Application Of Plates And Screws In Reconstruction Of Multiple Maxillofacial Fractures

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Abstract

The maxillofacial region is vulnerable to an injury and account for a significant proportion of visits to emergency departments. Road traffic accident, especially motor vehicle accident still remains the commonest cause of these injuries. Maxillofacial fractures are diagnosed clinically and confirmed radiologically. The treatment choices of maxillofacial fractures include observation, closed reduction and open reduction with internal fixation. In general, any displaced fracture should be treated by open reduction which can be accomplished via sublabial and/or transconjunctival approach depending on the extent of fractures.

A case of multiple maxillofacial fractures was reported in a 19-years old man and have been done reconstruction of fractures by open reduction via sublabial approach and internal fixation with plates and screws application.

Key words: Maxillofacial fractures, open reduction, sublabial approach, internal fixation, plates and screws

Abstrak

Regio maksilofasial rentan untuk terjadinya suatu trauma dan bertanggung jawab terhadap jumlah yang signifikan untuk kunjungan ke unit gawat darurat. Kecelakaan lalu lintas, khususnya kecelakaan sepeda motor masih merupakan penyebab terbanyak untuk trauma ini. Fraktur maksilofasial didiagnosis secara klinis dan dikonfirmasi dengan pemeriksaan radiologi. Pilihan terapi untuk fraktur maksilofasial meliputi observasi, reduksi tertutup dan reduksi terbuka dengan fiksasi interna. Pada umumnya, semua fraktur yang mengalami pergeseran sebaiknya ditatalaksana dengan reduksi terbuka yang dapat dilakukan melalui pendekatan sublabial dan/atau transkonjungtiva berdasarkan perluasan fraktur.

Satu kasus fraktur maksilofasial multipel dilaporkan pada pasien laki-laki usia 19 tahun dan telah dilakukan tindakan rekonstruksi fraktur dengan reduksi terbuka melalui pendekatan sublabial dan fiksasi interna dengan menggunakan lempeng dan sekrup.

Kata Kunci: *Fraktur maksilofasial, reduksi terbuka, pendekatan sublabial, fiksasi interna, lempeng dan sekrup*

INTRODUCTION

The maxillofacial region are commonly fractured due to its prominent position and are often encountered in the practice of emergency medicine which are associated with high morbidity resulting from increased costs of care and varying degrees of physical, functional and cosmetic disfigurement.[1,2]

The absolute rate of maxillofacial fractures among young males due to motor vehicle accidents still remains high. In light of this, prevention programmes that target high-risk groups would have the potential to produce the greatest public health gain.[3]

The French anatomist René Le Fort (1901) classified experimentally induced midface fractures in human cadavers and described them into Le Fort I, II and III.[4,5]

Internal fixation using plates and screws has been used in the facial region since late 19th century. Nowadays, these devices form an important part in the management of facial bone trauma and maxillofacial reconstructive surgery.[6,7]

CASE REPORT

A 19-years old man presented to Emergency Department Dr. M. Djamil Hospital on July 31st 2011 with bleeding from the nose since 2 hours before admission. Previously, the patient was driving a motorcycle in high velocity and suddenly had a road traffic accident with other motorcycle but the exact trauma mechanism was unknown. He had no loss of consciousness and was alert and oriented on admission. At Emergency Department, bleeding from the nose had been stopped and there was no bleeding from the mouth and the ear.

The patient complained pain and swelling on his face, especially on the nose and the left cheek. There were bruising on both eyes, but he had no impairment in vision. There was no pain and difficulty in opening the mouth. However, he reported a slight disturbance in chewing. There was no disturbance in swallowing, breathing and hearing. The patient had no history of previous head and facial trauma.

From the examination found the general condition was moderately ill with the Glasgow Coma Scale (GCS) 15. There was no abnormality on ear examination. Nasal examination revealed deformity and edema on the nasal dorsum with crepitation and

tenderness on palpation. Intranasal examination revealed inferior and medial turbinate eutrophy, no septal deviation and hematoma, no active bleeding and cerebrospinal fluid rhinorrhea. Intraoral examination revealed malocclusion, no trismus, no dental and palatal fractures. Throat examination revealed no abnormality. Facial examination revealed midfacial edema and bilateral periorbital ecchymosis (Figure 1) with crepitation and tenderness on palpation especially on the left maxillary region. There was an abnormal maxillary mobility at the left Le Fort II level. There was a 3 cm laceration on the left superior palpebra and was sutured by Ophthalmologist. Eye examination revealed bleeding on both conjunctivas. The detailed result was seen in table 1.

Figure 1. Pictures of patient's face after the accident, in anterior (**A**), right (**B**), right- oblique (**C**), basal (**D**), left (**E**), and left-oblique (**F**) views

Computed tomography (CT) scanning with three-dimensional (3D) reconstructions of paranasal sinus examination showed multiple fracture lines on nasal bone, right and left maxillary bone, left orbital floor and left zygomatic bone (Figure 2). There were air fluid levels at maxillary, ethmoid and frontal sinuses. From this result, it concluded a compound of right Le Fort I maxillary fracture, left Le Fort II maxillary fracture and left zygomatic fracture and hematosinuses.

Table 1. Physical examination of the eye

	Right Ocular	**Left Ocular**
Visual acuity	5/5	5/5
Palpebra	Hematoma (+)	Hematoma (+), laceration (+)
Conjunctiva	Bleeding (+)	Bleeding (+)
Cornea	Transparent	transparent
Anterior chamber of eye	Rather deep	Rather deep
Iris	Brown, rugae (+)	Brown, rugae (+)
Pupil	Round, reflex (+), Ø 2-3 mm	Round, reflex (+), Ø 2-3 mm
Lens	Transparent	Transparent

Intraocular Pressure	Normal	Normal
Funduscopy	Normal	Normal
Position	Ortho	Ortho
Movement	Free	Free

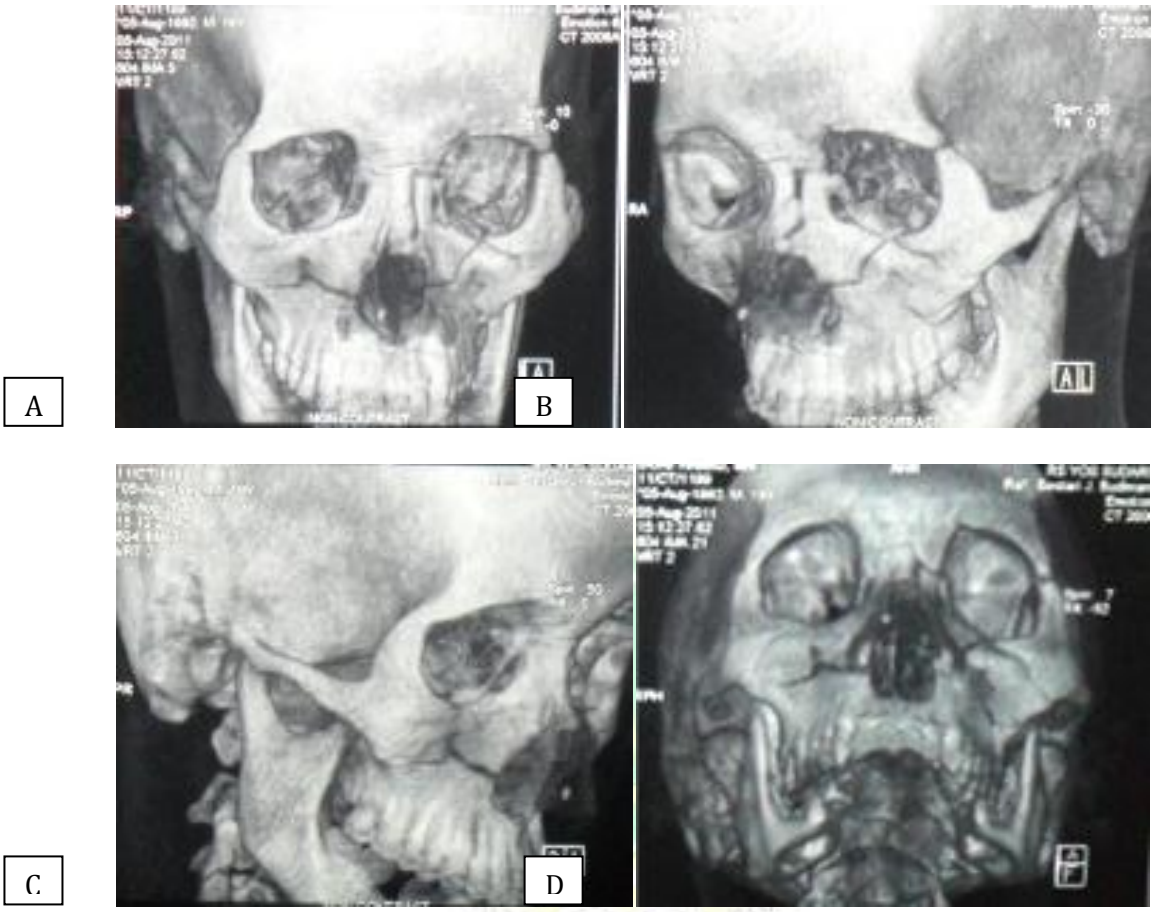

Figure 2. Computed tomography (CT) scanning with 3D reconstruction of paranasal sinus in anterior (**A**), left oblique (**B**), right oblique (**C**) and basal (**D**) directions

The patient was diagnosed as a compound of right Le Fort I maxillary fracture, left Le Fort II maxillary fractures and left zygomatic fracture with hematosinuses. The patient was planned to closed nasal bone reposition and open reduction with internal fixation using mini plates and screws on the left maxillary bone. The right Le Fort I maxillary fracture and the left zygomatic fracture were considered as stable fractures and no surgical intervention required.

The patient was given therapy ceftriaxone injection 1 gram twice daily, dexamethasone injection 0.5 mg 3 times daily, ibuprofen tablet 400 mg 3 times daily, pseudoephedrine HCl capsule 120 mg twice daily, ambroxol HCl tablet 30 mg 3 times daily.

Ophthalmology Department diagnosed the patient as subconjunctival bleeding on both eyes and treated the patient with topical eye antibiotic (chloramphenicol 1%, polymyxin B sulphate 5,000 IU) twice daily and topical eye antibiotic combined with steroid (neomycin sulphate 3,500 IU, polymyxin B sulphate 6,000 IU, dexamethasone 0.1%) six times daily and no specific surgical intervention needed.

Laboratory examination was performed as preoperative preparation and the result was within normal limit (haemoglobin 12.4 g/dL, leukocytes 9,100/mm^3, thrombocytes 213,000/mm^3, haematocrit 37%, prothrombin time 12.4 seconds, activated partial thromboplastin time 30.8 seconds).

After one week given antibiotic and steroid therapy, the facial edema was diminished (figure 3). At August 8th 2011, the closed nasal bone reposition and open reduction and internal fixation with mini plates and

screws application was performed. The operation was started with patient laid down on operating table and was performed aseptic and antiseptic procedures in operating field. Oral packing was applied. Evaluation with scope 0^0 to both nasal cavities was performed and shown the nasal cavity was wide, inferior and middle turbinate eutrophy, no nasal deviation and hematoma. With Boies elevator, the fractured nasal bone which aligned to the right was repositioned. Elevator was inserted into the nostril deeply to displaced fracture. The blade of the elevator opposed the thumb on the outside of the nose, and then gently attempted to raise the misaligned bones to the proper alignment. Bleeding in the nasal cavity was controlled by roll tampon.

Figure 3. Pictures of patient's face after one week antibiotic and steroid therapy, in anterior (**A**), right (**B**), right- oblique (**C**), basal (**D**), left (**E**), and left-oblique (**F**) views

For access to the left maxillary bone, incision with a sublabial approach was performed. Submucosal infiltration with adrenalin 1:200,000 was performed to reduce the amount of hemorrhage during incision and dissection. Incision was placed approximately 5 mm superior to the gingivobuccal junction along 5 cm without through the middle line of oral mucosa. Incision was made through the mucosa, submucosa, facial muscle and periosteum until reach the bone structure. The mucosa was retracted during incision. With periosteal elevator, the tissue in the subperiosteal plane was elevated and dissected superiorly to the infraorbital rim. The two fractures lines at maxillary wall was seen which was arise from orbital floor extend medially to the piriform aperture and laterally to the zygomatic bone. The fractured bones were reduction by a hook. Infraorbital nerve bundles were intact and preserved.

Plate with 4 holes was applied to the medial fracture bone and plate with 3 holes was applied to the lateral one. Drilling the two holes adjacent to the fracture line with drill corresponding to the core diameter of the screw. Thereafter, placement of the screws was performed. Sublabial incision was closured by subcuticular suture with 3-0 chromic catgut. Nasal packing was performed in both nasal cavities. Nasal gypsum was placed in nasal dorsum and fixated. Oral packing was removed and operation had been finished.

After operation, the patient was given therapy ceftriaxone injection 1 gram twice daily, dexamethasone injection 0.5 mg 3 times daily, ibuprofen tablet 400 mg 3 times daily, pseudoephedrine HCl capsule 120 mg twice daily, ambroxol HCl tablet 30 mg 3 times daily and educated to compress the left cheek and lip with ice for 1 day and warm compress for 2 days later. The patient was suggested to eat a soft meal. Paranasal sinus X-ray examination in Waters' view was performed on the next day and shown two mini plates in good position along the fracture lines at the left maxillary anterior wall and found hematosinuses in both maxillary sinuses (Figure 4).

On the next three days, nasal packing was removed and from evaluation found no active bleeding and no bone segment that fallen to the nasal cavity. Intraoral examination revealed slight malocclusion and incision wound in the left sublabial region was rather good and no sign of infection.

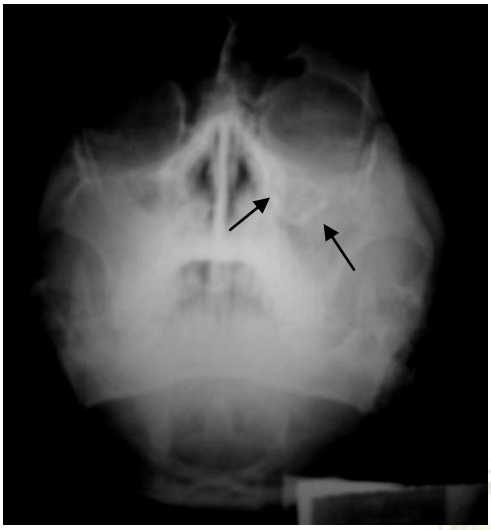

Figure 4. Paranasal sinus X-ray in Waters' view. *Arrow heads* indicate mini plates position on the left maxillary bone.

The patient was diagnosed as post closed nasal bone reposition and open reduction with internal fixation using mini plates and screws on the left maxillary bone as indication of left Le Fort II maxillary fracture, stable right Le Fort I maxillary fracture and left zygomatic fractures with hematosinuses. The patient was allowed to go home and given therapy cefixime tablet 100 mg twice daily, methylprednisolone tablet 4 mg 3 times daily, ibuprofen tablet 400 mg 3 times daily, pseudoephedrine HCl capsule 120 mg twice daily and ambroxol HCl tablet 30 mg 3 times daily. The patient was suggested to exercise mastication function by chewing more often at home and remain on a soft diet.

Two weeks after operation, the patient controlled to ENT-HNS outpatient clinic. Rhinorrhea, pain and numbness on the left cheek and lip was not complained by the patient. Ear and nasal examination revealed no abnormality. Intraoral examination revealed no malocclusion and incision wound in the left sublabial region was good and no sign of infection. The nasal gypsum was released and found the nasal bone was in a good alignment and no deformity in the left maxillary region. Bilateral periorbital ecchymosis and subconjunctival bleeding was diminished (Figure 5).

Figure 5. The pictures of patient two weeks after nasal bone reposition and open reduction with internal fixation using mini plates and screws on the left maxillary bone, in anterior (**A**), right (**B**), right- oblique (**C**), basal (**D**), left (**E**), and left-oblique (**F**) views

The patient was diagnosed as post closed nasal bone reposition and open reduction with internal fixation using mini plates and screws on the left maxillary bone as indication of left Le Fort II maxillary fracture, stable right Le Fort I maxillary and left zygomatic fracture with hematosinuses. The patient was given therapy cefixime tablet 100 mg twice daily, methylprednisolone tablet 4 mg 3 times daily, pseudoephedrine HCl capsule 120 mg twice daily, ambroxol HCl tablet 30 mg 3 times daily.

From Ophthalmology Department, the patient was diagnosed as bilateral subconjunctival bleeding in recovery and given the therapy topical eye antibiotic (chloramphenicol 1%, polymyxin B sulphate 5,000 IU) twice daily and topical eye antibiotic combined with steroid (neomycin sulphate 3,500 IU, polymyxin B sulphate 6,000 IU, dexamethasone 0.1%) 6 times daily.

Three weeks after operation, the patient complained of weakness in the left facial. No other complaint was reported by the patient. Ear, nasal and intraoral examination revealed no abnormality. Maxillofacial examination revealed no deformity and sign of infection at the site of mini plates. Facial nerve examination revealed peripheral paralysis of left facial nerve with good motoric function was 88% at level of stylomastoid foramen (House-Brackmann II).

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The patient was given therapy cefixime tablet 100 mg twice daily, methylprednisolone tablet 4 mg 3 times daily, pseudoephedrine HCl capsule 120 mg twice daily, ambroxol HCl tablet 30 mg 3 times daily, methylcobalamin capsule 500 mcg 3 times daily and neurotrophic vitamin tablet twice daily.

One month after operation, there was improvement in facial weakness. No other complaint was reported by the patient. Ear, nasal and intraoral examination revealed no abnormality. Facial nerve examination revealed peripheral paralysis of left facial nerve with good motoric function was 90% at level of stylomastoid foramen (House-Brackmann II).

The patient was diagnosed as post closed nasal bone reposition and open reduction with internal fixation using mini plates and screws on the left maxillary bone as indication of left Le Fort II maxillary fracture, stable right Le Fort I maxillary and left zygomatic fracture with hematosinuses and left peripheral facial nerve paralysis with good motoric function was 90% at level of stylomastoid foramen (House-Brackmann II). The therapy was continued.

Three months after operation, the patient had no complaint. There was no facial weakness anymore. Ear, nasal and intraoral examination revealed no abnormality. Facial nerve examination revealed no paralysis of facial nerve. The patient was planned to radiological examination and suggested to control three months later.

DISCUSSION

The maxillofacial region occupies the most prominent position in the human body and rendering it vulnerable to injuries quite commonly. In United State, there were more than 28 million injury-related visits to emergency departments and facial trauma account for a significant proportion of these visits. [2]

The incidence of maxillofacial fractures varies with geographic region, socioeconomic status and culture.[2,8] Maxillofacial fractures are commonly caused by road traffic accident, assaults, sports, industrial accidents and warfare.[1,2,3,8] Road traffic accident, especially motor vehicle accident still remains the commonest cause of these injuries (87%), followed by interpersonal violence (6%), fall and industrial injuries (4%) and sport injuries (3%). The highest numbers of injuries were observed in the second and third decades of life, the mean age being 24.3 years. The male to female ratio was 21.2:1.[1] In the present case, a 19-years old male patient was presented with multiple maxillofacial fractures caused by motor vehicle accident.

The classification of maxillofacial fractures include nasal fracture, naso-orbital-ethmoid (NOE) fracture, zygomatic complex fracture, frontal bone fracture, orbital fracture, maxillary fracture and mandibular fracture.[9,10] The location and pattern of the fractures are determined by the mechanism of injury, magnitude and the direction of impact force.[1,2]

At 1901, Le Fort was first to document a tendency for spesific fracture pattern of the midface. Le Fort described three zones of transverse weakness in the midfacial skeleton that classified into Le Fort I, II and III (Figure 6). But majority of maxillary fractures are seldom isolated and are usually comminuted, involved numerous combinations of Le Fort-type fractures.[4,11]

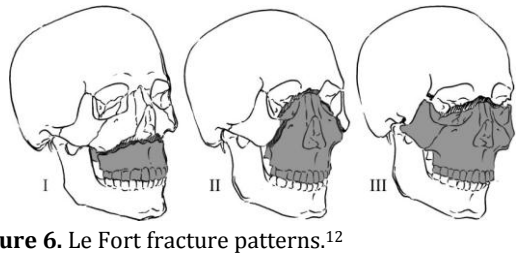

Figure 6. Le Fort fracture patterns.[12]

Le Fort I fracture is a horizontal fracture pattern that extends in a transmaxillary direction at the level of the piriform margin. This fracture separates the lower alveolar and palatal regions from the upper maxilla. Le Fort II fracture is a pyramidal or subzygomatic fratures that produce dissociation of the central midface from the orbitozygomatic complex that transverse through the orbital floor and nasal bones. Le Fort III fracture which also termed as "craniofacial disjunction" is a fracture that produces separation through the frontozygomatic suture and nasofrontal junction. The fracture line involves the lateral orbit, midface and medial orbit including the nasoethmoid complex and anterior skull base.[5,11]

In road traffic accident, the commonest fracture site was mandible (52%) and zygomatic complex (23.5%). Panfacial fractures were observed in 4.7% cases, involving the upper, middle and lower third of the facial skeleton. Maxillary fracture was seen in 11.2% cases in the form of Le Fort I in 6.2%, Le Fort II in 2.1% and Le Fort III in 3.2% cases. Frontal bone was involved in 8.9% cases. Orbital fractures (pure blow-out) occurred in 0.7% cases and impure blow-out with naso-orbito-ethmoid (NOE) complex in 0.7% cases.[1] In this case, the patient had suffered a compound of right Le Fort I maxillary fracture, left Le Fort II maxillary fracture and left zygomatic fracture.

Maxillary fractures are usually diagnosed clinically and confirmed radiologically. The suggestive clinical signs of a maxillary fractures include epistaxis, infraorbital ecchymosis or edema, maxillary swelling, increased vertical facial height ("equine facies") or increased facial width with a loss of anterior projection ("dishpan facies"). Malocclusion, maxillary bone instability and dental fractures are usually determined by palpation orally.[5,10,11,13] The presence of cerebrospinal fluid (CSF) leakage have to determined clinically by examining the straw-colored nasal drainage for the presence of glucose or a positive halo sign.[11] In this patient was found epistaxis, periorbital ecchymosis, bilateral midfacial swelling with abnormal maxillary mobility in the left Le Fort II level, and malocclusion. There was no dental and palatal fracture and evidence of CSF leakage neither from the nose and the ear.

Basic ophthalmologic evaluation should precede operative management. A minimal preoperative examination includes testing of visual acuity (subjective and objective in both eyes), visual field, pupillary function, ocular motility and intraocular pressure; inspection of the anterior chamber for hyphema; and visualization of the fundus for gross disruption.[8,13] In this patient, ophthalmologic examination revealed subconjunctival bleeding and other results were within normal limit.

In patient with maxillofacial fractures, conventional radiographs play a decreasing role in the diagnostic work-up of the location and extent of fractures.[14] Computed tomography scanning are the gold standard for imaging maxillofacial fractures.[15] Evaluation of a patient with these fractures has been greatly improved by the use of high-resolution CT.[8] In this case, the patient had performed CT scanning with 3-dimensional reconstruction of paranasal sinus and revealed fracture lines at nasal bone, both of maxillary bones and the left zygomatic bone. These radiological findings demonstrated a combination of right Le Fort I fracture, left Le Fort II fracture and left zygomatic fracture.

The management of maxillofacial fractures aim to restore preinjury facial appearance and achieve an anatomical correct reposition.[5,11] The treatment decisions of maxillary fracture include observation, closed reduction and open reduction with internal fixation. Observational treatment was indicated in nondisplaced stable fractures and general condition of the patient not allowing for surgical intervention. Ideally, any displaced fracture should be treated by open reduction and internal fixation.[16] The number of approaches depend on the extent of dislocation, comminution and the degree of stability following reduction based on clinical evaluation and CT scan findings.[5,11,16] In this patient, there were stable fractures of right maxillary and left zygomatic bone so that no treatment required. However, in the left maxillary bone there were multiple and displaced fractures that need an open reduction and the fractured nasal bone need a closed reposition.

During reconstruction of the midfacial fractures, it is very important to know about the various thicknesses lines of the maxillary bone which are known as facial buttresses.[11,17] The facial buttresses consists of vertical and horizontal buttresses (Figure 7).[8,9]

The connecting pieces, like pins, screws or wires have to apply to the thicker region of the bone for obtaining a secure and rigid bony structure and the diameters and lengths of the screws should be appropriate to bone thickness to ensure maximal support and subsequent primary healing (Figure 8).[11,16,17]

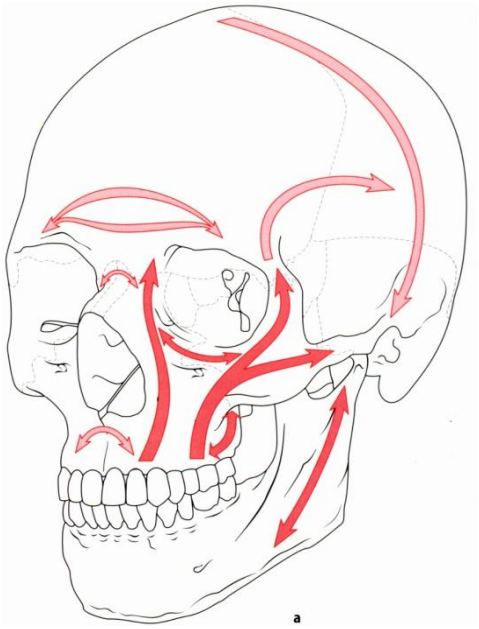

Figure 7. Diagram of maxillary buttresses[9]

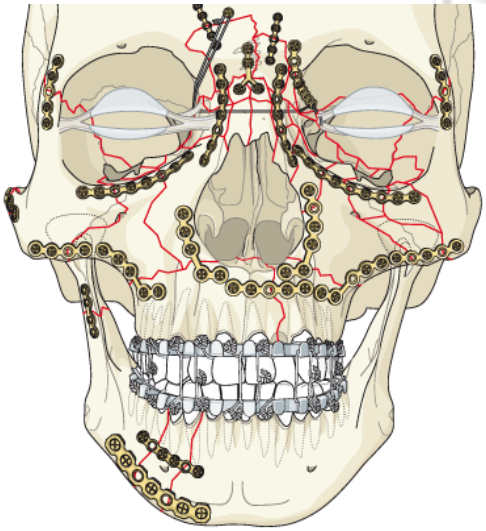

Figure 8. Fixation of facial fractures[16]

The procedures of reconstruction are delayed for 5 to 7 days to allow resolution of facial soft tissue edema. Preoperative and intra operative administration of steroids can reduce the progression of swelling during surgery and facilitate evaluation of reduction and application of fixation.[8] Perioperative prophylactic antibiotic coverage should be used in patients with maxillofacial fractures.[5,9] The repair is not delayed for more than 10 days to prevent facial soft tissues cicatricial contraction.[8] Extended delays in reconstruction may result in premature bone fusion that can make fracture reduction very difficult and may even necessitate the use of formal osteotomies to restore normal anatomy and ultimately can lead to adverse long-term result.[11] In this patient, reconstruction was performed after 1 week given antibiotic and steroid therapy and facial soft tissue edema was diminished.

The earlier techniques of closed reduction alone led to frequent complications including lack of midface projection and loss of vertical height. As a result, extended open reduction techniques were developed initially using wire and subsequently mini plate fixation of the maxillary buttress system. Open reduction and internal fixation of these fractures was chosen for its obvious advantages of direct anatomical reduction, early return to function and minimal complication.[1,5,11] It is important to visualize all fractures first before any fractures are stabilized. In severely comminuted fracture situations, a preliminary approximation may be performed with wire before definite fixation with plates and screws is undertaken.[9]

Open reduction and internal fixation of maxillary fractures are usually accomplished via an intraoral sublabial approach with gingivobuccal incisions placed unilaterally or bilaterally, depending on the extent of fractures requiring subperiosteal exposure and reduction. This approach allows subperiosteal access to the nasomaxillary and zygomaticomaxillary buttresses extending superiorly to the level of the infraorbital rims. This approach can be combined with various other methods including a transconjunctival or mid-lower eyelid approach to the orbital floor and rim. Both of these approaches are preferable to a subciliary incision.[5,11] In this patient, open reduction was carried out via sublabial approach with gingivobuccal incisions unilaterally to access the nasomaxillary and zygomaticomaxillary buttresses.

Implant material that used for maxillofacial fractures fixation are stainless steel, titanium and biodegradable polymeric materials. Stainless steel material consists of iron (62.5%), chromium (17.6%), nickle (14.5%) and molybdenum (2.8%). Corrosion resistance and compability are fair and can provoke toxic or allergic reaction. Titanium consists of titanium and oxygen. This material has a high corrosion resistance and biocompatible and minimal toxic nor allergic reaction. Biodegradable polymeric materials consist of 82% polylactic and 18% polyglicolic acid. These materials have high strength and ductility and degradability. No corrosion and tissue reaction are demostrated by these materials.[18] This rigid fixation allows immediate removal of maxillomandibular fixation. This procedure is much more technique sensitive than is closed or open reduction with interosseous wire fixation.[8]

Over the last 20 years, the introduction and acceptance of low profile titanium mini plates (1.5–2.0 mm screws) have improved the ability to stabilize the major load-bearing midface buttresses. Even smaller microplates (1.0–1.3 mm screws) assist in stabilizing

multiple comminuted segments in non-load-bearing regions after fixation of the major buttresses. The use of plate fixation should be kept to the minimum required to achieve fracture stabilization.[5] Rigid internal, three-point fixation is the current standard for treating maxillary fractures. Gap less than 5 mm can be tolerated, although defects secondary to comminuted buttress fractures should be filled with bone grafts. At least two screws should be placed on either side of the fracture line. Buttress fixation requires at least a 2 mm thick plate.[13,19] In this patient, plates with 1.5 mm screws was applied as a rigid fixation in Le Fort II fracture reconstruction which were placed at nasomaxillary and zygomaticomaxillary buttresses.

The patients were followed up for clinical and radiographic examination on regular intervals at one, three, six and twelve months post operatively. Clinical evaluation for reduction, stability, facial symmetry, occlusion and neurological disturbances of the facial and infraorbital nerves was carried out.[1] During follow up, there was facial nerve paralysis and had improved by therapy in two weeks. No malocclusion and instability of fractures was found.

The use of plates and screws has resulted in many advantages for the patients with maxillofacial trauma, however complications can arise and that's the reason for plate removal. As far as the cause of plate removal had been investigated, infection or discharging sinus had been the most common cause of the plate removal (37.04%). Other reasons for removal of the plate were psychological factors on patient's request that do not like palpable plates (14.81%), the plate fracture (11.11%), pain (11.11%) and paraesthesia (3.7%). In children, planned removal of plates due to age factor which occurred in 22.22% cases.[6] In this patient, there was no sign of infection at the site of plates application, no facial pain and paraesthesia, and the patient did not complained of palpable plates in his face which require removal of the plates.

Rigid internal fixation with metal such as titanium has fulfilled most qualities of the biomaterial requisites, but the elastic modulus of titanium is five times that of bone and this stiffness can cause a stress shielding effect on the bone leading to osteoporosis under the plate.[7,20] The use of bioabsorbable self-reinforced plates and screws seems to be an appealing alternative to titanium devices. However, the use of these devices should be restricted where mini plate fixation is stable enough.[20,21]

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