ORIGINAL ARTICLES

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Autologous versus synthesis materials used in the surgical closure of CSF leak

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Abstract: *The evolution of the endoscopic skull base surgery in the last ten years had led to the development of new surgical reconstructive techniques. In the endoscopic reconstructive surgery of the CSF leaks both synthesis and natural materials. The advancement of the endoscopic reconstructive surgery was closely linked with the production of new synthesis materials. The aim of the paper is to compare the efficacy of synthesis versus natural materials in the closure of CSF leaks and to point out certain rules of when and where to use a synthesis or natural material.*

INTRODUCTION

In the reconstructive surgery of the skull base, the surgeon can use both natural and synthesis materials.

The developments of the endoscopic surgery of the skull base had led to removing bigger tumors from high-risk areas that were not suitable for endoscopic surgical approach up to now. The endoscopic surgical approaches tend to replace the external approaches even in malignant tumors of the skull base in selected cases.

Because of that, the surgeon started to encounter more defects at the level of the skull base with or without CSF leaks.

New surgical reconstructive techniques started to be developed in close connection with the production of new surgical reconstructive materials and adhesives. [1]

The materials used in the reconstruction of the skull base defect can be divided in autologous tissue and synthesis reconstructive materials.

Autologous tissues that are used in the reconstructive skull base surgery are: fascia, cartilage, bone, fat, free mucosal grafts, vascularize flaps and free flaps with micro anastomosis.

Fat can be used to obliterate dead space or to plug a CSF leak.[1]

Fascia lata or fascia temporalis can be placed in an underlay technique between the dura and the skull base or overlay technique in the sinus cavities. Multilayered fascia lata was effective especially in the management of open cisterns or in cases of another type of high-pressure CSF leak.[2]

Bone or septal cartilage are placed in the underlying tech-

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nique and are used to support the larger reconstruction of the skull base.[3]

The free mucosal grafts can be used in the closure of small skull base defects with or without CSF leak.

The vascularized flaps can be used to reconstruct large defect with a high rate of success.

When loco regional vascularized flaps are not available, and we are dealing with large defects, we can use free flaps with micro anastomosis.[3]

Autologous tissue is popular because their availability, biocompatibility and does not involve a cost. We have to take into account the morbidity of the donor site and the additional time that it will be spent in the operating room. All the autologous materials can be harvest with minimal difficulty, and the harvesting process can be planned.[4,5]

One of the advantages of the autologous materials is the rapid incorporation in the surrounding tissue. Hoseman demonstrated that the free middle turbinate mucosa graft was fixed after six days and the re-epithelization had been seen microscopically after 12 days. The autologous grafts do not produce an important inflammatory response, an important quality for patients that do require follow up endoscopic or imagistic exam because unnecessary biopsies will be avoided.

Disadvantages of autologous grafts are the limited tissue availability, and the additional incision is created. The major complication is not reported, but the donor site can sometimes associate pain, minor complications and require additional healing time.

The synthesis materials use in the skull base surgery can be divided into two categories: acellular human dermis and engineered collagen products.

Acellular human dermis (Alloderm) is used in many anatomical areas in the head and neck surgery in the last ten years. Multiple layers reconstruction at the level of anterior and middle cranial fossa had proved to be effective. Studies have been shown a successful closure of the CSF leak in 90-100% of cases on the first attempt. Additional surgical harvesting time is not required. The material has to be soaked for ten minutes before use. The acellular human dermis is a low skink age material. Crusting may occur for about eight weeks. Some authors have raised the theoretical risk of transmitting prion-mediated diseases, despite the fact that the skin is not known to be a reservoir of infectious material as Creutzfeldt Jacob disease. A recent study has shown that in the USA more than two million patients had undergone reconstruction surgery using acellular dermis grafts without any case of infection.

The other category of synthesis materials are the engineered collagen products that are the result of advancement in bioengineering. Those type of products is collagen-rich sponges from the animal that were processed to remove all cells and antigens. The animal collagen matrix is chemically treated to induce a cross-linking among the collagen fibrils. The result is a porous matrix of collagen. Those products are designed to fully incorporate into native tissue using remodeling collagen technology with minimal surrounding tissue inflammatory response. Histopathologic studies have shown a fibroblast infiltration starting with four weeks after surgery a full incorporation in surrounding dura by 16 weeks after surgery.

Studies reported that the bigger the pore size it is (100 µm) the fastest incorporation we have. For matrixes with a pore size between 10-20 µm the fibroblast population started to grow after six months. In cases of small pore size (5 µm), no fibroblast migration was seen after six months from the surgical reconstruction. Severe inflation is rarely seen when using collagen-based products.

The skull base surgery also needs a rigid support in cases of important defects. Synthesis materials used for creating the rigid support are poly-methylmethacrylate, hydroxyapatite, titanium mesh or plates and polytetrafluoroethylene.

Methylmethacrylate products are easier to use comparing the hydroxyapatite products due to the faster hardening time (10 versus 30 minutes). Another important quality of the methyl-methacrylate is the ability to hardening in a wet field. Studies have shown that after using them in reconstructive surgery, both materials give a minimal inflammatory response.

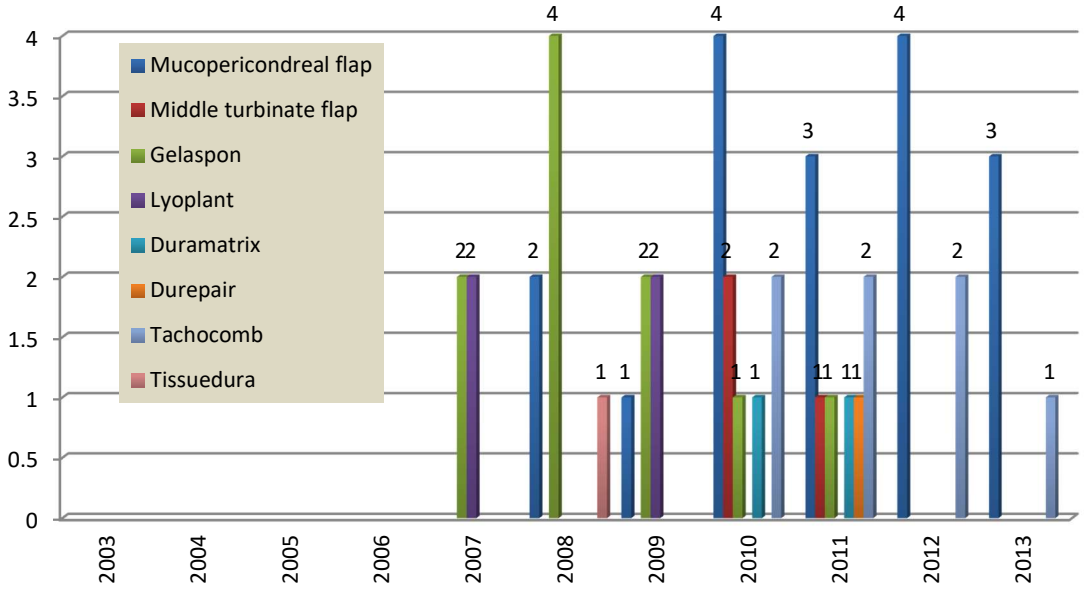
Titanium mesh and plates are malleable, are easy to see on imaging exams are quite safe to use in skull base reconstruction. Esposito found migration or dislodgement of the titanium mesh in 3 from 378 patients.

The surgeon must present the risk of a skull-base during dissecting the tumor and all the related risk to the procedure and the risks of not having the surgical treatment and the alternatives to the surgical treatment.

The surgeon is obliged to present to the patient all the reconstructive alternatives techniques, materials, biological glues used in the skull-base reconstruction.

Advantages, disadvantages, surgical risks and risks that occur if the reconstruction is not performed.

Table 1 – Synthesis and natural materials used in reconstructive surgery of the skull base in period 2003-2013



MATERIAL AND METHOD

We have used in our practice as synthesis materials collagen-based products. We have used starting with the year 2007 the following collagen products: Gelaspon, Lyoplant, Duramatrix, Durepair, Tachocomb, Tissuedura.

First, we have used those type of products to reconstruct small skull base defects with or without CSF leak in underlay and underlay technique. The important inflammatory response was not encountered. The results were good, and the primary closure of the CSF leak was 100%. The advantages of the synthesis products are the high availability, an important quantity of material availability and total integration in the host dura. The main disadvantage is the price of those products. We recommend using collagen-based materials in small skull base defects. When we are dealing with important defects of the skull the reconstruction using solely collagen-based product is not recommended, in that cases, the collagen products have to be used with vascularized intranasal or extra nasal flaps with rigid support.

RESULTS AND DISCUSSION

The natural materials that we have used in skull base reconstruction are fascia, cartilage, bone, fat, free mucosal grafts, vascularize flaps and free flaps with micro anastomosis. The main vascularized flaps that we have used are the mucoperichondrial septal flap described by Haddad and the middle turbinate flap.

CONCLUSION

We consider that naso-septal Haddad flap type to be the best option in skull base reconstruction due to its

good vascular supply and versatility. The vascular supply of that flap is the septal branch of the sphenopalatine artery. We have never encountered necrosis of the flap even after radiotherapy. In case of recurrence the flap can be reused, it can be taken down, preform ablative surgery and reposition the flap. The surgeon can cover defects up to 25 cm^2. The surgeon will have a limitation in pediatric population up to 13 years due to the development of the nasal septum that can lead to the insufficient surface of the flap. The flap can include the mucosa from the nasal fossa floor; it can be prepared bilateral or contra-lateral.

Acknowledgement
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