Complex facial trauma with combined surgical and orthodontic rehabilitation

Alexander Ballon¹ ✉ · Ling B² · Lelke A³ · Sader R⁴ · Landes CA⁴

¹ University Medical Centre, Frankfurt

² Office of Orthodontics, Am Sulzheimer Pfad 20

³ Office of Orthodontics

⁴ Dept. of Oral and Maxillofacial, Plastic Facial Surgery

Received: 6 March 2009 / Accepted: 8 June 2009

© Association of Oral and Maxillofacial Surgeons of India 2009

Abstract Severe panfacial trauma require broad reconstructive procedures. As in the case presented, a primary reconstruction with ideal aesthetic outcome cannot be reached in every case. If not, these cases often require further reconstructive procedures. What this can be and how long this could take, this article intends to show. This case report presents the history of a today 30 year old male patient with a severe central midfacial comminuted fracture with preexisting Angle class II and comprehensive reconstruction.

Keywords Trauma · Orthognathic surgery

Address for correspondence:

Alexander Ballon

Dept. of Oral and Maxillofacial and Plastic Facial Surgery
University Medical Centre Frankfurt/Main,
Theodor-Stern-Kai 7
60596 Frankfurt/Main/Germany
Ph: +49-69-6301-4660
E-mail: a.ballon@web.de

Introduction

Severe panfacial fractures caused by trauma are often associated with large soft tissue injuries sometimes with the loss of skin or bone. When the original features can not be effectively restored, patients may suffer from functional, aesthetic and psychological problems or poor social acceptance. Complex dysgnathic malformations require interdisciplinary cooperation between orthodontists and surgeons. The presented case shall illustrate combined traumatological rehabilitation of the osseous viscerocranium and combined therewith orthodontic and surgical treatment for dysgnathia as well as reconstructive surgery of the nose.

Case history

A 30-year-old male patient fell from a scaffold from a height of 3 meters in January 2003 directly onto a vertical metal rod. This rod impacted into the central maxilla and nose in the anterior/posterior direction. The patient was admitted to the ER of the university medical centre while conscious, where he underwent orotracheal intubation due to severe retromaxillary bleeding. He showed extensive injuries of the midface and maxilla. The CT scan showed a combination of frontal bone

fracture, comminuted frontonasal fracture with an impression fracture of the nasal skeleton, the nasoethmoidal region and the anterior frontal sinus wall with considerable fragmental displacement to the left side of the patient. Moreover a sagittal fracture of the maxilla, Le Fort I and II fracture were seen (Figs. 1 and 2). The patient was submitted to immediate open reduction and internal fixation of the fractures and fixation with titanium plate osteosyntheses.

A primary open fracture repositioning and fixation was done including a temporary submandibular intubation as the open osseous fractures were combined with extensive soft tissue trauma. First a wire trauma splint (IMF) stabilized the transversal palatal dimension. Inspection of the head wound included minor extension to Kilian's access. After reconstruction of the anterior frontal sinus wall a silicone tube for drainage was left in situ for 3 months. The nasal reconstruction required repositioning of multiple comminuted minute bone fragments. A primary plastic reconstruction of the nasal skeleton was done after repositioning of the zygomatic bone by transbuccal pulling of a pointed hook. The nasal reconstruction included reinsertion of the anterior nasal spine, adaptation of the lateral cartilage wings and finally the septum was re-erected and stabilized by two silicone splints.

Next the definite reconstruction of the Le Fort I and the sagittal maxillary fracture was performed intraorally by open reduction and plate fixation with titanium miniplates (Normed®, Tuttlingen, Germany).

Due to the massive comminution, a traumatic saddle nose and traumatic telecanthus resulted, which required later correction after the orthodontic treatment which shall first provide a solid dental and osseous basis.

It became evident in the primary operation that the patient had furthermore suffered from severe malocclusion, Angle class II, 1 with a retrognathia of the mandible, a skeletal deep configuration as well as a transversal narrow maxilla and mandible [1] before the accident. The disharmony of the basal structures was combined with narrow dental arches and incisors were strongly protruded.

Orthodontic treatment was begun to enable a surgically assisted sagittal widening of the maxilla and symphyseal distraction in November 2003 (Figs. 10 and 11). In the same operation the maxillary titanium miniplates were removed and all wisdom teeth osteotomized. Tooth borne distraction devices were fabricated by the treating orthodontist. Both screws permitted a maximum widening of 11 mm which was needed fully in the upper arch. In the lower dentition a widening of 8 mm proved to be sufficient.

The maxillary distraction procedure was performed by subtotal Le Fort I osteotomy, the mandibular with a median symphyseal split (Fig. 11).

In March 2004 both distractors were removed and removable retainers were given since the inflammation of the gingiva did not allow the immediate bonding of a fixed appliance. Treatment was continued in May 2004 with fixed appliances (Figs. 12 and 13).

Consecutively the patient underwent a bimaxillary procedure with setback and impaction of the maxilla and mandibular advancement and clockwise rotation in March 2005. At that moment the orthodontic treatment was in the state of contraction and the teeth in full movement.

Until October 2005 the orthodontic treatment was completed. The final morphological and functional result was satisfying for the patient (Figs. 14–16).

Osseous structures of the nose were intentionally reconstructed within the initial operation. However the cartilage deficit resulted to be too severe for sufficient primary reconstruction. Even after completed orthodontic and orthognathic surgical treatment, widespread soft tissue injuries with significant loss of nasal cartilage had finally resulted in a traumatic saddle nose with insufficient nasal dorsum and alar cartilage projection. Breathing was also impaired due to collapse of the right ala in forced inspiration. For reconstruction within open rhinoplasty approach, a columellar strut was harvested from the septum which was itself corrected and straightened. The strut was introduced in-between the alar median crura and fixated by PDS sutures. Autologous cartilage graft harvested from costal cartilage was transplanted to the nasal dorsum in a soft tissue pocket and fixated by PDS sutures. The right alar cartilage was reinforced by transplanted septal cartilage to the alar circumference. Bilateral infrafractures narrowed the nasal pyramid, the columellar flap was repositioned. Silicone splints for 5 days and a nasal splint for 7 days and 7 more nights stabilized the result.

A follow-up documentation was done in December 2006 (Figs. 17–19). The occlusion had settled well, except for small rotations between frontal teeth. The class one intercuspitation remained stable. Now two Hawley retainers were handed out for wearing at night. Extraoral and intraoral the patient was fully satisfied with the result.

Fig. 1 3-D reconstruction of the computed tomography on arrival in the ER after orotracheal intubation. It shows a comminuted midfacial and nasoethmoidal fracture with considerable lateral displacement of the left midface.

Fig. 2 Shows the concomitant soft tissue destruction. The lip, nose, especially the alar cartilages, left dorsum and left canthus, eyelid and lateral forehead are disrupted; the face is asymmetric due to the displacement of the left midface from the zygomatic bone down to the maxillary tooth arch.

Fig. 3 and 4 Frontal and lateral photograph 3 months after the trauma. In spite of open repositioning and fixation of the left midface, some facial asymmetry persisted. The patient has a saddle nose and an exaggerated sublabial fold, resulting from narrow upper and lower tooth arches, strongly protruded incisors, a deep bite and severe class II occlusion.

Fig. 5 Shows the deep bite and the sagittal compression in maxilla and mandible.

Fig. 6 shows the overjet of 13.5mm and 7.3mm vertical overbite the lower incisors being 4mm in supraocclusion.

Discussion

Laine et al. [2] state, that emergency situations may lead to poor preoperative imaging and inadequate treatment planning. On the other hand, a delayed

operation may increase infectious risk, non-union and possibly malocclusion [3] and often yield disappointing results [4,5]. The treatment planning in emergency reconstruction surely is not on the scale of a planned operation but in cases of

Fig. 7 to 9 Lateral cephalogram, Water's projection and dental tomogram after primary open reduction and internal fixation. Water's projection was taken immediately after primary surgery, lateral cephalogram and dental tomogram within follow up a few months later. The titanium miniplates can be seen as well as the displaced wisdom teeth. The class II malocclusion with protruded upper maxillary front teeth, crowding and retrognathia of the mandible are obvious.

Fig. 10 and 11 Intraoral view after maxillary and mandibular distraction and initiated orthodontic treatment.

Fig. 12 and 13 Frontal photograph and intraoral view after orthodontic alignment of the dental arches. The deep bite is still obvious, whereas teeth arches are harmonized and the patient can now undergo orthognathic surgery.

severe facial injuries, an experienced surgeon should be able to reach an acceptable result yet with the drawbacks of difficult nasal and nasoethmoidal reconstruction and sometimes suboptimal aesthetic result [6].

In modern ER management, all patients receive full trauma-scans which include computed cranial-, facial-, cervical-, thoracic- and abdominal tomography. That CT-scan is normally of comparable quality to elective examinations so that the surgical

outcome is mostly not influenced by the radiographic imaging. A delay of some days is required for initial stabilization of vital functions as respiration in thoracic trauma. This does not increase the risk of malocclusion or non-union. This could only occur when patients are delayed for weeks because of unstable vital function under intensive care and eg. major immobilization in cervical spine injuries.

In any case, soft tissue reconstruction should be accomplished before a significant

memory (internal scarring) is developed [7] and was therefore performed immediately within the primary operation.

The complication rate after immediate reconstruction of the frontal sinus as performed in our case was studied by Gabrielli et al. [8]. The authors reported that a primary reconstruction should take place if there is no extensive comminution or dislocation and the frontonasal duct is intact. In the present case, the sinuses were not severely fractured so that a primary reconstruction was performed. A sinus drainage tube as performed in this case is also recommended in dorsal wall fractures if the dura mater is intact and also if the posterior sinus wall is not fractured without evidence of a higher complication rate [9,10]. The upper face reconstruction follows the patterns given by Manson et al. [7]. Although Manson et al. [7] describe lateral orbital alignment to be the best guide for zygomatic reconstruction it has not been done in this case. The surgeon considered fixation of the zygomatic bone at the arch and the zygomaticoalveolar crest stable enough, and not needing additional fixation at the laterosupraorbital suture. This moreover avoided another scar in an esthetically important region.

Manson et al. [10], Kelly et al. [11] and Becelli et al. [12] likewise reported their experience based on the right placing of the zygomatic arch as the key for midface reconstruction.

In comminuted midfacial fractures including the palate, the fractured segments should be linked mainly from fractured segment to fractured segment and finally to a non-fractured landmark [7].

Fig. 14 to 16 Frontal and lateral photograph, lateral cephalogram at the end of the combined orthodontic and orthognathic surgery treatment. The inferior face profile has improved; the sublabial fold and convex profile are adequately harmonized. In the lateral cephalogram shows good intermaxillary relations, the overbite and overjet are regular. The wisdom teeth and some titanium osteosyntheses have been removed. The intraoral view shows a regular denticulation with a good midline profile.

Fig. 17 to 19 Frontal and lateral photograph and dental view at 1 year follow-up after the end of the treatment. The orthodontics are finished, the saddle nose is reconstructed.

In this case the mandible was not fractured in any way. Intermaxillary linking was therefore performed using intraoperative wire fixation (IMF) after transversal maxillary stabilization by palatal splinting.

Due to the displacement of the inner angle of the left eye, the patient sustained a telecanthus. Although the osseous base had been reconstructed primarily and the inner tendon was fixed to the canthus, a telecanthus resulted from osseous displacement. A corrective operation was omitted because the patient was satisfied and further improvement was not certain.

In the presented case a pretraumatic dysgnathia was aggravated from the traumatic maxillary dislocation. The Angle class II, 1 with deep bite, transversal compression and crowding was now severe.

Two problems remained to be solved: Firstly there was the lack of space. Because of multiple crown breakage an extraction of four premolars and thus, further teeth loss should be avoided. Even though the widening of 11 mm in the maxilla and 8 mm in the mandible was risky because both jaws

were further weakened, this way was chosen.

Secondly there was the sagittal and vertical disharmony of the skeletal base.

In patients with a Le Fort I fracture, the maxilla is often displaced posterior and impacted, resulting in an open bite after intermaxillary fixation [7]. In our case no open bite but a deep bite was present. It could though be assumed that the maxilla therefore was in the same position as it had been before [7].

One possibility would have been to correct the orthognathic problems in the same operation, when the midfacial open reduction internal fixation was done. However exact adjustment is not possible and orthodontic pre-treatment not given. Another problem is the lack of informed consent by the patient. If the patient is not informed about the elective orthognathic treatment, legal consequences could follow.

In this case a single jaw surgery for solving the severe Angle class II was considered to be unstable and aesthetically ineffective for an orthognathic and aesthetically harmonious result.

A bimaxillary procedure was therefore chosen in this case with a severe Class II malocclusion in combination with skeletal open bite and obstructive sleep apnoe [14].

The bimaxillary procedure was performed before the presurgical orthodontic treatment was finished. The still enlarged overjet allowed an overcorrection of the sagittal positioning of both jaws and thus a later stable neutral position of the jaws and a class I occlusion was possible.

In the author's experience, transversal correction, followed 6 to 12 months later by sagittal correction in these outstanding cases has been the most reliable form of correction. The sagittal correction can be safely performed using resorbable up-to-date osteofixation [15,16].

The osteotomy of the wisdom teeth was both an orthodontic and a prophylactic decision.

At last the nasal reconstruction took place towards the end of the orthognathic therapy because the projection outcome after sagittal widening and bimaxillary surgery is not predictable and therefore the

nasal correction should ideally take place at the end of the orthognathic treatment.

It is a known problem that the correction of late deformities such as a shortened saddle nose put high demands on the plastic surgeon [17,18]. Certainly this patient was patient enough to have a stage-by stage reconstruction and his personality as social framework supported well the necessary measures eg. guided occlusion, hospitalization.

Conclusion

Complicated staged reconstruction is possible and most satisfying for the patient and the surgeon if surgical interdisciplinary management and expertise are joined with realistic expectations and a high level of compliance on the patient's side.

References

1. Segner D, Hasund A (1988) Individualisierte Kephallometrie.
2. Laine P, Kontio R, Salo A, Mesimäki K, Lindqvist C, Suuronen R (2004) Secondary correction of malocclusion after treatment of maxillofacial trauma. *J Oral Maxillofac Surg* 62(10):1312–1320
3. Press BH, Boies LR Jr, Shons AR (1983) Facial fractures in trauma victims: the influence of treatment delay on ultimate outcome. *Ann Plast Surg* 11(2): 121–124
4. Kawamoto HK Jr (1982) Late posttraumatic enophthalmos: a correctable deformity? *Plast Reconstr Surg* 69(3): 423–432
5. Tessier P (1986) Complications of facial trauma: principles of late reconstruction. *Ann Plast Surg* 17(5): 411–420
6. Becelli R, Renzi G, Perugini M, Iannetti G (2000) Craniofacial traumas: immediate and delayed treatment. *J Craniofac Surg* 11(3): 265–269
7. Manson PN, Clark N, Robertson B, Slezak S, Wheatly M, Vander Kolk C, Hiff N (1998) Subunit principles in midface fractures: the importance of sagittal buttresses, soft-tissue reductions, and sequencing treatment of segmental fractures. *Plast Reconstr Surg* 103(4): 1287–1306
8. Gabrielli MF, Gabrielli MA, Hochuli-Vieira E, Pereira-Fillho VA (2004) Immediate reconstruction of frontal sinus fractures: review of 26 cases. *J Oral Maxillofac Surg* 62(5): 582–586
9. Gerbino G, Rocca F, Benech A, Caldarelli C (2000) Analysis of 158 frontal sinus fractures: current surgical management and complications. *J Craniomaxillofac Surg* 28(3): 133–139
10. Manson PN, Hoopes JE, Su CT (1980) Structural pillars of the facial skeleton: an approach to the management of Le Fort fractures. *Plast Reconstr Surg* 66(1): 54–62
11. Kelly KJ, Manson PN, Vander Kolk CA, Markowitz BL, Dunham CM, Rumley TO, Crawley WA (1990) Sequencing Le Fort fracture treatment (Organization of treatment for a panfacial fracture). *J Craniofac Surg* 1(4): 168–178
12. Becelli R, Carboni A, Gasparini G (1998) The importance of the correct restoration of the transverse dimension in midfacial fractures. *Minerva Stomatol* 47(9): 443–446
13. Thilander B, Ronning O (1985) Introduction to orthodontics. Congress Stockholm
14. Hamada T, Ono T, Otsuka R, Honda E, Harada K, Kurabayashi T, Ohyama K (2007) Mandibula distraction osteogenesis in a skeletal Class II patient with obstructive sleep apnea. *Am J Orthod Dentofacial Orthop* 131(3): 415–425
15. Landes CA, Ballon A (2006) Skeletal stability in bimaxillary orthognathic surgery: P(L/DL) LA-resorbable versus titanium osteofixation. *Plast Reconstr Surg* 118(3): 703–721
16. Landes CA, Ballon A (2006) Five-year experience comparing resorbable to titanium miniplate osteosynthesis in cleft lip and palate orthognathic surgery. *Cleft Palate Craniofac J* 43(1): 67–74
17. Converse JM, Smith B (1963) Naso-orbital fractures. *Trans Am Acad Ophthalmol Otolaryngol* 67: 622–634
18. Converse JM, Smith B (1966) Naso-orbital fractures and traumatic deformities of the medial canthus. *Plast Reconstr Surg* 38(2): 147–162

Source of Support: Nil, **Conflict of interest:** None declared.