FIXATION OF FRACTURED ORBITAL BONE USING AUTOGENOUS CALVARIAL BONE PLATE

Yun-Seok, Yang, D.D.S, M.S.D.

Visiting Scholar
Department of Oral and Maxillofacial Surgery
University of Washington, Seattle, Washington

자가 두개골 플레이트(autogenous calvarial bone plate)를 이용한 골절된 안와골의 고정

양윤석 D.D.S., M.S.D.

Visiting Scholar
Department of Oral and Maxillofacial Surgery
University of Washington, Seattle, Washington

Miniplate의 사용은 Champy등의 보고 이후 구강외과 영역에 있어서 외상 혹은 악교정수술등 많은 분야에 이용되기 시작했다.

전통적인 악간고정 방법에 비해 miniplate는 사용하기 쉽고, 정확한 해부학적 정복 및 고정을 가능케 하며 결과적으로 빠른 치유를 가능케 한다는 장점들을 갖고 있다.

그러나 감염, wound dehiscence, 부식, 나사의 헐거워짐, 주위조직의 변색 그리고 stress shielding effect등의 후유증들이 보고되어 왔으며 가장 무해한 금속이라고 알려진 titanium 또한 주위조직 및 lung, spleen, liver 그리고 kidney 등과 같은 조직으로 metal을 전이시키는 것으로 보고되고 있다.

특히 안와골 주변과 같은 상부 연조직이 얇은 곳에 miniplate를 사용할 경우 miniplate가 만져지거나 보일수도 있다는 점이 보고되었으며 따라서 술후 사용되었던 miniplate를 제거해야만 할 것인가가 또한 주된 관심사로 보고되고 있다.

이에 저자는 이러한 금속성 miniplate의 단점을 개선하고자 자가 두개골을 이용한 플레이트를 고안하였다.

'자가 두개골 플레이트'의 적응증은, enophthalmos 개선의 목적으로 두개골을 채취해 임플란트로 사용하는, enophthalmos를 동반한 관골 및 안와골의 복합골절환자에 있어 두개골의 추가채취가 가능한 경우가 될 수 있겠다.

자가 두개골을 이용해 플레이트를 고안하려는 본 증례에서의 시도는 구강외과 영역에 있어서 자가 두개골이 골편의 고정재료로도 쓰일 수 있다는 가능성을 보여주었다는 점에서 의미가 있다고 저자는 생각한다.

I. Introduction

In case of zygomatico-orbital complex fracture, due to the anatomic and physiologic complexity of the orbit, trauma can cause a variety of sequelae characterized by enophthalmos, diplopia, hypothalmos and so on.[1,2,6]

If enophthalmos should develope, one can perform autogenic or allogenic implants.[1]

Glass beads have been recommended but only in patients with nonseeing eyes.[3] Implants of silicon, polyethylene, methylmethacrylate and teflon beads have been all described. Irradiated cartilage, autogenous cartilage and fascia have been reported but long-term results could be disappointing because of eventual resorption.[4,5,7]

The calvarial bone, among the autogenous materials, has been described as more optimal than other types of bone or materials.[9,10,11] After placement of autogenous implant into the orbit, one should manage the fractured zygomatic bone.

The routine use of miniplates in oral and maxillofacial surgery is now a commonly accepted method of treatment after Champy and colleagues.[20]

The miniplate system is easy to use, allowes precise anatomic reduction, and in most cases, conventional maxillomandibular fixation is not necessary, thereby facilitating early recovery.[21]

However, complications of miniplates such as infection, wound dehiscence, corrosion, loosening of screw, discoloration of surrounding tissue and stress-shielding effect have been described.[14,15,16,17,18,19]

Even titanium alloys, which have been described as one of the least corrosion-resistant materials, have been reported to release metal into adjacent tissues and distant organs such as the lungs, spleen, liver, and kidneys.[22]

Late sequelae of miniplate fixation sometimes result in additional surgery for plate removal.

Palpability and visibility, especially around the thin-skinned regions of the orbit, are of particular concern.[23]

There has been nearly no trial of designing autogenous calvarial bone plate. This plate would not show any foreignbody reaction, and hopefully it may be dessolved after finishing it's role as a plate, thereby eliminating additional surgery for plate removal.

I, therefore, harvested additional calvarial bone to design the calvarial autogenous bone plate for fixation of fractured orbit in case of zygomatico-orbital complex fracture combined with enophthalmos after harvesting of calvarial bone for surgical correcton of enophthalmos.

The result was not uneventful, so I report it.

II. Case Report

A 26 year old male patient was seen with the chief complaint of painful swelling of left periorbital area due to a traffic accident. Clinically enophthalmos was seen, but diplopia was not evident.

Through clinical and radiologic evaluation, the diagnosis was made as zygomatico-orbital complex fracture combined with enophthalmos.

I planned to perform a calvarial bone graft to improve the enophthalmos and harvest additional calvarial bone to design the autogenous bone plate for the fixation of the fractured bone.

A hemi-coronal incision was made 3cm behind the hairline down to the preauricular crease.

The incision was made parallel to the hair

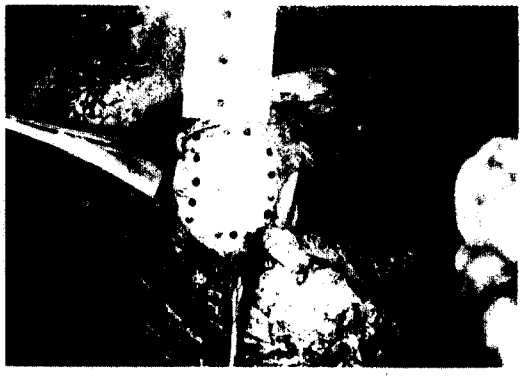

Fig. 1 Making burr holes onto the calvaria along the designed outline

Fig. 2 (1) Outer table of calvaria to be harvested for making autogenous bone plates.
(2) Marrow portion of calvaria after the harvesting of outer table for the correction of enophthalmos

follicles through the galea into the loose areolar plane, leaving the pericranium intact.

The flap was elevated inferiorly in the loose areolar plane.

A horizontal incision was made 3cm above the orbital rim, and this allowed subperiosteal elevation over the superior orbital rims.

Prior to further inferior dissection in the anterior temporal region, a horizontal incision was made 2.0cm above the zygomatic arch through the superficial layer of deep temporal fascia into the superficial temporal fat pad.

Within this fat pad, the superior aspect of the entire zygomatic arch was exposed.

This arch dissection and the dissection along the lateral orbital rim were then connected, allowing dissection and exposure of the malar region and lateral orbital rim.

The fracture line of the frontozygomatic(F-2) suture and the zygomatic arch were identified.

An infraorbital incision and dissection were made. A compound fracture of infraorbital rim was identified and I removed some bony fragment.

I marked the outline of the calvarial bone to be harvested for grafting into the orbit with methylene blue.(3.5cm×4.5cm)

I made a burr hole along the outlines, confining the depth to just the outer table of the calvaria.(Fig.1)

I connected the all holes with bur and harvested the outer table with curved osteotomes.

I divided the grafted bone into 2 pieces and I placed 2 pieces of bone onto the infraorbital area to correct the enophthalmos.

I also marked the outline of the calvarial bone to be harvested for designing of the autogenous bone plate(3.0cm×4.0cm)(Fig.2) and then it was harvested.

I carved with a denture bur to make a adaptable bone plate to the fracture site, one for the infraorbital rim and one for the frontozygomatic suture area.

After carving, the thickness of the calvarial bone plate for the F-Z suture line was 1.5mm. In the infraorbital area, I carved the calvarial bone with the central convexity to compensate for the bone defect of infraorbital area because I removed some bony fragments from the infraorbital area.(Fig.3)

Fixation of autogenous bone plates were

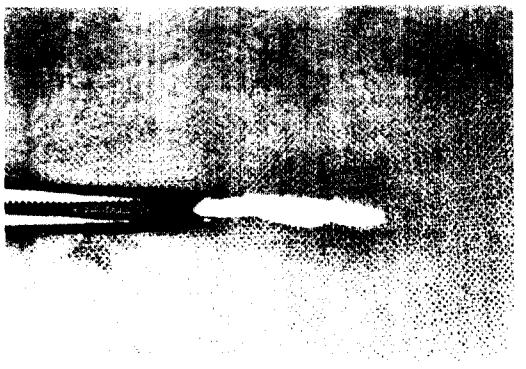

Fig. 3 Calvarial bone plate with central convexity for the fixation of infraorbital rim area

Fig. 4 After fixation of the calvarial bone plate in frontozygomatic suture area

done with titanium screws(7mm) (Fig.4&5) and fixation of the zygomatic arch was done with wire. 3−0 vicryl and 6−0 black silk were used in closure of operation site.

In early follow-up, the result was uneventful and the patient complained only of frequent headache. In a follow-up by telephone after 2 years, the patient did not complain of any palpable hardware on the operation area or of any other symptoms except for occasional vague disomfort in the operation area.

Fig. 5 After fixation of the calvarial bone plate in infraorbital rim area.

III. Discussion

I designed autogenous calvarial bone plate which will hopefully eliminate the problems of miniplate. the thin outer table of calvarial bone plate would be eventually remodelled to a acceptable form to the orbit after the period of bony healing, and so eliminate the necessity of plate removal.

However, some complications such as dural laceration, injury of sagittal sinus, intracranial hemorrhage and infection have been reported in calvarial bone harvesting.[12]

Therefore, I would confine the indication of calvarial bone plating only to the case of zygomatico-orbital complex facture with enophthalmos which requires the harvesting of calvarial bone as an implant for the correction of enophthalmos.

I carved the calvarial bone to make the adaptable plate to the orbital area with a denture bur.

Mathog reported that contouring of the cranial graft is limited by the thinness and the curvature of the calvarial bone.[1] I, However, consider the thinness and curvature of cranical bone to be an advantage in making a calvarial bone plate.

The curved surface of the orbit enabled me

to contour the calvaial bone to make an adaptable plate easily.

Thinness was no problem because I tried to make a plate as thin as possible little noticable upon external palpation and facilitating the remodelling of plate after the bony healing.

Therefore, technically, I think it is easy to carve the calvarial bone withe a denture bur because, as dentists, we are already accustomed to handling it. I do not exactly know the fate of calvarial bone plate yet, but according to the patient's review by telephone, it seems to have remodelled to acceptable form in orbital area. Eventhough any palpability of screws was not noted I eventually would try to remove the screws to see the fate of calvarial gone plate and elminate the possibility of eventual palpability of screws.

I think that this trial showed the possibility of the use of autogenors calvarial bone for fixation of fractured bone in oral and maxillofacial surgery.

Ⅳ. References

1. Mathog RH, Hillstrom RP, Nesi FA. Surgical correction of enophthalmos and diplopia. Arch Otolaryngol Head Neck Surg 1989 ; 115 : 169−178
2. Converse JM, Smith B. Enophthalmos and diplopia in fractures of the orbital floor. Br J Pllast Surg 1957 ; 9 : 265−274.
3. Smith B, Obear M, Leone CR. The correction of enophthalmos associated withe anophthalmos by glass bead implantation. Am J Ophthalmol 1967 ; 64 : 1088−1093.
4. Borghouts JM, Otto AJ. Silicone sheet and bead implants to correct deformity of inadequately treated orbital fractures. Br J Plast Surg 1979 ; 31 : 254−258.
5. Stalings Jo, Pakian AT, Cory CC. The late treatment of enophthalmos : A case report. Br J Plast Surg 1973 ; 26 : 57−60.
6. Mathog RH, Archer KF, Nesi FA. Posttraumatic enophthalmos and diplopia. Otolaryngol Head Neck Surg 1986 ; 94 : 69−77.
7. Kawamoto HK, Jr. Late post traumatic enophthalmos : A correctable deformity ? Plast Reconstr Surg 1982 ; 69 : 423−432.
8. Frodel JL, Marentette LJ. The coronal approach : Anatomic and technical considerations and morbidity. Arch Otolarygol Head Neck Surg 1993 ; 119 : 201−207
9. Chen NT, Glowacki J, Bucky LP, Hong HZ, Kim WK, Yaremchuk MJ. The role of revascularization and resorption on endurance of craniofacial onlay bone grafts in the rabbit. Plast Reconstr Surg 1994 ; 93 : 714−724.
10. Kusiak JF, Zins JE, Whitaker LA. The early revascularization of membranous bone. Plast Reconstr Surg 1984 ; 76 : 510−514.
11. Zins JE, Whitaker LA. Membranous versus endochondral bone : Implications for craniofacial reconstruction. Plast Reconstr Surg 1983 ; 72 : 778−784.
12. Frodel JL, Marentette LJ, Quatela VC, Weinstein GS. Calvarial bone graft harvest : Techniques, considerations, and morbidity. Arch Otolaryngol Head Neck Surg 1993 ; 119 : 17−23.
13. Tams J, Rozema FR, Bos RRM, Roodenburg JLN, Nikkels PGJ, Vermy A. Poly(L-lactide) bone plates and screws for internal fixation of mandibular swing osteotomies. Int J Oral Maxillofac Surg 1996 ; 25 : 20−24.
14. French HG, Cook SD, Haddad HJ. Correlation of tissue reaction to corrosion in osteosynthetic devices. J Biomed Mater Res 1984 ; 18 : 817−828.
15. Uhthoff HK, Finnegan M. The effects of

metal plates on post-traumatic remodelling and bone mass. J Bone Joint Surg 1983 ; 65 : 66−71.
16. Winter GD. Tissue reactions to metallic wear and corrosion products in human patients. J Biomed Mater Res 1974 ; 8 : 11−26.
17. Jasmine MS, Dahners LE, Gilbert JA. Reduction of stress shielding beneath a bone plate by use of a polymeric underplate : An experimental study in dogs. Clin Orthop Res 1989 ; 246 : 293−299.
18. Moyen BJL, Lahey PJ, Weinberg EH, Harris WH. Effects on intact femora of dogs of the application and removal of metal plates. J Bone Joint Surg 1978 ; 60A : 940−947.
19. Nakamura S, Takenoshita Y, Oka M. Complication of miniplate osteosynthesis for mandibular fractures. J Oral Maxillofac Surg 1994 ; 52 : 233−238.
20. Champy M, Lodde JP, Schmitt R. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. J Maxfac Surg 1976 ; 6 : 14−21.
21. Cawood JI. Small plate osteosynthesis of mandibular fractures. Br J Oral Maxillofac Surg 1985 ; 23 : 77−91.
22. Schliephake H, Lehmann H, Kunz U. Ultrastructure findings in soft tissues adjacent to titanium plates used in jaw fracture treatment. Int J Oral Maxillofac Surg 1993 ; 22 : 20−25.
23. O'Hara DE, Delvecchio DA, Bartlett SP, Whitaker LA. The role of microfixation in malar fractures : A quantitative biophysical study. Plast Reconstr Surg 1996 ; 97 : 345−353.