IMPLANT TRIDIMENSIONAL DE TITAN CU FORMĂ ANATOMICĂ PENTRU RECONSTRUCȚIA UNEI FRACTURI DE PLANȘEU ORBITAR CU DEFECT LARG POSTERIOR: CAZ CLINIC

3D ANATOMICALLY SHAPED TITANIUM IMPLANT FOR THE RECONSTRUCTION OF AN ORBITAL FLOOR FRACTURE WITH LARGE POSTERIOR DEFECT: A CASE REPORT

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The orbital floor has several anatomical features which are essential during reconstruction. The task of reconstructing the orbital floor wall is difficult and usually exist an important discrepancy between the shape of the implant to be inserted and the anatomical three dimensional shape of the orbital wall. We present the case of a 25 years old woman, with a left orbital fracture after domestic assault; for the reconstruction of the defect from left orbital floor, we used a Matrix Orbital plate, with minima adjustments to the length of the plate, not to the predesigned contour. The follow up extended 6 months after the titanium implant with excellent biocompatibility. The Matrix Midface Preformed orbital plate has the advantage of insertion without contouring, except bending and trimming of the fixation holes, thus is more independent on experience of the surgeon.

Planșeul orbitar are mai multe trăsături anatomice care sunt esențiale în timpul reconstrucției. Sarcina reconstrucției planșeului orbitar este dificilă și, de obicei, există o discrepanță importantă între forma implantului care urmează a fi inserat și forma tridimensională anatomică a planșeului orbitar. Prezentăm cazul unei femei de 25 de ani, cu o fractură orbitară stângă după agresiune; pentru reconstruirea defectului din planșeul orbitar stâng, am folosit o placă Matrix Orbital din titan, cu ajustări minime la lungimea plăcii, nu la conturul predefinit. Supravegherea s-a efectuat până la 6 luni după realizarea implantului de titan cu o biocompatibilitate excelentă. Placa orbitară Matrix Midface are avantajul introducerii fără conturare, cu excepția îndoirii și frezării găurilor de fixare, fiind astfel mai independentă de experiența chirurgului.

Keywords: *titanium, implants, orbital floor, fracture, reconstruction*

1. Introduction

The task of reconstructing a fractured orbital floor wall, especially the infero-medial one, is difficult. Usually exists an important discrepancy between the shape of the implant to be inserted and the anatomical three dimensional shape of the orbital wall [1]. Just the simple fitting of an implant in place, does not restore the original form of the respective bony wall. Also, the misposition of the implant, creates interferences with the normal functioning of the extraocular muscles, or can alterate the correct volume of the orbit, which leads to double vision, or ocular dystopia [2].

In order to avoid such complications, the surgeon must know the subtleties of the anatomical shape of the bony wall of the orbit in order to restore it's form as precisely as possible. In many cases, the surgeon has to modulate by hand the titanium implant, copying the particular anatomically form of the orbital floor to rich a perfect fitting [3]. But how one must be able to do so, when the orbital wall is completely fractured, and the periorbital tissues are herniated? In this article we are making a case report with a large posterior defect into orbital floor where we are exploring the advantages of a 3D anatomically shaped titanium implant developed by Synthes, versus the standard preformed titanium plates.

The orbital floor has several anatomical subtleties, which are of outmost importance when one is about to do a reconstruction [4]. On recreating the delicate curvatures of the floor of the orbit, the surgeon must keep in mind that, the complex geometry consists in an initial short flat-convex section behind the rim and then it dives inferiorly for about 15 mm, past the orbital fissure and then continues upwards to the superior orbital

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fissure [5]. None of the walls are flat, they are curvilinear in shape, and it must be noted that the transition to the medial orbital wall is not very well defined [6].

Small defects can be reconstructed using resorbable or teflon membranes, whereas large defects involve stable materials for long term support of the orbital contents – titanium implants which are well tolerated and do not induce inflammation or oxidative stress injuries [7].

We noticed also that, the severity of the trauma it is not entirely dependent on the size of the defect and the number of the walls involved, but also on the localization. The defects localized on the anterior side of the orbit, have limited influence over the globe position meanwhile the fracture involving the posterior and medial wall, lead to herniation, and hypoglobus [1].

The accuracy of the reconstruction is evaluated using the sagital and coronal CT scans postoperatively, and in particular is evaluating the posterior extension of the implant, which needs to stand firm on the posterior edge, the orbital plate of the palatine bone [3].

After the reconstruction, the patients are typically evaluated up until 6 to 9 months, when a stable result is obtained.

2.Case report

A 25 Year old woman experienced a left orbital floor fracture after a domestic assault, with acute vertical diplopia, discomfort in all fields of gaze, vertigo.

The preoperative computed tomography scan showed a major fracture of the left orbital floor, with minimum involvement of the medial wall, and important herniation of the orbital soft tissues in the maxillary sinus, including the inferior rectus muscle which is elongated (Figure 1).

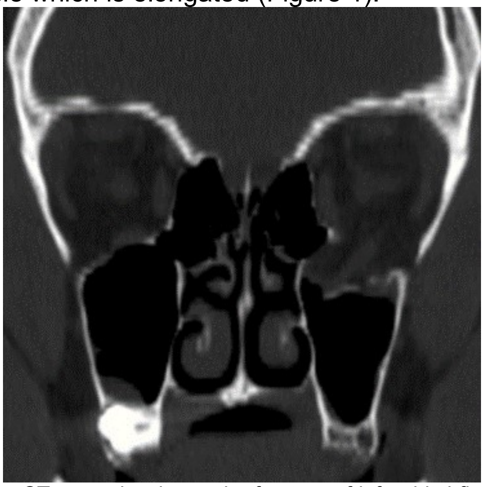

Fig. 1 - CT scan showing major fracture of left orbital flour with important herniation of the orbital soft tissues into the left maxillary sinus / *CT scan care arată o fractură masivă a planșeului orbitar stâng, cu herniere importantă a țesuturilor moi orbitare în sinusul maxilar stâng.*

We used a subtarsal approach for the orbital wall, with subperiosteal dissection to expose the fractured orbital floor (Figure 2).

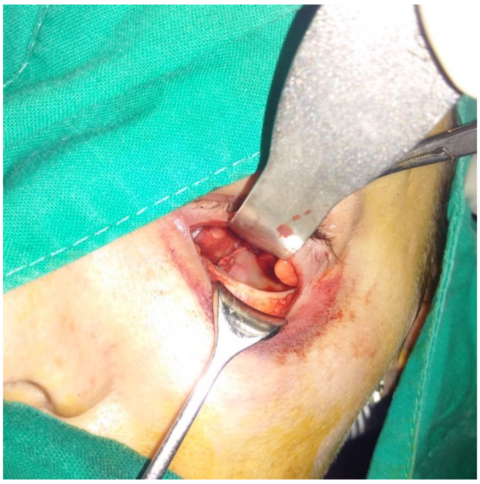

Fig. 2 - Intraoperative aspect showing the fractured orbital floor before reduction / *Aspect intraoperator care arată planșeul orbitar fracturat înainte de reducere* .

The extent of the defect was important, medial to the infraorbital canal, and posteriorly to the orbital palatine plate. After the repositioning of the soft tissue, the defect was reconstructed with the Matrix Orbital (TM) plate (Figure 3). The letter,,L'' on the plate is for left orbital floor.

Fig. 3 - Image of the Titanium implant – Matrix Orbital (TM) Plate */ Imagine a implantului de titan – placă Matrix Orbital (TM).*

We made minimal adjustments to the length of the plate, not to the predesigned contour. (Figure 4).

The control radiography of cranium profile two days after surgery showed a very good tolerance and a correct position of the Matrix orbital plate (Figure 5).

Fig. 4 - Intraoperative aspect after reconstruction with the Matrix Orbital plate / *Aspect intraoperator după reconstrucție cu placa Matrix Orbital*

Fig. 5 - Postoperative control radiography two days after surgery, showing the correct position of the Matrix Orbital plate / *Radiografie de control postoperator, care arată poziția corectă a plăcii Matrix Orbital .*

The follow-up extended as in the other cases, 6 months after the titanium implant was inserted, and the clinical assessment showed good support of the orbital structures and the globe, and excellent biocompatibility with no signs of local inflammation.

3.Discussion

The typical disadvantages of the standard preformed titanium plates include the difficulties derived from the time consuming „free hand" adaptation of the plate, which is prone to traumatic intraoperative bleeding and possible damage to the delicate and thin tissues of the periorbit [8].

The repeated adjustment of the uncontoured implant can lead to errors of position, and posterior stabilization of the plate. The most common fear of the surgeon is the risk of damaging the optic nerve, so the posterior extension of the dissection to the stable bony ridge of the orbital process of the palatine bone and the length of the plate are usually not sufficient [9].

This is the most common problem when reconstructing with the usual titanium implants- the titanium mesh or the preformed titanium implant. The lack of posterior support, on the long term leads to enophtalmus and persisting diplopia [2].

The ideal material for orbital reconstruction remains a matter of controversy between different authors, with numerous materials available for this purpose, including cartilage from the nasal septum, polydoxanone sheet, teflon, calvarial bone, titanium mesh or other [10,11]. The more elastic materials are not resistant enough to withstand the dynamic stresses of large bony orbital defects, and can induce foreign body reactions, and relapse via late resorption. In the past, the use of autogenic bone has been the gold standard in orbital wall reconstruction. Usually calvarial bone was used due to maximal biocompatibility and low cost. However, the harvesting of autogenous bone is associated with donor site morbidity, variable degree of resorption, prolonged total operating time, postoperative pain, scaring. Also autologous bone grafts are usually rigid and cannot be bend to match the concave-convex shape of the orbital floor, and provide less drainage from the orbit than with titanium [10].

Porous polyethylene sheets (PPE) presents the advantage of easy contouring and smooth edges, but are not radiopaque and can present a lack of rigidity in heavily displaced fractures with massive tissue herniation into the maxillary sinus. However, infection is the most disastrous complication with the use of the PPE in the orbital wall reconstruction. Composite of porous polyethylene and titanium are increasingly being used to prevent postoperative enophthalmus, but that are recent reports that show the risk of late complications such as infection, diplopia and implant migration associated with them [12, 13].

An alternative resorbable material consisting of stiff sheets of pure polyglactin – polydioxanone (PDS) implants to bridge small-to-moderate defects has been described. After resorption of the implant, the resulting scar might not be stiff enough in all cases to provide adequate support for the globe and to prevent sagging of the periorbita into the maxillary sinus. Another drawback of pure PDS was that degradation may lead to an inflammatory reaction involving the surrounding periorbita, with possible scar formation and consecutive functional motility disturbances of the globe, leading to recurrence of diplopia [14,15].

Titanium implants have o long history in the reconstruction of all types of midface defects, with proven biocompatibility and efficiency. Orbits reconstructed with titanium mesh show better results than those reconstructed with bone grafts, especially for posterior fractures which may produce important haemorrhage or granuloma [15, 16]. It is malleable and therefore easily adapted to the shape of the orbital defect and it is the most biocompatible of all available material. Because of the mesh structure, connective tissue can grow around and through the implant and prevent migration. It is also preferred in significant fractures with large defects. However this has the potential disadvantage of making the implant very difficult to remove if required, and may lead to complication. The standard titanium implants (Figure 6) – mesh or preformed, which are not 3D contoured, involve "free hand" time consuming adaption in the defect zone, and are dependent on the experience of the surgeon involved [17].

Fig. 6 - The standard titanium implant for reconstructing orbital floor fractures / *Implantul de titan standard pentru reconstrucția fracturilor de planșeu orbitar.*

The Matrix Orbital plate (TM) made from pure titanium developed by Synthes using a big pool of data from CT scan data, closely reproduces the complexity of the anatomy of the human orbital floor and medial wall. It comes in 2 sizes (small and large) specifically designed for the left and right orbital medial and inferior floor. Therefore, it reduces to a minimum the amount of surgical time; it facilitates the plate insertion through the incision line, and has very little interference with the surrounding soft tissue. But the most important feature in our opinion is the possibility of accurately restoring the shape of the posterior orbital floor, which leads to a correct position of the globe.

4.Conclusion

The Matrix Midface Preformed orbital plate has the advantage of insertion without contouring, except bending and trimming of the fixation holes, thus is more independent on experience of the surgeon. It easily adapts to the contour of the fractured walls, reconstructing the difficult three dimensional convex-concave anatomy of the orbit, and the precise volume of the orbit and consequently restores the correct position of the globe.

By avoiding the necessity of contouring the implant in place, it avoids posterior incontrollable malposition of the implant, and reduces the risk of damage to the optic nerve. It can be placed in the same location for every patient, regardless of the anatomy of the fracture. It can be safely secured at the orbital rim with titanium screws.

Ethical approval

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

Acknowledgment

We would like to acknowledge the contribution of our radiologist Dr. Andreea Marinescu, she has done an accurate CT scan and radiological examinations.

Competing interests

Authors have declared that no competing interests exist.

Authors' contributions

This work was carried out in collaboration between all authors. Authors Cătălin Florin Cîrstoiu, Daniela Vrînceanu, Bogdan Bănică and Raluca Papacocea designed and wrote the first draft of the manuscript. Authors Cătălin Florin Cîrstoiu, Daniela Vrînceanu, Bogdan Bănică and Toma Papacocea were the operating surgeons. Authors Raluca Papacocea and Toma Papacocea managed the literature searches. All authors read and approved the final manuscript.

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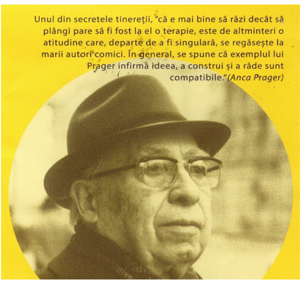
CENTENAR – ROMANIA MARE 1918 – 2018



CONFERINŢA - EMIL PRAGER (1888-1985) – 130 de ani

În ziua de 25 mai 2018 a avut loc în casa Costa-Foru din Dealul Mitropoliei nr. 7, evocarea personalităţii inginerului EMIL PRAGER, la 130 de ani de la naştere, de către domnul inginer constructor Nicolae Şt. Noica. Acesta l-a cunoscut pe Emil Prager în anul 1984 când avea 96 de ani, fiind decanul de vârstă al inginerilor constructori din ţara noastră. Lectura lucrării ,,Betonul armat în România" scrisă de Emil Prager la vârsta de 90 de ani, l-a determinat pe domnul Noica să preleveze două grinzi din beton armat dintr-un planşeu al spitalului Brâncovenesc după demolare, pentru a le testa la Facultatea de Construcţii din Bucureşti. Când i-a prezentat rezultatul testului domnului Emil Prager, acesta l-a felicitat.

Emil Prager s-a născut în august 1888, a urmat cursurile liceului Gheorghe Lazăr, secţia reală, apoi Şcoala Naţională de Poduri şi Şosele (în prezent Universitatea Politehnică Bucureşti din str. Polizu) care avea un regim militar. A avut următorii profesori eminenţi: Constantin Mironescu, David Emanoil, Anghel Saligny, Elie Radu, Ion Ionescu-Bizeţ, Grigore Cerchez, Grigore Capşa ş.a. În anul 1912 devine inginer în cadrul Ministerului Lucrărilor Publice când are legături cu şantierele de construcţii din portul Constanţa unde se foloseşte betonul armat. Printre primele sale lucrări au fost: Casa de Credit a PTT, Muzeul Etnologic din Kiseleff, proiectul Şcolii de Arhitectură (împreună cu prof.ing.arh. Grigore Cerchez). În timpul primului război mondial a lucrat la Direcţia Generală a Muniţiilor condusă de Anghel Saligny, când s-a ocupat de refacerea căilor ferate, a podurilor ş.a.

În anul 1925 a creat Antrepriza de Construcţii Emil Prager care s-a ocupat de construcţii civile, drumuri, căi ferate, canalizări, construcţii industriale, energetice, monumentale. În Bucureşti a construit: Palatul Regal, Academia Militară, Palatul Ministerului Afacerilor Interne, clădirea Fundaţiei Dalles, blocul Zodiac, clădirea Muzeului Ţăranului Român, iar la Ateneul Român, în urma bombardamentelor din 1944, s-a ocupat de refacerea cupolei acoperişului, a ornamentelor interioare şi a coloanelor. De asemenea, a construit Palatul Foişor de la Sinaia ;I Biblioteca Central[Universitară - Iași

În anul 1948 antrepriza a fost naţionalizată şi a lucrat ca inginer şef la Întreprinderea Sovrom Construct iar în 1958 devine inginer principal în Direcţia tehnică a Ministerului Energiei Electrice, unde activează până în anul 1980, având vârsta de 92 de ani.

Demn de semnalat este gestul nobil al lui Emil Prager faţă de fostul său profesor Ion Ionescu-Bizeţ care, grav bolnav, avea nevoie de sprijin financiar. Cu delicateţe, pentru a-l menaja, Prager i-a propus publicarea în trei volume şi 200 de exemplare a diverselor lucrări şi articole apărute în decursul vremii. Astfel, au fost editate „Povestiri Ştiinţifice şi Tehnice" spre a fi un sprijin profesional generaţiilor viitoare de ingineri constructori. Veniturile obţinute au acoperit tratamentul medical de care Ionescu-Bizeţ avea imperioasă nevoie.

Conferinţa a avut scopul de a-l prezenta pe Emil Prager ca model demn de urmat pentru performanţa, rezultatul unei instrucţii şi educaţii alese, a unei firi cutezătoare şi tenace. Şi-a marcat viaţa prin lucrări remarcabile de o frumuseţe şi trăinicie impresionante [1].

1. lucrarea EMIL PRAGER UN MODEL, autor Nicolae Şt.Noica

Virginia Moldoveanu