

THE CARE OF DELAYED MALUNION AFTER MAXILLARY FRACTURE BY DIFFERENT METHODS : REPORT OF THREE CASES

Jae - Ha Yoo, D.D.S., Ph.D. Won - Yoo Lee, D.D.S., Ph.D.

Soo - Jang, Rew, D.D.S.

*Dept. of Dentistry, Wonju Christian Hospital, Wonju College of Medicine
Yonsei University, Wonju, Korea*

When open reduction of maxilla fractures is postponed due to concurrent life - threatening injuries, delayed union may result with malunion or nonunion.

If delayed malunion is occurred, significant facial deformity may result, including a dished - out face, irregular retramaxillism with Angle's class III malocclusion, open anterior bite, nasal collapse, telecanthus and malar flattening.

The treatment planning for this problem includes cephalometric evaluation anterior and lateral tomograms, dental casts, orthodontic planning, dental planning and use of impression tray to rupture the fibrous tissue attachment at the fracture site.

In this paper, one case presented a 58 - year - old female patient with maxilla retrusion after comminuted fracture, who was treated with orthodontic methods of maxillary protraction headgear and Plaster headcap, whereas the other two cases were about male patients who were treated principally with surgically open reduction or Le Fort I - controlled transverse osteotomy with iliac bone graft.

I . Introduction

The frequency of multiple injury, including the maxillofacial trauma, is more increased in the modern traffic or industrial accidents.

When the patient with multiple injuries is transferred in emergency room, time is allocated to reestablish cardiovascular or respiratory dynamics, obtain additional diagnostic information and initiate treatment of associated conditions^{4, 9, 32}.

The acute complications after maxilla fracture are respiratory obstruction, hemorrhage, infection, nerve dysfunction and cerebrospinal fluid rhinorrhea, whereas late complications are nonunion, delayed union and malunion^{6, 24}.

If primary treatment of maxilla fractures is postpo-

ned due to concurrent life - threatening injuries, delayed union may result with malunion or nonunion^{1, 32, 34}.

The many surgeons said that the principles for treatment of delayed union were as follows : (1) Up to six weeks, slow traction via suspension from a headcap, halo or extraskelatal traction usually will reduce the fracture and provide fixation. (2) Horizontal fractures up to four months old may also be corrected by traction^{4, 9, 13, 23}.

In orthodontics, a reverse headgear such as maxillary protraction appliance have been in use since 1960.

Maxillary protraction appliances must, by definition, function reverse, and anchorage is obtained by using the frontal and mental regions of the skull.

Much has been written in the last 30 years regarding successful maxillary protraction, in both experimental animals and orthodontic patients^{11, 18, 21, 26}).

But when malunion occurs, significant facial deformity may result, including a dished out face, irregular retromaxillism with Angle's Class III malocclusion, open anterior bite, nasal collapse, telecanthus and malar flattening^{4, 34}).

The planning of any surgical approach to this problem includes cephalometric evaluation, anterior and lateral tomograms, dental casts, photographs and orthodontic and dental planning^{1, 10, 25, 29}).

Some late deformities may be treated by autogenous bone or cartilage onlay grafts with fairly good results.

The LeFort I - controlled transverse maxillary osteotomy may be used for the retromaxillism due to malunion of a LeFort I fracture^{10, 12, 14}).

With advancement in craniofacial surgical techniques, the treatment of LeFort II and III maxillary malunion fractures by osteotomy and autogenous bone grafts is giving better results^{1, 4}).

In this paper, we reviewed an adult patient with delayed malunion who was treated with orthodontic methods of maxillary protraction headgear and headcap, and two patients who were treated with surgical open reduction and LeFort I-controlled transverse osteotomy with iliac bone graft.

II. Report of cases

Case 1.

A 58-year-old female patient, with traumatically induced maxillary retrusion, was referred for proper treatment, two weeks after the original fracture. The initial trauma occurred at a road traffic accident by autobicycle, when multiple injuries were sustained. These included hemoperitoneum due to jejunal perforation, fractures of clavicle and tibia, cerebral contusion, renal contusion and subdural hygroma. The facial injuries consisted of comminuted LeFort I and II fractures. (Fig 1, 2) A laparotomy was performed as emergency operation, and intraabdominal hemorrhage was then controlled.

Two weeks later oral & maxillofacial examination revealed moderate facial deformities, including dished-out face, retromaxillism bilaterally with class III malocclusion and anterior crossbite of 4.5 mm. (Fig 3)

At 3 weeks after trauma, when the general condition had stabilized, surgical exploration of maxilla fracture was carried out, but fracture fragments of maxilla were not movable due to comminuted fracture characteristics. The plaster headcap traction was thus considered, instead of more open reduction by refracture. (Fig 4)

Therefore, incised wound through the labial sulci bilaterally was closed primarily. Because the patient was in supine position by absolute bed rest, plaster



Fig 1. Preoperative facial photograph



Fig 2. Preoperative Waters' view



Fig 3. Anterior Cross-bite occlusion



Fig 4. Forward traction by Plaster headcap.



Fig 5. Orthodontic treatment by a reverse headgear.



Fig 6. Light class III intermaxillary elastic traction by use of removable appliances.

head cap traction was applied for protraction of retruded maxillary dentition. But the patient was not tolerable due to severe headache by cerebral contusion and discomfort to headcap itself, and thus plaster headcap was removed at first week after the operation.

Three weeks later after the operation, orthodontic treatment was started, using a reverse headgear such as maxillary protraction appliance, applying a protracting force of 500 gm to each side of an upper removable appliance, which incorporated posterior bite planes to prevent cuspal interference. (Fig 5)

In addition, light class III intermaxillary elastic traction was used onto a lower removable appliance in force of 100 g. (Fig 6)

All appliances & elastics were requested to be worn full time, and at least 20 hours of wear were achieved each day.

After that method above during 2 months, the slight favorable occlusion was attained at anterior cross-bite of 2.5 mm, but the more favorable occlusion was not retained due to dislodgement of the reverse headgear itself.

For a rapid & satisfactory occlusal correction of maxillary fracture union authors used a dental tray with impression material of Optosil to make a mold of maxillary teeth.

With the patient under sedation and local anesthesia, the tray is grasped and moved from side to side

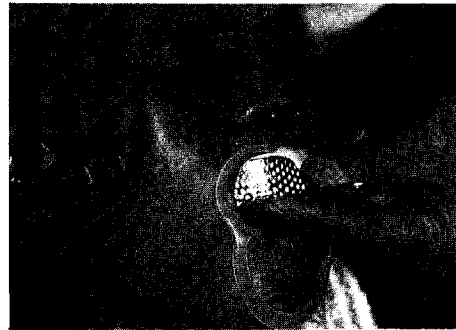


Fig 7. The tray is grasped and moved for occlusal correction.



Fig 8. Established normal occlusion.

and up and down in an attempt to rupture the fibrous tissue attachments at the fracture site. (Fig 7)

After that method, the Plaster headcap was again applied to protract the maxilla fracture fragments, in spite of discomfort of the employment of it.

In the employment of the plaster headcap during

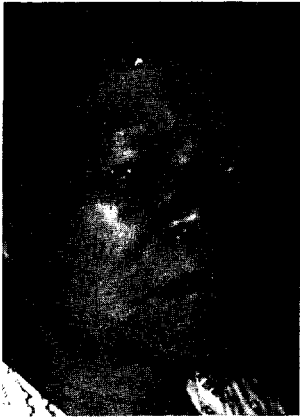


Fig 9. Final facial contour.



Fig 10. Pre-operative Waters' view

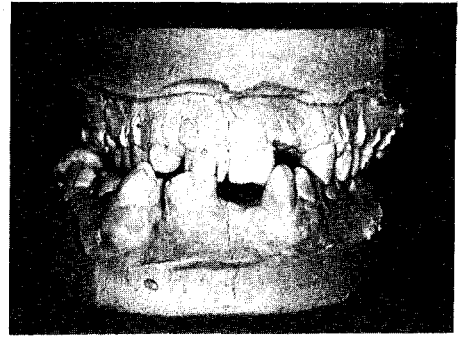


Fig 11. Asymmetric retromaxillism



Fig 12. Operation field.

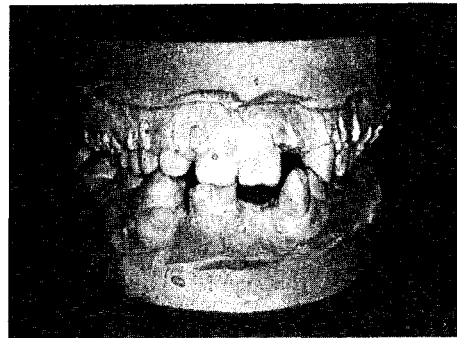


Fig 13. established normal occlusion

two months, normal occlusion was established and the maxillary complex and teeth were firm to palpation without further relapse tendency. (Fig 8, 9)

Case 2.

A 28-year-old male patient was consulted to our dept. of oral surgery due to the delayed union of maxilla fracture, five weeks later after the initial trauma.

The multiple injuries were as follows; cerebral contusion, both comminuted compound depressed fracture of frontal bone, basal skull fracture, acute subdural hematoma, pneumocephalus, cervical fracture of C6 and C7 spine and Le Fort I, II, III fractures. (Fig 10, 11)

The emergency operation such as partial decompressive craniectomy and reconstruction of both frontal comminuted compound depressive fracture with mul-

tle wiring and dura repair with muscle pieces was done and drowsy mental state with irritable condition was then continued during four weeks.

At fifth week after the operation, systemic condition was improved with alert mental status and operability under general anesthesia.

Under general nasotracheal anesthesia, the bony separating was done with difficulty along the fracture site of LeFort I & II and interosseous wirings were done tightly in normal occlusion. (Fig 12, 13)

During the procedure anterior movement of the maxilla was possible without comminution of fracture fragments, but Rt. maxillary contour was more depressed than Lt. side. (Fig 14)

The plaster headcap traction was thus done obliquely toward anteriolateral direction on pyriform aperture of Rt. maxilla during 1 month and the favorable result was attained with mild enophthalmos of Rt.

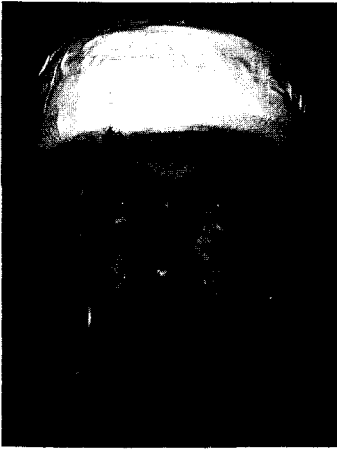


Fig 14. Plaster headcap traction toward anterior lateral direction.

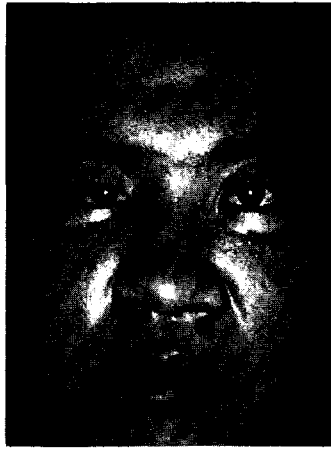


Fig 15. Post - op facial contour with Rt mild enophthalmos.

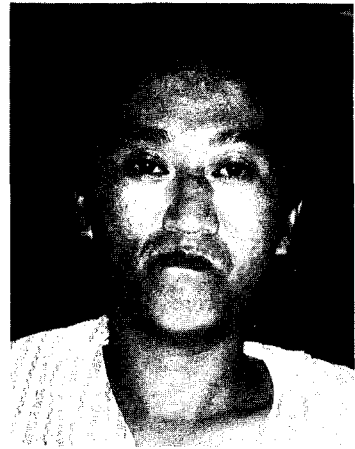


Fig 16. Dished face by old maxilla fracture.

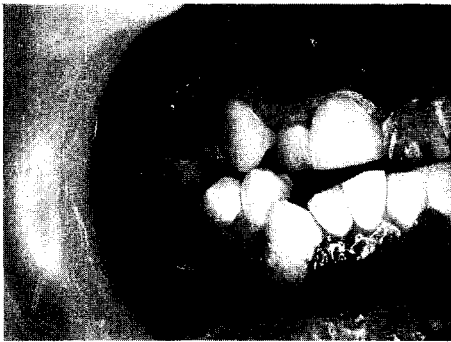


Fig 17. Pre-operative occlusion.



Fig 18. Pre-operative waters' view.

side eye. (Fig 15)

Case 3.

A 35-year-old male patient, with delayed malunion after maxilla fracture, was referred for proper treatment in six months after the original fracture. (Fig 16, 17)

The initial trauma occurred at a road traffic accident when multiple injuries were sustained with comatous mental status. These included comminuted compound depressed fracture of midfrontal region, basal skull fracture, cerebral contusion, pneumocephalus, subdural hematoma, subdural hygroma, and tentorial hemorrhage. The facial injuries consisted of Le Fort I & II fracture of maxilla & zygoma & nasal bone. (Fig 18)

A tracheostomy was performed initially and closed

drainage through a bur hole was done on frontal area as emergency operation under general anesthesia.

But severe neurologic problem was not improved and semicomatous mental status was showed until five months after the accident.

When the consciousness was returned moderately, the patient was referred to our dept. of oral surgery of Wonju Christian Hospital.

Six months later, when the general condition had been stabilized, treatment planning of malunited maxilla and zygoma fracture was carried out.

The planning of any surgical approach to this problem included photographs, cephalometric evaluation, plain radiographic examination, computed tomography, articulator analysis of dental casts and orthodontic and dental planning. (Fig 19)



Fig 19. Preoperative cephalo tracing

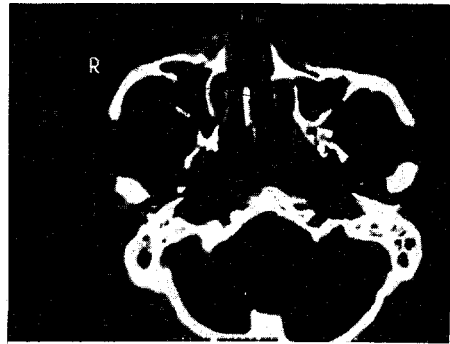


Fig 20. Preoperative maxilla computed tomogram.

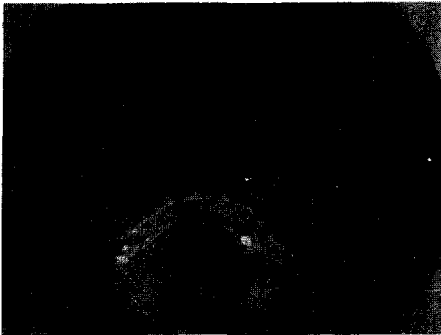


Fig 21. Post - operative Waters' view



Fig 22. Post - operative facial contour.

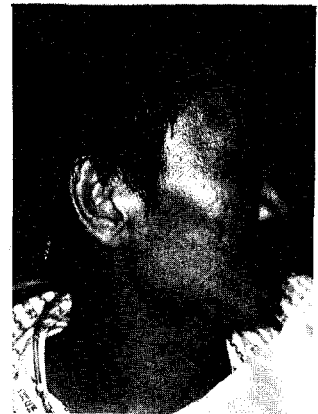


Fig 23. Final face after secondary rhinoplasty

The photographs revealed a dished out facies, irregular retromaxillism with Angle's class III malocclusion and nasal collapse.

Cephalometric evaluation was as follows; The angle for SNA was 76 degrees and that for SNB was 84 degrees, making the ANB difference 8 degrees. The computed tomogram of maxilla showed the more displaced fracture fragments with comminuted compound characteristics. (Fig 20)

Study model analysis also revealed the skeletal class III malocclusion of 8 mm retrusion bilaterally in first molars' relationship of maxillary and mandibular dentitions.

The maxillary complex and teeth were firm to palpation and all teeth were vital.

Because the orthodontic treatment by protraction headgear of maxilla was impossible due to very long time after initial trauma, early surgery was planned by Le Fort I osteotomy with autogenous iliac bone grafts.

Under general nasotracheal anesthesia, Le Fort I osteotomy was done with autogenous iliac bone graft at about six months after the original fracture. (Fig 21)

After the intermaxillary fixation was applied with wafer during six weeks, mouth opening was trained and normal masticatory function was then attained in fifth week. (Fig 22)

Three months later after the operation, secondary operation such as rhinoplasty by use of iliac bone and

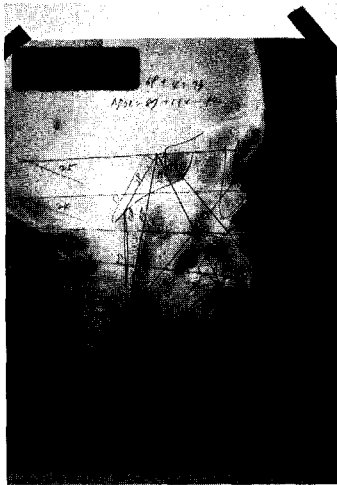


Fig 24. Final cephalogram

conchal cartilage graft was done for the correction of nasal collapse deformity, and more favorable result was then taken. (Fig 23, 24)

III. DISCUSSION

The integrated management of the multiple injured patient with maxillofacial trauma is best provided through a prioritized assessment and treatment protocol. In this protocol treatment is divided into three basic phases^{1, 6, 16, 32}.

The first phase, the primary survey, involves a rapid assessment of the patient's airway, breathing, circulation, and neurologic condition. Life-threatening conditions are treated as they are encountered, and resuscitation is initiated.

The secondary phase can best be described as a methodical head-to-toe examination to identify all of the injuries sustained by the patient.

Treatment in this phase is designed to stabilize the patient so that no further damage is incurred prior to definitive treatment or transport of the patient to a facility better equipped to handle the injuries.

The third phase involves definitive care of all the injuries the patient has sustained. This phase may begin immediately or may be delayed, depending on the nature and extent of the injuries.

Though there are usual indications for immediate surgery after severe multiple injuries, such as uncontrolled hemorrhage, unresolved airway obstruction, compound fractures and penetrating wounds of abdomen, neck or axilla, maxillofacial operation was often delayed because of poor systemic condition under general anesthesia^{4, 9, 24}.

Therefore the primary operation of maxillary fractures is postponed owing to the intensive care of concurrent life-threatening injuries and delayed malunion may result with facial deformity.

The basic principles for treatment of delayed union are as follows: (1) Early reduction and fixation; From 10 to 14 days the fracture may be reduced by conventional means. (2) Up to 6 weeks, slow traction via suspension from a headcap, halo or extraskeletal traction usually will reduce the fracture and provide fixation, though open reduction and wire fixation can not be accomplished. (3) Horizontal fractures up to four months old may also be corrected by traction^{4, 7, 13, 23, 27}.

In orthodontics, conventional headgear appliances have been in use since the early nineteenth century, and much has been written in the literature to document their varied forms, modifications and uses^{11, 18, 21, 26}. Maxillary protraction appliances, however, are relatively recent additions to the group and the literature before 1960 contains few reports on the use of such devices.

In 1943 Johnson used such a reverse headgear to move the posterior teeth mesially and Oppenheim also used an appliance comprising a headcap and chin cup, which allowed elastic traction to 6|6 bands connected by a palatal arch^{19, 30}.

Forces of 110 g were used, and successful corrections of class III malocclusion were reported, both in growing children and one adult. Maxillary protraction appliances continued to evolve in design. Marx used cervicomental anchorage, whereas Nelson used a modified American football helmet with a projecting anterior bar to allow elastic traction^{21, 23, 28}.

In 1971 Delaire used the 'orthopaedic mask', a light but rigid framework supported by the frontal

and mental regions^{7,17)}.

This design still remains popular today. An individually made, closely fitting facial mask, was introduced by cooke and Wreakesa in 1977⁹⁾.

In japan in 1975, Irie and Nakamura reported that several class III malocclusions had been treated successfully using maxillary protraction headgear, and confirmed their role in th treatment of cleft lip and palate patients with maxillary retrusion¹⁷⁾.

They advised treatment in the early mixed dentition, and used force magnitudes of 400gm. Biomechanical aspects of protraction headgears have been discussed by Nanda, who modified force application to the maxillary molars by means of a reverse entry facebow.

Animal studies have complemented clinical observations^{18,20)}. Maxillary protraction of up to 1cm has been produced in monkeys with forces comparable to those used clinically. Again it was noted that skeletal changes were greater in young growing animals²⁶⁾.

In the adults, changes were restricted to movement of the dentition itself. Traumatically induced maxillary retrusion has also been treated using protracting forces^{13, 17)}.

Ciaburro et al, reported on the use of an external fixation apparatus, the Delbet - Tessier diadem. This was a metal framework rigidly attached to the frontal region of the skull⁹⁾.

Forward traction to the maxilla could be applied via multiple elastics, or by a winch, adapted to the diadem, and connected to the maxilla by steel wires.

On the other hand Kazanjian advocated the use of extraskeletal fixation for support of the fractured maxilla and zygomatic compound. The rubber band traction between the suspension wire and an outrigger on a head cap provides support for the maxillary and zygomatic fragments^{5,23,28)} .

This method is reserved for patients in whom complete stabilization by open reduction and wire fixation can not be accmplished^{22,27)}.

In the case 1, the maxillary protraction headgear and headcap were well used because proper open

reduction was impossible due to comminuted fracture characteristics, and the result was more favorable.

In the case 2, open reduction and fixation were done, in spite of relatively long duration of five weeks after initial fracture because there were no comminuted fracture types, and the result was also favorable.

A rapid and satisfactory reduction was also accomplished by the method described by Dingman and Harding^{4,9)}.

In this method, a dental tray with dental compound is used to make a mold of the maxillary teeth. With the patient under general anesthesia, the tray is grasped and moved from side to side and up and down in an attempt to rupture the fibrous tissue attachments at the fracture site. This frequently will release the fracture and allow reduction and fixation.

But in the case 1, author used a dental tray with Optosil impression material under sedation and local anesthesia, instead of modeling compound under general anesthesia.

The maxilla consists primarily of cancellous bone nourished by an extensive vascular network, which accounts for the infrequency of nonunion. But initial inadequate reduction and prolonged retention of a maxillary fracture may result in malunion^{6, 16, 24, 32)}.

Avoidance of this complication depend upon careful primary reduction and suspension. The suspension wires must support but not decrease the vertical height of the midface by compression.

When malunion occurs, significant facial deformity may result with malocclusion and the planning of surgical approach is then considered with orthodontic correction.

The LeFort I - controlled transverse maxillary osteotomy may be used for the retromaxillism due to malunion of a maxilla fracture.^{10, 12, 14)}

This requires preoperative cephalometric evaluation with orthodontic planning and preoperative preparation of a plastic dental splint for proper intermaxillary fixation.

The osteotomy is performed through the labial sulci bilaterally. If the fractured segment is severely retruded with comminution of the pterygoid plates, care

must be taken in separating the maxillary segment to avoid injury to the greater palatine neurovascular bundle.

If postoperative fixation is unstable, external skeletal fixation as described by Georgiade is necessary^{13, 15, 25, 33}.

Careful surgical planning and mucosal flap design may help avoiding the complication of bony avascular necrosis; with loss of tooth vitality, periodontal disease and relapse of the malunion^{2, 29, 31}.

In the case 3 described, after the evaluation of cephalometrics, computed tomogram and model analysis on the articulator, LeFort I - controlled transverse osteotomy with iliac bone graft was preferred for the correction of retromaxillism due to malunion of LeFort I and II fractures.

During the operation excessive hemorrhage was not found in the greater palatine neurovascular bundle and complications such as bony avascular necrosis and loss of teeth vitality were not present without relapse tendency toward the retromaxillism during 1 year.

Additional operations after the facial bone osteotomy frequently include medial canthoplasty, dacryocystorhinostomy, rhinoplasty, septal reconstruction and onlay bony augmentation^{6, 24, 29, 34}.

As described in these 3 cases, secondary operations such as rhinoplasty and septal reconstruction were considered and then nasal tip rhinoplasty by use of iliac bone and conchal cartilage was done, in 3 months later after the primary operation of LeFort I osteotomy with onlay iliac bone graft.

The result was more favorable and relapse tendency was not present during about 9 months.

IV. SUMMARY

Three patients with the retromaxillism after old fracture of maxilla were consulted to the department of oral and maxillofacial surgery, Wonju College of Medicine, Yonsei University, Wonju, Korea.

The first patient was a 58-year-old female patient, with traumatically induced maxilla retrusion

in 3 weeks after comminuted fracture, who was treated with orthodontic methods by use of maxillary protraction headgear and Plaster headcap after surgical exploration.

The second patient was a 28-year-old male patient, with traumatically induced maxilla retrusion in 5 weeks after not comminuted fracture, who was treated with open reduction and Plaster headcap traction.

The third patient was a 35-year-old male patient, with traumatically induced retromaxillism in about six months after LeFort I, II, III fractures, who was treated with surgery only of LeFort I controlled transverse osteotomy with iliac bone graft and secondary operation of rhinoplasty.

In view of occlusion and facial deformity, the favorable results were attained in all three cases.

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국문초록

치료법을 달리한 상악골절후 부정유합 2 예

연세대학교 원주의과대학 원주기독병원 치과(구강악안면외과, 교정과)
 유재하 · 이원유 · 류수장

현대 사회에서 외상의 특성은 다발성 손상이 빈발하는 것이며 상악골절시 생명을 위협하는 다발성 전신손상이 동반되면 수술이 지연되어 골절부의 지연된 부정유합을 보일 수 있다. 또한 골절된 양상에 따라라도 관혈적 정복술의 적용여부가 고려되는데 특히 골절편의 분쇄가 심하면 수술시 골절부위의 이개 후 정상위치로의 이동이 어렵고 설사 골절편의 이동이 이루어졌다고 하여도 정상위치로의 고정이용이하지 않을 뿐만 아니라 분쇄골절편의 상실량이 많아지면 골이식까지 시행해야 하는 등 외과적이 술식의 적용에 많은 난관이 예상된다.

따라서 상악골절 후 통상 6주일 간의 시간경과가 없다면 오히려 상악골절편의 이동방향을 예측하여, 전방견인용 headgear 또는 headcap을 사용한 교정적인 치료를 시도함이 바람직할 수도 있다.

더우기 reverse headgear를 이용한 치료법은 골절된 경우가 아니라도 상악골의 전방이동에 유용함이 실험적으로나 임상적으로 입증된 만큼 이를 상악골절후 후퇴된 상악골의 전방견인에 적용할 경우 교정치료의 최대장애인 cortical bone의 연속성이 골절로 인해 끊어지고 섬유성 유착상태로 남게되어 교정력의 효과가 치아이동 뿐만 아니라 골편의 이동에 매우 유익하리라 사료된다.

이에 저자는 상악골절이 분쇄양상인 한 환자에서 headgear와 headcap을 이용한 교정치료법을 5개월간 적용해 양호한 결과를 얻었고, 골절양상이 분쇄형이 아닌 중례에서는 외상후 5주간 경과되었지만 관혈적 정복술을 시행하여 정상교합을 회복했으며, 심한 두부 손상으로 6개월만에 의식 회복을 한 LeFort I, II, III, 환자에서는 두부방사선 계측학적 분석, 교합기 상에서의 모형분석, 전산화 단층촬영 검사 등을 시행한 후 새로운 골면예다 LeFort I -osteotomy with iliac bone graft를 시행해 정상교합 및 안모추형을 개선시켰기에 이를 보고한다.