The use of titanium mesh sheet in the frontozygomatico-orbital region. Case reports

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Abstract

Six cases reconstructed in the zygomatico-fronto-orbital region with titanium mesh are reported and a discussion of the use of this material in oral and maxillofacial surgery is presented.

Key words: Titanium mesh sheet, facial fractures, reconstructive surgery, case reports.

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Introduction

Transosseous stainless steel wire fixation and stainless steel or titanium mini-plates rigid fixation are two popular methods for osteosynthesis in maxillofacial surgery.[1-5]

The evolution of mesh osteosynthesis is contemporaneous to that of plates. A rigid steel mesh was used in the USA in the early 1960s and a new slightly malleable vitallium mesh was introduced at the same time.[6-8] The wide range of maxillofacial injuries from the Vietnam war gave rise to the production of the malleable titanium mesh (TiMesh) for semi-rigid fixation.[5] Titanium mesh proved useful in mandibular fractures,[9,10] mandibular and jaw defects,[11-14] augmentation of edentulous alveolar ridges,[15,16] Le Fort I osteotomies,[5,17,18] Le Fort III osteotomies,[19] ramus osteotomies,[20] free grafting mandibular condyle,[21] mandibular reconstruction,[5,16] orbital wall reconstruction,[22,23] osteosynthesis at the fronto-zygomatic suture, reconstruction of the anterior wall of the frontal sinus, and in augmentation of the articular eminence.[5]

The purpose of this article is to present the use of titanium mesh sheet in the reconstruction of the anterior wall of the frontal sinus, the orbital walls and zygomatic butresses and to discuss the reported advantages of this material for semi-rigid fixation in maxillofacial surgery.

Materials and methods

Since 1990 a titanium mesh system§ has been in use in the Oral and Maxillofacial Surgery Clinic, Aristotelian University of Thessaloniki, G. Papanikolaou General Hospital. This system contains mesh implants for the full mandible, right and left large mandibular segments, right and left short mandibular segments, mandibular angle segments for either side, mini mesh sheet, mesh sheet, ligature wire (0.4/0.5/0.6 mm), bone screws (2.0×5-15mm) and emergency bone screws (2.3-9 mm) self tapping, flat and round nose pliers, straight and angled wire cutting scissors, twist drills with stops, screw drivers and screw driver with screw holding device. The use of mesh sheet in comminuted fractures of the frontal sinuses and orbital walls as well as in zygomatic defects caused by fractures and ablative surgery is presented.

Case 1

A 57 year old male sustained comminuted fractures in the right anterior wall of the frontal sinus (Fig. 1) and superior orbital rim and fractures in the right inferior orbital wall and rim because of a car accident.

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Fig. 1.–*Case 1* Comminuted fractures of the anterior wall of the right frontal sinus.

Fig. 2.–*Case 1* Reconstruction of the comminuted fractures in the right anterior wall of the frontal sinus and supraorbital rim with use of a titanium mesh plate.

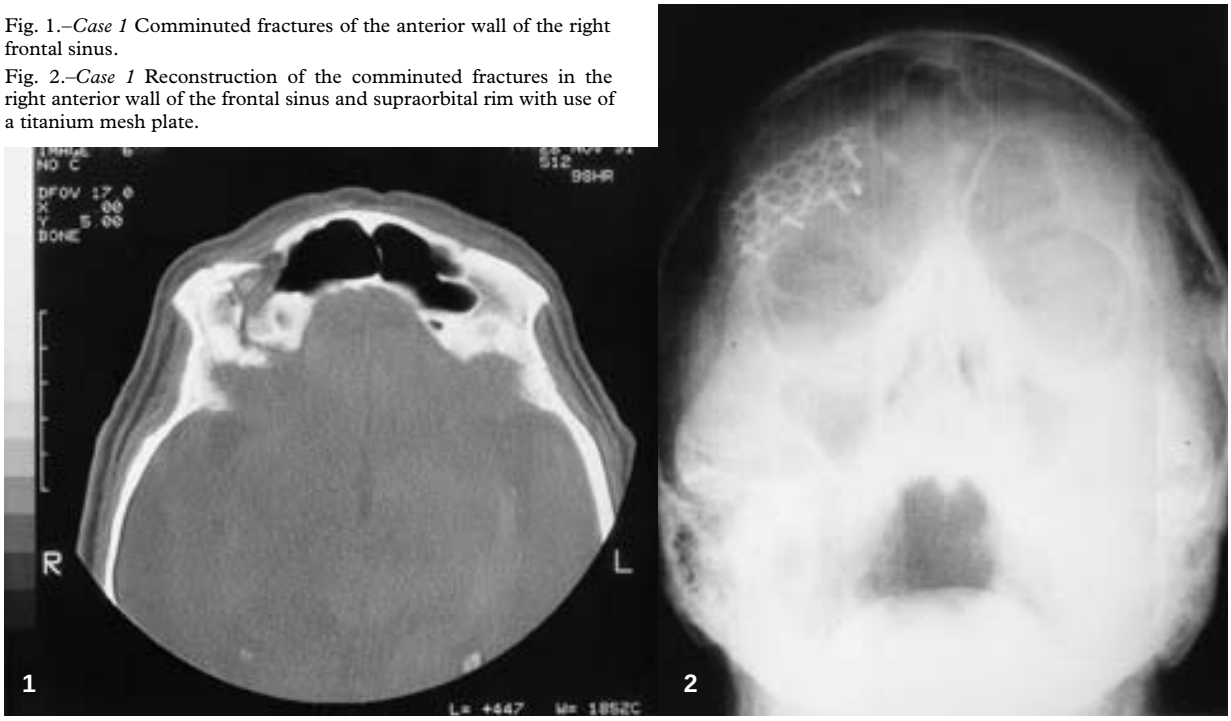
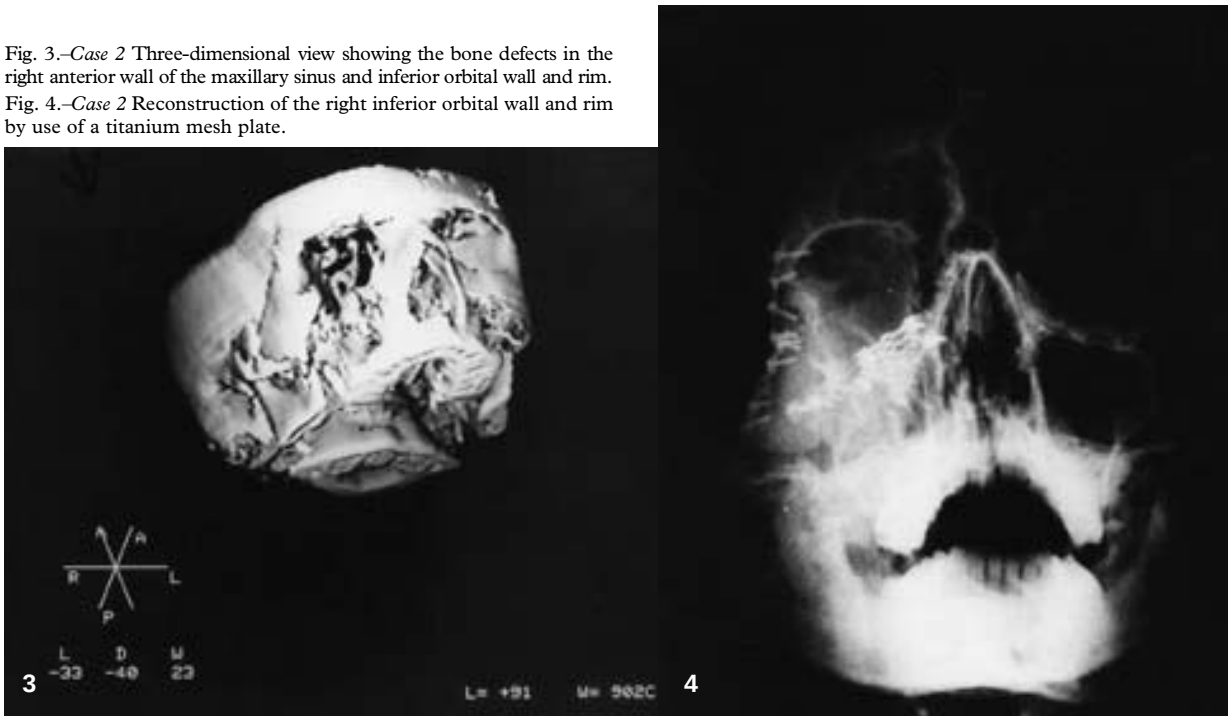


Fig. 3.–*Case 2* Three-dimensional view showing the bone defects in the right anterior wall of the maxillary sinus and inferior orbital wall and rim.

Fig. 4.–*Case 2* Reconstruction of the right inferior orbital wall and rim by use of a titanium mesh plate.



Titanium mesh was applied over the anterior wall of the frontal sinus and the superior orbital rim (Fig. 2) and a sheet of lyodura was inserted over the inferior orbital wall with an additional stainless steel wire fixation of the inferior orbital rim.

Case 2

A 22 year old female sustained deep facial trauma in the right zygomatic bone and inferior orbital area in a car accident. Radiographic examination showed comminuted fractures of the zygomatic bone with large bone defects in the anterior wall of the right maxillary sinus and the inferior orbital wall and rim (Fig. 3).

The defect in the anterior wall of the maxillary sinus was reconstructed with an osseous autogenous graft from the right parietal bone which was compacted with a long narrow piece of titanium mesh. The fracture lines extending from the fronto-zygomatic suture area up to the zygomatic arch were stabilized also with a long narrow piece of titanium mesh. The inferior orbital wall and rim were

Fig. 5.–*Case 3* Comminuted and depressed fractures in the anterior wall.

Fig. 6.–*Case 3* Reconstruction of the anterior wall of the frontal sinuses with use of a titanium mesh plate.

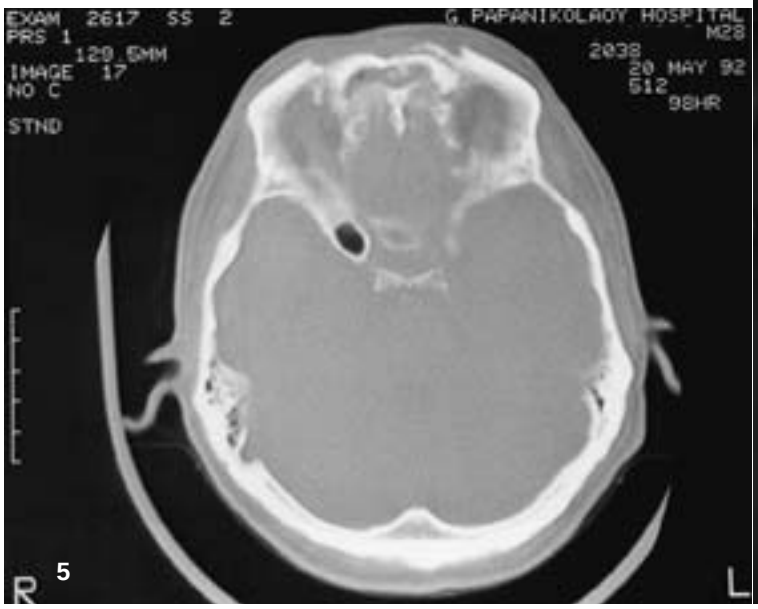


Fig. 7.–*Case 4* Recurrent myxoma on the surface of the left zygomatic bone.

Fig. 8.–*Case 4* Titanium mesh plate stabilized over defect of the left zygomatic bone.

reconstructed by means of a titanium mesh plate (Fig. 4). Healing was uneventful.

Case 3

A 29 year old male sustained comminuted and depressed fractures of the anterior wall of the frontal sinuses (Fig. 5) and fractures in the nasal bones and in the left inferior orbital rim and wall in a car accident. Mini-plates were applied in the nasal bones and in the inferior orbital area (Fig. 6), and a sheet of lyodura was inserted over the infraorbital wall. Comminuted fractures of the anterior wall of the frontal sinuses were reconstructed by means of a titanium mesh plate (Fig. 6).

Case 4

A 15 year old male presented with a swelling 30×20×20 mm in dimension on the left zygomatic bone (Fig. 7) which was hard and painless and covered with dermis. The swelling became obvious two months after a blow on the malar area with a

Fig. 9.–*Case 5* Depressed fracture of the anterior wall of the right frontal sinus and supraorbital rim.

Fig. 10.–*Case 5* Reconstruction of the anterior wall of the right frontal sinus with use of a titanium mesh plate.

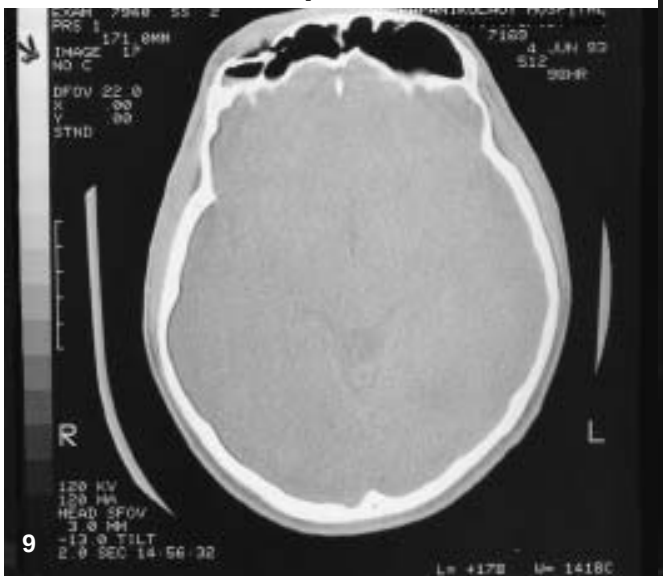
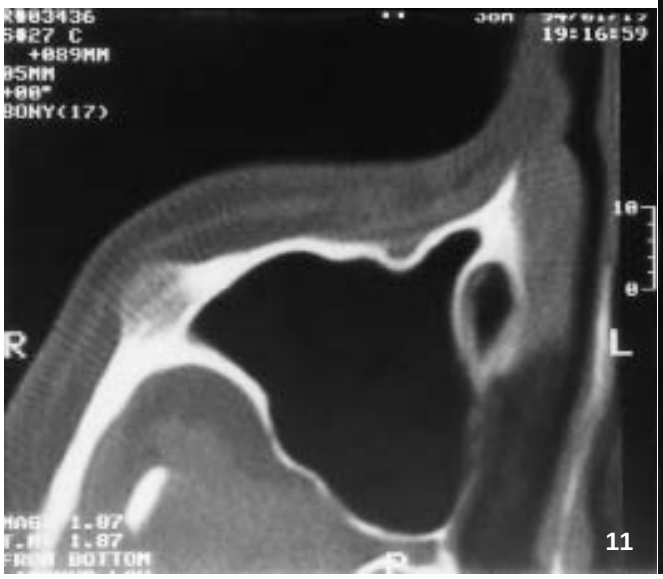


Fig. 11.–*Case 6* Haemangioma of the right zygomatic bone.

Fig. 12.–*Case 6* Titanium mesh plate applied over the defect of the right zygomatic bone.



wooden stick. An incisional biopsy was made on the lesion. The histological examination showed that it was a myxoma with well-defined borders.

One month later the lesion recurred. It was block resected along with healthy bone using a semi-coronal and an inferior orbital approach. A titanium mesh plate covered with a sheet of lyodura was stabilized over the left malar defect (Fig. 8). Histological examination showed a well marked myxoma. So far there has been no evidence of recurrence.

Case 5

A 22 year old male presented with depressed factures in the right anterior wall of the frontal sinus (Fig. 9) and superior orbital rim sustained in a motorcycle accident. The superior orbital rim was stabilized with two mini-plates and the anterior wall of the frontal sinus was reconstructed by means of a titanium mesh plate (Fig. 10).

Case 6

A 39 year old male presented with an osteolytic swelling on the right zygomatic bone, 5×7 mm in

dimensions (Fig. 11), which was painless and covered with healthy dermis. There was a history of trauma to the area three years earlier. The lesion was resected along with healthy bone using an inferior orbital approach. Histological examination showed that it was an haemangioma of the bone with well-defined borders. The bony defect was restored with a titanium mesh plate secured by three screws (Fig. 12). Healing was uneventful.

Discussion

Titanium mesh has proved a useful material for semi-rigid fixation and reconstruction of craniofacial defects. Versatility, stability and acceptability are three major advantages of this malleable metal compared with other materials and devices.

Titanium mesh in mandibular fractures avoids intermaxillary fixation and as a result the airway is less vulnerable and a normal diet can be eaten, reflecting a better physiological and psychological profile of the patient.[5] In addition, as is known, intermaxillary fixation is not advisable in patients with severe head injuries, cerebral injuries, epilepsy, psychiatric diseases, and airway disturbances.

The semi-rigid fixation achieved by the malleable titanium mesh improves bone healing because of the micromovements at the fractured ends[24] while rigid fixation with plates may evoke stress-forces within the callus during its formation and in the mass of the bone[25] causing ischaemia under the area of the plate.[26]

The biocompatibility of titanium implants has been demonstrated histologically,[27] and the titanium oxide surface of the implant has been shown to improve the quality of the very thin layer of proteoglycans into which collagen filaments are obvious only 20 μm from the oxide surface.[28] However, further documentation is needed to prove the suitability of titanium applied over bone surface and bone defects, as well as exposed to cavities of maxillary, frontal or ethmoidal cavities.[29]

Titanium mesh is considered a valuable material for the orbital floor reconstruction because it is adaptable to the orbital contour; it is strong in thin sections permitting the bridging of larger defects than other materials like silicone which tend to sag. It does not produce many artifacts on CT scans and radiographs. It does not migrate because connective tissue grows through and around its lattice structure. And last, it can be sterilized in conventional autoclaves.[23]

In a long series of orbital reconstructions in which three or four walls of the anterior and middle orbit were destroyed, titanium mesh was useful as it allowed the conversion of large defects to smaller ones, making bone grafting easier and more stable.[22]

Also, individually shaped titanium mesh filled with bone grafts can be used for maxillary defects resulting not only in good cosmetic appearance but permitting the construction of a simple prosthesis or even endosseous implants[14] as in other jaw defects[5,11-13] and augmentation of the edentulous alveolar ridge.[15,16]

The cost of a titanium-mesh kit is less than most mini-plate kits although screws and mesh are more expensive. But this cost is offset by the following because the number of mesh panels is fewer or the same as that of mini-plates needed for the same procedure; fewer screws are required to hold mesh than for the same osteosynthesis with mini-plates; there is no need for different plate lengths and shapes, and there is a saving of time due to the rapidity of the procedure with the mesh technique.[5]

There are two considerable disadvantages. First, the fact that initial mandibular fractures were often approached extraorally for the placement of mesh panels.[10] However, mandibular fractures approached intraorally with subperiosteal placement of the mesh to the lateral aspect of the mandible have proved equally rapid and effective.[5] Secondly, there is a difficulty when mesh panels have to be removed, because the connective tissue grows around and through the lattice structure of the panels.[23] This may not be a real disadvantage since less than 2 per cent of the 108 titanium mesh placements[5] and only one of the 56 extraoral titanium mesh placements[10] required removal, whereas 17 per cent and 7 per cent of mini-plates used for trauma and for orthognathic operations respectively required removal.[30] Also, in relation to the orbital floor, where defects are larger than 25×25 mm, it is better that they be routinely bone-grafted or reconstructed with single thin titanium sheet because of the fear of difficult removal.[23] However, as the connective tissue is growing around and through the lattice structure of the mesh,[28] it is worth mentioning that of the 38 cases with large defects in three and four walls of the anterior and middle orbit treated with titanium mesh plates, only two required removal because of infection from paranasal sinuses in a three-year follow-up period.[22]

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