand and Burn Surgery, BG-Trauma Center, Eberhard Karl's University Tubingen, Germany introduced a novel option in negative pressure wound therapy (NPWT) for chronic and acute wound care. They concluded that after a long period of preserving a monopoly market position of the V.A.C. ™ system, a new comparable option was successfully tested in this preliminary study. The polyurethane foam-based NPWT system (RENASYS GO™ - F/P, Smith & Nephew GmbH) is an efficient and cost-effective alternative NPWT system, which we effectively implemented in therapeutic management of different kinds of wounds.

Usman Ghani, Momin Malik, Zahid Hussain, Javed-Ur-Rehman and Irfan Shukr concluded that The vacuum-assisted closure is a relatively new technique. It is very effective in promoting healing in acute, subacute and chronic non-healing wounds. It helps by reducing wound size and promoting granulation tissue. It is also effective in promoting granulation tissue on bones devoid of any periosteum, tendons without any paratenon and even bare orthopedic implants. Many of such patients would have required a plastic surgical procedure but with application of this simple technique it was possible to close these defects with simple partial thickness grafting or delayed primary closure.

CONCLUSION

In comparison to gauze dressing foam dressing was very easy to prepare, we just have to roll it and wrap it into clean sheet and autoclave it as compared to gauze pads first we have to make gauze pads by gauze sheets and cotton rolls and to autoclave it. Foam is highly absorptive to absorb exudate and adhesive to wound surfaces that causes dead tissue debridement as well. This minimizes the time of healing and decreases the chances of infection to persist; it is far cheaper than gauze pads.

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ORIGINAL ARTICLE

Control cases of extreme cleft hand and feet deformities in three generations

Danish Imran FRCS , Matthew Erdmann FRCS, FRCS(Plast) , N. A. Siddiqui

***SUMMARY*:** We present a family of four affected individuals in three generations with extreme clefting of the hands and feet anomalies. The lack of interest for medical treatment of the individuals is appraised here in the context of the current strategies of management.

Key Words: cleft hand, congenital anomaly

The International Federation of Surgical Societies of the Hand (IFSSH) in one series gave a minimum estimate of 22.91 limb deficiencies occurring per 10,000 births with radial club hand representing 1.3.[1] In another population based Hungarian study 17% cases of limb deficiencies were related to genetic disorders.[2] The currently used classification is based on that of Swanson modified by IFSSH in 1983,[3,4,5] though from time to time non-classifiable cases are still reported from every part of the globe.[6,7,8]

Limb buds may be considered a single developmental field with the rostral set (arms) developing somewhat earlier than the caudal (legs).[9] Digit formation is apparently controlled by the zone of polarizing activity which releases a diffusible morphogen specifying positional information along the anterior/posterior axis.[10] Vertebrates have 39 HOX genes organized into four clusters with major roles in development. A variety of limb malformations in human beings are now known to be caused by chromosomal deletions involving HOXD and HOXA clusters, specific and regulatory mutations in HOXD 13 and HOXA 13 genes.[11] The environmental factors, teratogens induced,[12] and genetic factors both can cause limb defects.

The following case report illustrates the aspects mentioned above.

Case Report

A fifty-year-old lady with a thirty year old daughter and eight and six year old grandsons were seen in our clinic incidentally while they were visiting another patient. All of them showed an identical deformity in all limbs. The hands comprised of a single digit present on the ulnar side. The digit was rotated radially and the rest of the hand, though smaller in breadth, was present up to the palm. The feet also comprised of only one digit present on the fibular side. The sensory and motor functions in all the limbs were normal.

They were all products of uncomplicated full term pregnancy, labour and normal vaginal delivery. They were found to have normal height and weight and systemic examination was normal.

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Radiological examination revealed an ulnar based finger with two metacarpals, absent trapezium but normal wrist and distal radio ulnar joints and radius and ulna in both hands. In their feet a single fibular digit and a fibular metatarsal were present with absent cuneiform bones.

A diagnosis of failure of formation presenting as a variant of bilateral longitudinal radial ray deficiency in hands and bilateral tibial ray deficiency in feet was made. The identical deformity in three generations indicated the expression of an autosomal dominant gene.

Functionally, the ability to hold both small and large objects with their hands unilaterally and with both hands combined was very good and the gait was normal. The family allowed the examination but refused the option of surgical treatment for any member of the family.

Discussion

The above family presents with uniform expression of extreme clefting in all limbs, with a solitary ulnar digit in the hands and a solitary fibular digit in the feet in all three generations, suggesting an autosomal dominant mode of inheritance. Surgeons have improved their armamentarium with microvascular tissue transfer and bone lengthening techniques.[13] Increasing experience with timing and selection of surgical techniques has helped in decision-making and improved outcome.[14]

Together with counselling, occupational therapy and social support services, it is now possible to achieve what was once unimaginable.

Antenatal ultrasound, analgesics, amniotic fluid and chorionic villus sampling have allowed malformations to be predicted[15], allowing parents to be mentally prepared of the outcome of the pregnancy, or offer them the option of termination. Genetic counselling can be offered at this stage as a useful guide for future pregnancies.

Such detailed management plans for these patients emphasize how western society sees such malformations as having profound implications on the physical, psychological, and social welfare of the individual.

On the other hand, the refusal to seek medical help by the reported individuals verifies the fact that adaptation to the physical limb deformities does occur within a cohesive family based unit. It is salutatory that the acceptance of the deformities within the family has produced relatively normal functioning individuals and calls into question the need for specialised surgical intervention in current western society.

The above-mentioned case puts into question the plans to follow the long and arduous path of surgical intervention to correct these deformities, or even considering termination of a pregnancy. Control groups of patients who have had absolutely no surgical intervention can play an important role here, with whom the outcomes of surgery can be compared, to see whether a tangible difference to the lives of these people is really made or not? Are these patients offered an improvement in quality of life, the extent of which is largely unknown due to the lack of control cases, at the expense of a protracted surgical and rehabilitation process and improved cosmesis?

It may also be argued that in western society the social stigma attached to such deformities would make the option of no surgical intervention unacceptable, and that only in certain sub-cultures may this practice of non-intervention be acceptable, perhaps even recommended?

Perhaps, a better way to deal with these deformities is to reassure and support the parents and the child, with the idea that a deformed but functioning hand is better than a scarred, stiff, and possibly less satisfactorily functioning hand, which will still look deformed[16].

Fig 1

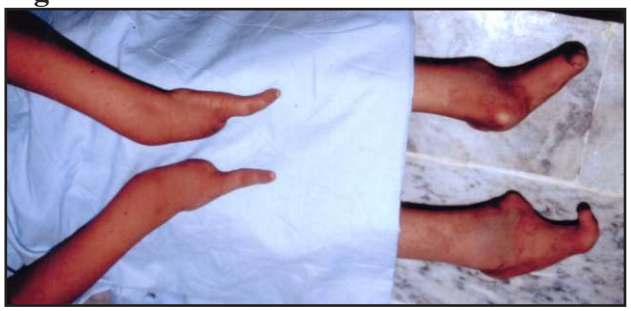

Fig 2a

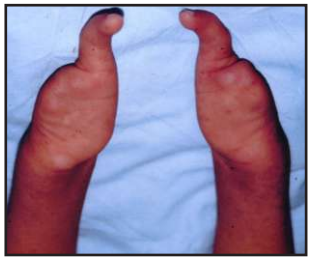

Fig 2b

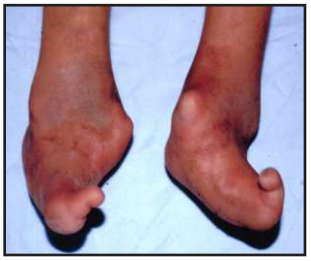

Fig 2c

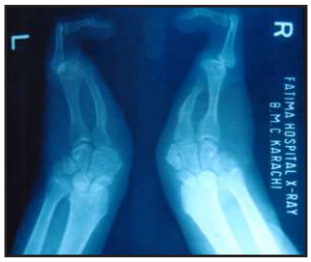

Fig 2d

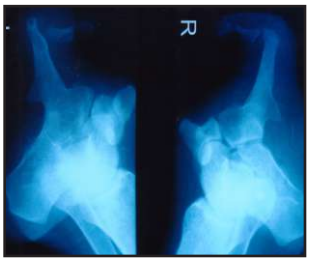

Fig 2e

Fig 3a

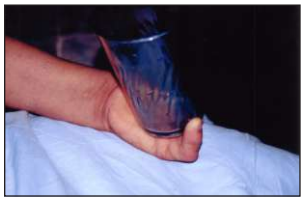

Fig 3b

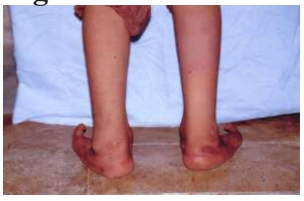

Fig 3c

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ORIGINAL ARTICLE

Reconstruction of Scalp Defects with Free Flaps

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***SUMMARY*:** We present our experience of reconstruction of six cases with large scalp defects. All repairs were performed for defects which resulted from tumour resections. Out of these six cases, three were of squamous cell carcinoma (SCC), two of basal cell carcinoma (BCC) and one case was of Haemangiopericytoma. The defects involved scalp with bone exposure in three patients. Resection of the outer table of the skull was done in one case. Extensive defect involving both inner and outer tables with exposed duramater occurred in one case, whereas in one of the cases the duramater had to be repaired. The average size of the defect ranged from 7 x 18 cm up to 15 x 25 cm. The flaps utilised for reconstruction included two radial forearm flaps, three latissimus dorsi muscle flaps with partial thickness grafts and one myocutaneous rectus abdominis flap. All flaps survived completely. No significant donor or recipient site complication occurred. Average hospital stay was 11 days (range 8 days to 14 days).

Our experience confirms that in cases of complex or large scalp defects requiring reconstruction and where there is inadequacy of local tissue, microvascular transfer of well vascularized tissues with adequate bulk and size is the preferred option for single stage, successful reconstruction.

Key Words: Scalp, Tumour, Free flaps

Among the causes of scalp defects, trauma and tumour resection are the major contributors. Other causes include infection, congenital malformations and radiation induced necrosis [1,2,3,4,5]. In cases where pericranium is intact, split thickness skin graft is the simplest and best choice in acute settings, where direct primary closure of the wound is not possible, as commonly is the case due to inherent tightness and lack of elasticity of the scalp [3,4].

In more extensive defects in which either the pericranium is lost or there is loss of calvarial bone, locoregional or distant flaps become necessary to provide adequate coverage of the defects [3,6]. Various local flaps based on the major scalp vessels namely superficial temporal and occipital arteries are described. In case of inadequacy of local tissue [15,16], free flaps are the best options. Another technique available is the use of tissue expanders to pre-expand the local tissue for reconstruction in cases of planned non tumour cases or secondary replacement of previous graft or scar tissue [1,2,3,4,7,8]. In the presence of number of these options available to us we retrospectively assessed our patients whose scalp defects were repaired with free flaps. We also assessed our results, patient satisfaction, justification of use of free tissue transfer and the efficacy of this treatment modality

Patients and Methods

A retrospective study was carried out in the Department of Plastic and Reconstructive surgery, Combined Military Hospital, Rawalpindi between 1995 to 2001.

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A total of six patients were operated for tumours of the scalp (Table 1). Both male and female patients were included in the study. Out of these three were females and rest were males. Age of the patients ranged between 25 years to 72 years (median age 49 years). Only the cases involving scalp were included and the cases involving mid-face and neck region were excluded from the study. Out of these six cases, three were of SCC, two BCC and one case was of Haemangiopericytoma scalp.

All the cases were assessed thoroughly, with history, clinical examination and relevant laboratory investigations. Pre-anaesthetic assessment was performed in all elective cases and due consideration was given to concurrent illnesses and other co-morbid conditions. Proper preoperative staging workup was done including Plain radiographs of the skull, X-Ray chest, ultrasound examination of the abdomen, CT scan/MRI scan wherever indicated, along with clinical assessment of nodal status and preoperative fine needle aspiration cytology. All cases were histopathologically confirmed with incisional biopsy before definitive surgery.

The scalp defects ranged in size from 7 x 18 cm to 15 x 25 cm. The defects involved exposure of bone in three cases. Outer table of the skull was removed in one case. In two cases both the inner as well as outer table of the skull had to be removed to achieve adequate tumour-free margins and in one of these cases duramater was resected and was repaired by a neurosurgeon.

The flaps utilized for primary reconstruction were radial forearm[2], latissimus dorsi muscle with split thickness skin graft[3] (Figures 1a, b, c, d and e) and rectus myocutaneous (Figures 2a, b, c and d). The superficial temporal artery was the main recipient vessel in four of the cases. In two cases facial artery and external jugular vein were used. Donor areas were either closed primarily or covered with split thickness skin grafts.

Results

All the free flaps survived completely, with no significant problems with flap and wound healing. The donor sites on trunk for latissimus dorsi and rectus abdominis flaps were closed primarily. There was no incidence of seroma formation. Radial forearm flap donor defects were skin grafted and healed primarily without complications.

Our average operative time was 7.5 hours ranging from 7 hours to 10 hours including resection and reconstruction. Drains under the flaps were removed on fifth post operative day with no problems subsequently. All wounds healed within two weeks time with aesthetically acceptable results. Total hospital stay on the average was 11 days, ranging from 8 to 14 days. None of the cases needed any secondary procedure or re-exploration. Four out of six cases received postoperative radiotherapy. The mean follow up time was 33 months ranging from 10 to 48 months. No tumour recurrence was observed during minimum follow-up of 10 months.

Discussion

A large number of procedures are described in the literature for the reconstruction of scalp defects. Both size and depth of the defect are considered to be important factors in deciding for the best option for reconstruction [1,2,3,4,5]. In retrospective assessment of our cases the causative factor was tumour resection which entailed wide local excision for adequate disease control [3,8,13]. This led to fairly large defects which were not amenable to coverage with the available local tissue. This is evident from the defects created post resection, which were between 7 x 18 cm to 15 x 25 cm in our cases. Thus in our study one of the important determinant for selection of free flap for reconstruction was size of the defect along with peculiar sites like fronto-parietal and temporo-parietal regions in three of the five cases and 3/4th of the vertex in two, where local scalp rotation advancement flaps could

not be sufficient [2,3,4]. None of the pedicled flaps like latissimus dorsi, trapezius, pectoralis major, temporalis or supraclavicular flaps could reach this far for primary closure of the defects.

One consideration for our selection of free flap was the need of postoperative radiotherapy in three of the cases for local tumour control. This is another advantage of the well vascularized free tissue, transferred to the region, that withstands radiation very effectively. Such large defects and the relative resistance of transferred tissue to the effects of radiation are in accordance with the findings mentioned in a series of microsurgical scalp reconstructions for cancer from M. D. Anderson cancer centre , Texas, USA[3]. With our previous experience with relatively small to moderate sized defects which were closed with local scalp flaps, we experienced significant wound healing problems such as partial wound dehiscence, wide scars or at times need for further flap advancements as secondary procedures. This is due to the inherent tightness and relative lack of elasticity of the scalp tissue which invariably closes under tension[3,4]. With the use of free tissue this problem can easily be avoided and thus prevent any delay in wound healing or need for any secondary procedure.

Whereas in the hair bearing scalp local tissue is always the preferred alternative to avoid patches of alopecia, in malignant cases such as ours, the primary goal is early and adequate disease control and an accelerated convalescence time to get the benefit of other treatment modalities like chemotherapy and radiotherapy. This important feature far outweighs the morbidity related with the primary illness in older age group as was the case in our study[3,8]. The use of expanded local tissue is a very attractive alternative, but it needs at least 6-8 weeks for adequate tissue to be generated and will cause significant delay in treatment of a malignant disease which may by that time become unresectable or have metastasized. Another role of tissue expanders can be subsequent replacement of scar tissue or even the flap to improve the local aesthesis and restore hair bearing skin[3,4,5,8,13].

For indications such as osteomyelitis and post irradiation osteoradionecrosis, free flaps definitely have a superior edge. The richly vascularized free flap tissue brings a very good source of blood supply to these diseased and relatively avascular zones thus improving healing and providing a very favourable final outcome. We consider the above reason to be an important indication for utilising free flaps for scalp defects as has been presented in a study published by F. C. Wei et al from Taipei, Taiwan[4], in which the size of the defect did not seem to be the most important determinant.

Conclusion

We conclude with the remarks that for large scalp defects, factors like size, depth and infection / radionecrosis are the key factors which most of the time dictate the need of free tissue transfer for single stage reconstruction of scalp defects. They definitely prove superior to other alternatives like skin graft or loco regional pedicled flaps, which at times are not adequate, possible or feasible.

No	Sex	Age	Diagnosis	Flap	Special features	Complication
1	M	55y	SCC	Rectus abdominis myocutaneous	Whole calvarium & dura exposed	None
2	F	69y	SCC	Radial forearm	Bone exposed	None
3	M	72y	BCC	Latissimus dorsi + SSG	Outer table removed	None
4	F	65y	BCC	Radial forearm	Bone exposed	None
5	F	25y	Hemangio-pericytoma	Latissimus dorsi + SSG	Whole calvarium & dura exposed	None
6	M	62y	SCC	Latissimus dorsi + SSG	Anterior scalp	None

Fig 2A. Large SCC involving frontal sinus and orbit.

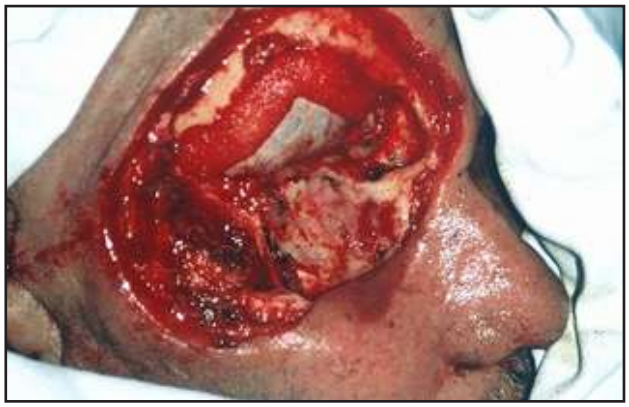

Fig 2B. After complete orbital resection including Ant. Cranial fossa floor.

Fig 2C. Reconstruction with Rectus abdominis free flap.

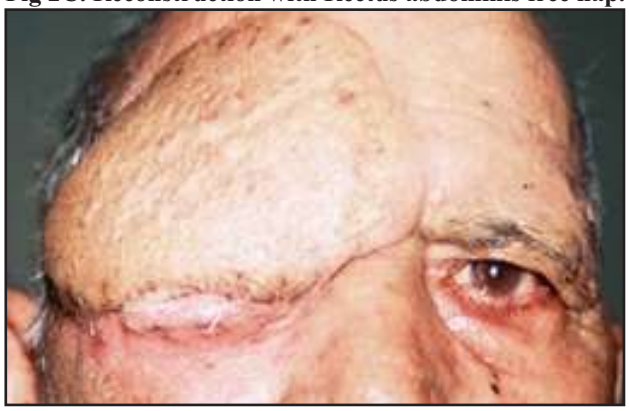

Fig 2D. Stable flap cover at 4 months.

Fig 1A. Giant Hemangiopericytoma of the scalp.

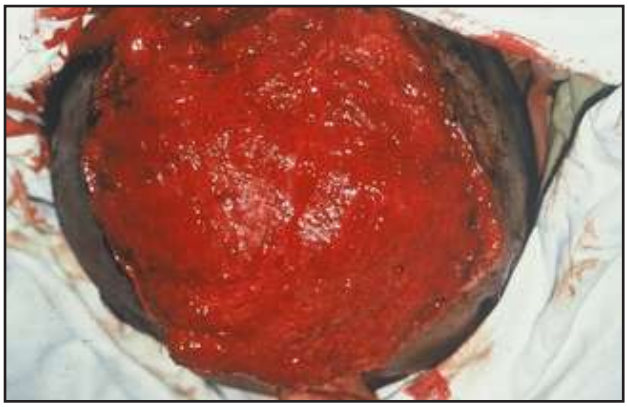

Fig 1B After resection including involved skull and coverage with whole Lat. Dorsi free flap. This was covered with a skin graft.

Fig 1C. Well Vascularized flap with good graft take on day 10.

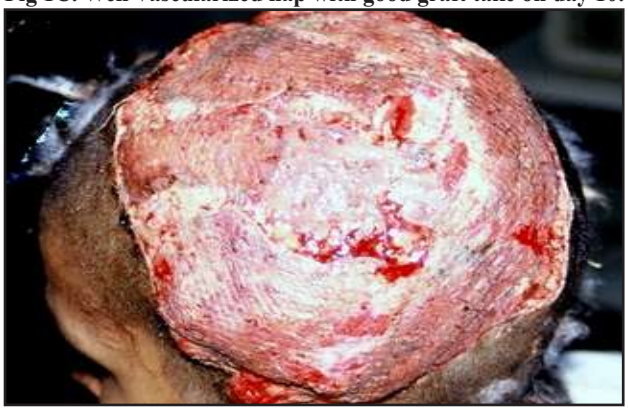

Fig 1D.Well Vascularized flap with good graft take on day 10.

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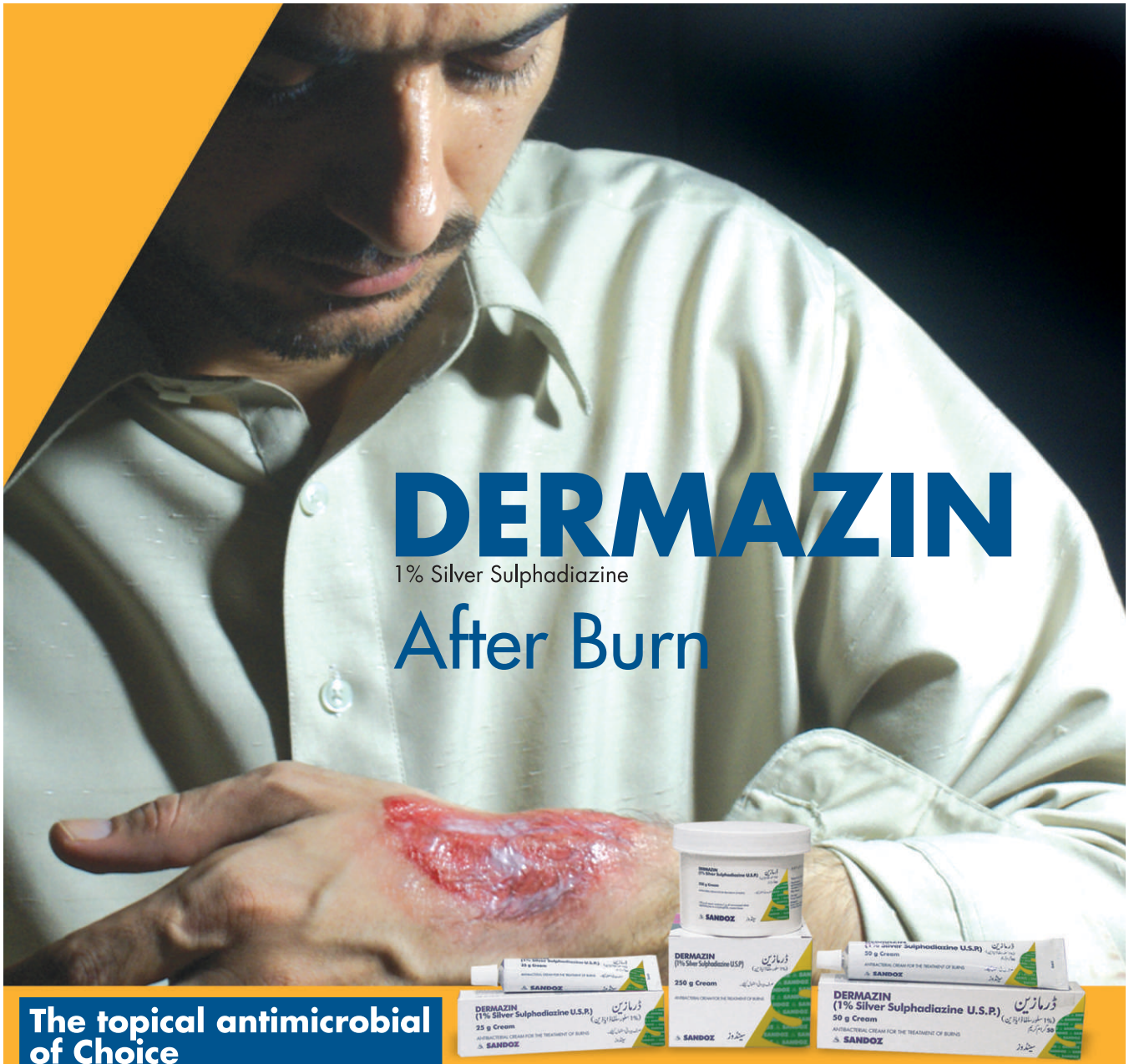

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