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RECONSTRUCTION

The Correction of Post-Traumatic Pan Facial Residual Deformity

K. Ranganath · H. R. Hemanth Kumar

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Abstract Disfiguring post-traumatic deformities of the midface sometimes persist even after the treatment. Such deformities, after healing, are among the most formidable challenges faced by the surgeons, apart from the psychological impact on the patients. Following the basic principles of craniofacial reconstruction and with newer techniques, better results can be achieved. Symmetry is key to proper reconstruction in general and face in particular. Proper facial projection and height must be re-established with harmonious occlusion. Our basic approach to the evaluation of deformities and particularly useful techniques for their correction are presented, with a representative case of malunited panfacial fracture that we treated with an iliac bone onlay grafting for zygoma along with correction of mandibular deformity by osteotomies.

Keywords Post-traumatic residual deformities · Malocclusion · Malunion · Iliac onlay graft · Corrective osteotomy

Introduction

Experienced surgeons recognize the challenge of restoring premorbid form and function to patients with established deformities after craniofacial trauma. The factors that lead to persistent deformities after craniofacial trauma include severe comminution (especially that which requires bone grafting), lack of definitive treatment, excessively delayed initial treatment, and inadequate initial surgical repair [1]. Malpositioned or missing skeletal fragments provide a faulty foundation and disrupt the harmony of the overlying soft tissues. Weak bony support will lead to the collapse and cicatricial loss of soft-tissue volume, thereby increasing the difficulty. Successful management hinges on the surgeon's ability to distill the disfigurement to its individual components. In addition, proper facial projection and height must be reestablished. Systematic evaluation of the midface, including position of the globes, orbits, zygomatic (facial) width, and occlusion, is of paramount importance.

Some contour deficiencies can be camouflaged by relatively simple procedures, whereas some deformities may require osteotomies and repositioning of the displaced segments. As a rule, the need for refracture and repositioning increases with the severity of malposition. The perfect replacements in these cases are the tissues that are identical to the missing or deformed tissue. Autogenous tissue meets this criterion best [2]. Malunited panfacial fractures especially in zygomaticomaxillary region are typically manifested by diminished anterior projection and lateroposterior displacement of the malar eminence. Augmentation of the zygomatic complex can be achieved by either autogenous or alloplastic onlay graft [3].

A case of panfacial residual deformity treated inadequately elsewhere and successfully managed by us is reported with review of literature.

Case Report

A 27 year male patient reported to our department with a chief complaint of facial asymmetry and difficulty in

K. Ranganath (✉) · H. R. Hemanth Kumar
Department of Oral & Maxillofacial Surgery, M. S. Ramaiah Dental College and Hospital, No. 28, M.I.G, 2ND Stage, K.H.B Colony, Basaveshwaranagar, Bangalore 560079, Karnataka, India
e-mail: dr_rang29@rediffmail.com

chewing and swallowing for the past 7 months, with a history of RTA there was loss of consciousness; he was shifted to primary trauma care centre where he was stabilised neurologically, from there he was referred to a different centre for the management of his facial injuries, where he underwent treatment for his facial fractures. On clinical examination the patient had gross facial asymmetry with depressed malar prominence on the right side, a mild increase in lateral scleral show of the right eye, lip incompetence (Fig. 1a), dearranged occlusion with right anterolateral openbite (Fig. 2a). On radiographic examination PNS view showed untreated comminuted fracture of the right zygomatic complex and a two holed miniplate at the left buttress region, orthopantomograph showed deviation in mandibular margins with four holed miniplates at the left parasymphysis and right angle regions (Fig. 3a, b). CT images (Fig. 4) with 3-D reconstruction was used to correlate with the clinical and other radiological findings. Patient earlier diagnosed with fractured right zygoma, right angle and left parasymphysis of fracture right zygoma, the right angle and left parasymphysis of mandible with residual deformities. The diagnostic work up and treatment planning included plaster models of upper and lower dental arches to calculate the amount of discrepancy in occlusion and to plan the osteotomies in the mandible, surgical grid to calculate the discrepancies in the zygoma by correlating with the normal side, on clinical and radiological pictures. The surgical treatment plan was iliac bone onlay graft for the zygomatic deformity and osteotomies in the mandible to achieve favourable occlusion.

Fig. 1 **A** Pre-operative extra-oral photograph. **B** Post-operative extra-oral photograph

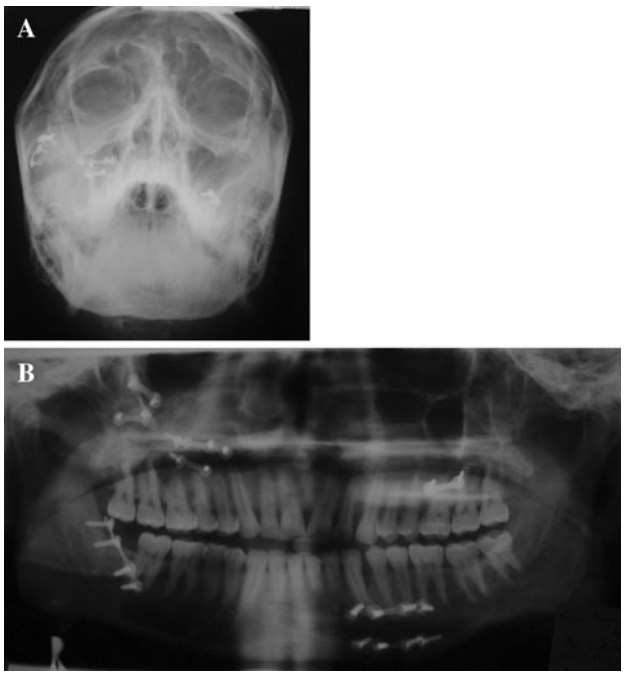

Fig. 3 **A** Post-operative PNS radiograph. **B** Post-operative Orthopantomograph

Surgical procedures were performed under general anaesthesia with left nasotracheal intubation through intraoral approach.

Malunion sites in the mandible, the left parasymphysis and the right angle were exposed through intra oral incisions, the mini plates used in the first surgery were removed along with the right mandibular third molar tooth and the planned osteotomy cuts performed, the segments were mobilized and intermaxillary fixation was done in the desired occlusion, a single 2.5 mm × 4 holed mini plate

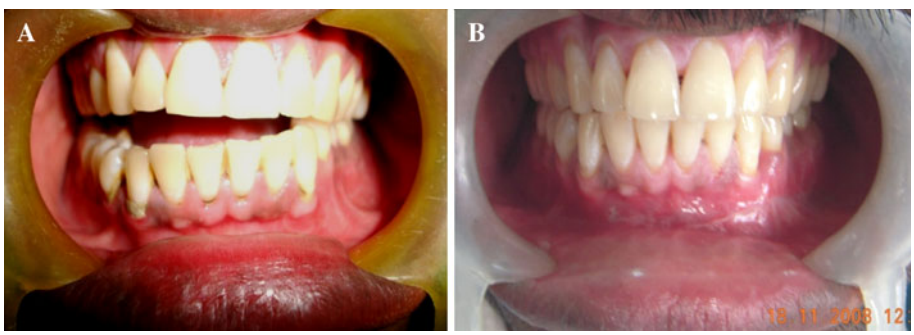

Fig. 2 **A** Pre-operative intra-oral photograph. **B** Post-operative intra-oral photograph

Fig. 4 Pre-operative CT scan

was used at the right angle region and two 2.5 mm × 4 holed mini plates were used at the left parasymphysis region, to fix the osteotomized segments.

The right zygoma was exposed via intra oral degloving incision extending from the right lateral incisor to the right first molar tooth, subperiosteal dissection was carried out to expose the infra orbital neurovascular bundle, the infra orbital rim, frontal and the temporal processes of the zygomatic bone, thereby creating a subperiosteal pocket. A chunk of Iliac bone was procured from the right iliac crest, the graft was then osteotomised and shaped to form the zygoma considering the measurements at different levels, a groove was made at the level of infra orbital foramen to accommodate the neurovascular bundle (Fig. 5a, b), multiple periosteal incisions were made within the pocket to insert the graft and to minimise soft tissue tension over the graft, the graft was placed into the pocket and fixed to the maxilla by 2.0 mm plating system (Fig. 6b), wound closure was with 3–0 resorbable sutures, Post-operative phase was uneventful.

Discussion

Management of comminuted fractures of the facial skeleton require definitive planning and approach during primary surgery, the possible requirement of an onlay graft should always be considered during treatment planning as Merville et al. (1974) have rightly written in the treatment of facial fractures, one should strive for restoration of the architecture of facial skeleton. Sir Harold Gillies (1968) divided post-traumatic facial deformities into those with substantial loss of tissue and those without. When there is no serious loss of tissue, residual deformities are due to-Failure to diagnose correctly, i.e. to assess the nature and extent of the original acute injury, Failure to disimpact or wholly replace displacements from such an injury and/or to provide adequate fixation [4]. Deformities are classified into groups with common reconstructive considerations based on anatomic sub-sites frontobasilar, nasoethmoid, periorbital, and maxillary-mandibular [1].

Our case showed malunited, comminuted fracture of the zygomaticomaxillary complex which was not addressed during the primary surgery and malunited fractures of the mandible which was fixed in the wrong position.

A full history is essential in diagnosis of secondary deformities; of particular importance are patient's complaints or concern. Our patient mainly was concerned with inability to chew food comfortably and wanted restoration of his right cheek prominence. In PTRD patients axial and coronal planes yield very useful information, however an additional benefit is to generate three dimensional images which allow the surgeon to visualise all aspects of the deformity and can sometimes reveal the underlying cause of deformity or discrepancy, which is difficult to assess by two-dimensional scans [5]. If an onlay graft is to be used, the site and extent of the augmentation should be similarly established pre-operatively.

Appropriate treatment may not be applied if the surgeon is inexperienced or the injuries are inadequately diagnosed.

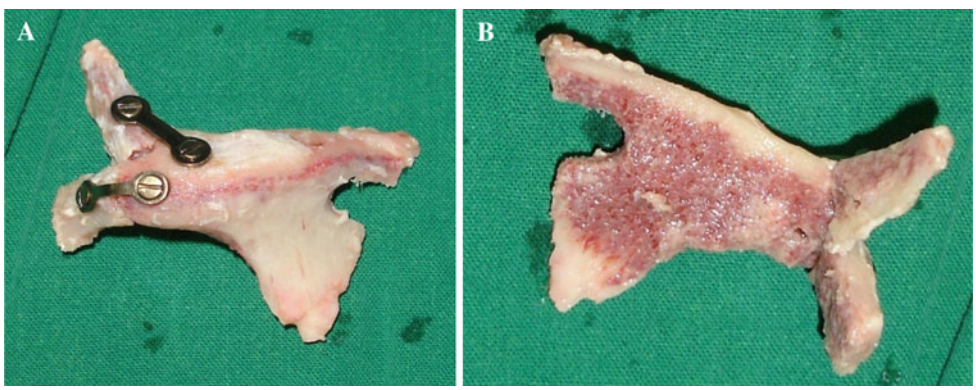

Fig. 5 **a**, **b** Sculptured iliac bone onlay graft

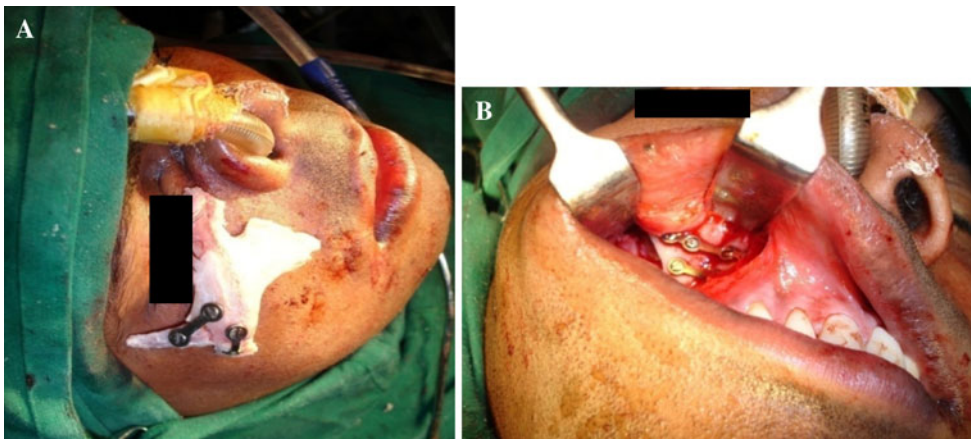

Fig. 6 **a** Onlay graft positioned on the patient. **b** Onlay graft plated to the maxilla

Understanding the nature of the injury is very crucial. The timing of intervention and the status of the overlying soft tissue envelope are two key principles which deserve special discussion in every case of PTRD. Earlier operations enable a more accurate pre-operative assessment of the extent to which the skeletal deformity results from skeletal malposition versus bone resorption [1]. Revisional surgery for secondary deformities of midface fractures requires assessment of the bony and soft-tissue structures. Some contour deficiencies can be camouflaged by relatively simple procedures, whereas more significant deformities may require osteotomies, recreating the fracture sites, and repositioning of the displaced segments. As a rule, the need for refracture and repositioning increases with the severity of malposition [2].

The principal goals of reconstruction are to: (1) return anatomical alignment of the bony skeleton, (2) secure proper skeletal support before addressing the soft tissue, and (3) replace missing tissue with like tissue. The materials available for restoration are abundant and the best choice is often autogenous tissue. Although alloplastic substitutes can be used, they should be regarded as a second-best alternative [2].

Augmentation of the zygomatic complex can be achieved by either autogenous or alloplastic onlay grafts, or by various midface osteotomies.

With regard to zygomatic deformities after publication of the zygomatic "sandwich" osteotomy (ZSO) Maurice et al. 1999, the technique gained quick acceptance by maxillofacial surgeons. The rotation of the zygomatic body increases projection in two directions; the segment moves more than 2.5 mm anteriorly when it is swung 5 mm laterally. This is in contrast to other osteotomy techniques that create merely anterior or lateral projection. Most cases of post-traumatic deformity are not suited to this type of osteotomy. The displacement of the infraorbital rim, the enophthalmus, and the canthal dystopia are not addressed with this procedure. However, it can sometimes be used in secondary reconstruction. In some centres, attempts to improve malar projection with a mixture of smooth HA granules and fibrin glue have produced satisfactory results [6]. Eitner successfully corrected a post-surgical malar depression with a FDFG (free dermal fat graft) in 1920. In 1931, the use of FDFGs was first reported in the American literature, since then few reports showing the use of FDFGS for repair of facial contour defects have been published. "Despite these reports, the use of FDFGs for facial reconstruction has not achieved widespread clinical acceptance [7]. Onlay grafts are placed onto the bone surface where the recipient bed may be poorly vascularized cortical bone with a paucity of osteogenic precursors to initiate new bone matrix formation. For this reason, various strategies are available to enhance the wound healing dynamics of onlay grafts. These include the addition of autogenous (platelet products) and/or purified (growth factors) stimulants to healing. The long-term response to the graft will be dependent upon the type of graft employed and importantly the biomechanical constraints of the anatomical placement site. Thus, an onlay graft employed in the reconstruction of the zygoma will need to provide long-term mechanical tissue support [8].

The injectable calcium phosphate cement used for zygomatic deformities correction in various studies, represents another development in bone mineral substitutes, the material which was extensively investigated in animal experiments. It hardens in situ under physiologic conditions into crystalline dahllite, therefore can be adjusted immediately after implantation to fit the defect exactly. The material is designed to replicate the mineral phase of bone including the carbonate content and to be replaced by bone by remodelling that also involves osteoclastic resorption. In certain cases, the material can be implanted for defect filling and bone augmentation just like cancellous chips or cortical blocks from endogenous bone. In a study, the cement hardened consistently within 10 min and could be formed into the desired shape within 2–5 min after

application; additionally, post processing with rotating instruments was possible [9]. But all these alloplastic injectable materials usually get covered by fibrous capsule which holds the graft passively. Hence the material requires further evaluation.

(Medpor) Porous polyethylene is a high density alloplastic implant material used frequently for reconstruction or augmentation in the maxillofacial region; it is nonantigenic, nonallergic, nonresorbable, highly stable and easy to fix. It has a unique pore size distinguishes it from other materials by facilitating the ingrowth of soft tissue, thereby firmly stabilizing this material in position. The use of this material at various locations in the maxillofacial region and the complications, are available in the literature as long term follow up analysis [10].

The overriding consideration in correction of jaw abnormalities is restoration of the premorbid occlusion. When correcting malocclusion that result from malunion, it has been found that resorting to osteotomy designs different from the original fracture pattern yielded a better final result [1]. When a malunited mandibular angle fracture is treated by performing a ramus procedure, some degree of compromise is inherent in the result. If the extent of deformity is mild, no apparent defect is likely to result. More severe deformities may result in significant cosmetic or functional defects if the final position of the ramus is markedly abnormal. In this situation, malposition of the occlusion is corrected at the expense of creating malposition of an adjacent anatomic unit. Correction of a malunion created by a posterior body or angle fracture may result in abnormal medial or posterior rotation of the ramus. For example, as the angle is moved, correcting the open bite, the ramus may protrude posteriorly. This area may be trimmed to prevent impingement upon the pterygo-masseteric sling and unfavourable esthetics. Similarly, correction of malocclusion created by a parasymphysis fracture may result in a midline deviation of the chin. If this appears to occur, strong consideration should be given to correction of the malunion at the site of deformity [11]. The above statements proved to be true in our case. Nonetheless, attempting improvements in severe malocclusion, even if the ideal bite is not achieved, is warranted so as to improve masticatory function and create a better biomechanical environment for the mandible [2]. In our case the orthodontic rehabilitation was not required and satisfactory occlusion was achieved from osteotomy per se.

Conclusion

Meticulous case evaluation with special investigations and appropriate treatment plan are the prime requisites in the management of post-traumatic panfacial residual deformities. Selection of osteotomy techniques and the choice of onlay graft material should be at the discretion of the operating surgeon depending on the case presenting to him. However the ultimate goal is to take care of the patient's concerns and satisfaction.

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