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Comparative Characteristics of Bone-Plastic Materials for Mastoidoplasty

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Abstract

The paper presents the results of the comparative characteristics of the use of various bone-plastic materials for mastoidoplasty. The study included 30 patients who underwent an open-type sanitizing operation with mastoidoplasty with osteoplastic materials. When comparing drugs, the following criteria were used: 1) convenience of modeling the material; 2) the course of the wound process; 3) osseointegration - the process of formation of "new bone tissue (CT of the temporal bones 6 and 12 months). As a result, it was confirmed that the samples of the main groups of bone replacements studied by us. preparations (biositalls, composite materials and β- tricalcium phosphates) can be successfully used in mastoidoplasty after open types of sanitizing operations on the middle ear.

Keywords: Mastoidoplasty; Bone-Plastic Materials; Collapan; Biosit-Elkor

Abbreviations: CT: Computed Tomography; HU: Hounsfield Scale.

Introduction

Despite significant achievements in the field of otosurgery, the improvement of the technique of operations on the middle ear remains relevant to this day. One of the ways of surgical treatment of patients with chronic purulent otitis media is the so-called “open type” of sanitizing surgery, in which the posterior bone wall of the external auditory canal is removed. As a result, a trepanation cavity is formed, in which the inflammatory process is often preserved. One of the causes of the “disease of the trepanation cavity” is its significant volume [1,2]. In order to reduce the size of the trepanation cavity, mastoidoplasty is performed, including using bone-replacing materials. Currently, the pharmaceutical market presents a large number of substances for bone grafting of domestic and foreign production, which raises the question of choosing the drug optimal for a particular clinical situation. Publications with the results of the use of bone-plastic materials began to appear in the domestic literature relatively recently, mainly during operations in traumatology and orthopedics, maxillofacial surgery, oncology [3,4]. Osteoplastic materials are implantable materials that promote bone formation by providing osteo-conductive, osteoinductive or osteogenic function. The following compounds are most often used: bioglass, composite bone-plastic materials, bone allografts.

Bioglass (biositalls) refer to modern materials of the latest generation, consisting of a vitreous matrix and microcrystals about 4 μm in size. Biositals when implanted in a bone defect are not encapsulated, but are in direct contact with bone tissue. A necessary condition for the binding of this material to bone tissue is the formation of an apatite

layer on their surface in a biological environment. This layer is formed as a result of the chemical reaction of the glasses with the surrounding biological fluid, in which calcium ions are released, and a hydrated layer of silicon oxide is formed. In the Russian market there are preparations Biogran (Biomet, USA), Nova Bone (USBiomaterialis, USA), Perio Glas (Block Drug Company, USA), Biosit-Elkor (ELKOR, Russia, registration certificate No FSR 2011/11634).Russian drug is a bioactive osteosaciating material, which includes oxides of calcium, silicon, aluminum, magnesium, zinc and dallite.

Composite bone-plastic materials or composites are a mixture of several synthetic and / or biological materials with a synergistic effect. Composites consist mainly of a mixture of hydroxyapatite (from 30 to 50%) and binding biopolymers, mainly collagen. Collagraft (Zimmer, USA), Gen-Os (Alpha-bio, Israel), Biomplant (Konectbiofarm, Russia), KollapAn (Intermedapatite, Russia, registration certificate No FSR 2011/10304).In particular, KollapAn is available in the form of granules, plates and gel. It consists of artificial hydroxyapatite, collagen and antimicrobial substance [5]. The diameter of the granules is from 1 to 6 mm. Porosity is more than 90%. The choice of Kollapan in the form of granules, plates or gel is due to the convenience of filling bone defects of various shapes and locations. "CollapAn" is a biocompatible, gradually resorbable and at the same time replaced by a newly formed bone matrix that has antibacterial, osteoinductive and osteoinductive properties and has a multifactorial effect on the processes of activation of reparative osteogenesis.

β-tricalcium phosphates(β-TCF)- a group of drugs, Combining a complete chemical analogue of bone minerals. Also have absolute biocompatibility, contribute to easier penetration of osteogenic cells and diffusion of biological fluids between its particles. Produced Cerosorb ("Curasan", Germany), ChronOs putty ("Synthes", Switzerland, FS 2006/147). ChronOS putty is a synthetic material for bone replacement (β-TCF). ChronOS putty is used in all cases when it is possible to use a spongy autograft. This material combines the main factors: porosity, the relationship of macropores and micropores which provides the most optimal conditions for the formation of bone tissue [6,7]. The filler has a porosity of 60% for granules and 72% for blocks. The size of macropores ranges from 100 to 500 μm. This creates optimal conditions for vascularization and migration of osteoclasts and scaffolds. Times measures of micropores less than 10 μm, which speeds up the remodeling process [8-10]. The ideal time required for the formation of bone tissue is the period from 6 to 18 months. As a result of the special chemical composition and the main factors, the material most quickly and effectively forms "new bone tissue". The process of resorption and bone formation occurs simultaneously. If resorption occurs too quickly, then osteoblasts lose the "platform" necessary for the formation of new bone tissue. If the bone material resolves too slowly or not completely, then it will not be replaced by bone tissue in an adequate period of time.

The purpose of the study is to conduct a comparative characteristic of the use of various bone-plastic materials for mastoidoplasty.

Patients And Methods

The study included 30 patients diagnosed with chronic purulent epitympano-antral otitis media. All patients were informed about the upcoming surgical treatment, materials used for mastoidoplasty, which is confirmed by written consent. The age of the patients ranged from 18 to 60 years. Men - 20 people, women - 10 people. The main complaints were purulent or mucopurular discharge, hearing loss, tinnitus, dizziness. At the time of surgery, all patients had no exacerbation of the inflammatoryprocess. Mastoidoplasty was performed to reduce the volume of the trepanation cavity. In the preoperative period, all patients underwent a complete general clinical study, otomicroscopy, otoendoscopy, audiometric examination, tuning fork examination of the auditory analyzer, computed tomography of the temporal bones. Patients were divided into 3 groups of 10 people each. In the 1st group, CollapAn (Composite bone-plastic materials) was used, the 2nd group was ShronOS putty (β-TCF),in the3rd - biosit-elkor (bioglass).

The study included 30 patients diagnosed with chronic purulent epitympano-antral otitis media. All patients were informed about the upcoming surgical treatment, materials used for mastoidoplasty, which is confirmed by written consent. The age of the patients ranged from 18 to 60 years. If necessary, surgical intervention was supplemented with tympanoplasty and ossiculoplasty. Rubber-gauze turunds were placed in the cavity, which were removed after 14 days. In the postoperative period, standard antibacterial and symptomatic therapy was performed.

When comparing the drugs, the following criteria were used: 1) the convenience of modeling the material by size and shape of the trepanation cavity; 2) the course of the wound process - the reaction of the surrounding tissues (hyperemia, edema), the presence of discharge in the trepanation cavity, the displacement of the graft into the trepanation cavity. The assessment was carried out at the time of removal of turunda, after 1,6,12 months; 3) osseointegration - the process of formation of "new bone tissue", corresponding to the density of the patient's bone tissue (CT of the temporal bones 6 and 12 months).

Results and Discussion

The most convenient material for modeling the size and shape of the trepanation cavity is ChronO Sutty, because it has very good plasticity. CollapAn is worse modeled, since relatively large granules mix relative to each other. In addition, the material, being in the wound, increases in size, so it is necessary to fill only 2/3 of the volume of the trepanation cavity. Biosit-Elkor is also less convenient to work with than ChronOS putty. Granules of the drug when compacted easily shift relative to the original location.

Inflammatory changes in the surrounding tissues when using ChronOS putty were absent. When using Biosit-Elkor, 1 patient had hyperemia in the behind-the-ear region during the first 2 days. CollapAn caused a reaction of surrounding tissues in the form of hyperemia, edema and soreness in the behind-the-ear region in 2 out of 10 patients during the first 3 days.

At the time of removal of turunda from the ear canal, there was no significant difference both during the examination of paraauricular tissues and during otoscopy. On examination 1 month after surgery, all patients did not have an inflammatory reaction of tissues in the behind-the-ear region. During otoscopy, the mastoidal cavity retained its given shape, partially epidermisized, there was a scant wound discharge. When using the drug Biosit-elkor in 2 cases out of 10 in the trepanation cavity, a small amount of the drug was found outside the grafts covering the obliteration zone. After 6 months, patients had good epidermization of the mastoidal cavity, the absence of pathological discharge. After 12 months, during otomicroscopy, in all cases, complete epidermization of the trepanation cavity, the absence of pathological discharge was noted. When feeling the implantation sites with a button probe, a dense surface was determined.

Computed tomography (CT) scan of the temporal bones was performed 12 months after surgery. To assess the density of the material in the implantation area, the Hounsfield scale (HU) was used. according to which the organs differ in their density. The study was conducted on the apparatus SIEMENS AR HP with a scanning thickness of 2 mm. In the visual evaluation of tomograms in all cases, there was a lack of a clear boundary of the implant and the surrounding bone tissue, which indicates good osseointegration.

Conclusion

Thus, the samples of the most common currently studied groups of bone-replacing drugs (biositalls, composite materials and β-TCF) can be successfully used in mastoidoplasty after open types of sanitizing operations on the middle ear.

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