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SPONTANEOUS VERSUS GUIDED BONE REGENERATION OF BONE DEFECTS IN THE JAWS

СПОНТАНА НАСПРОТИ ВОДЕНА КОСКЕНА РЕГЕНЕРАЦИЈА КАЈ КОСКЕНИ ДЕФЕКТИ ВО ВИЛИЦИТЕ

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Abstract

Aim: The goal of this work is to compare the bone density and regeneration of the bone with or without using the GBR technique after cystectomy, using the x-ray examination. **Material and method:** The clinical case includes two male patients, at the age of 30 and 40 with detected radicular cysts in the mandible right and maxillae left quadrant. They are clinically and radiologically observed in a period of 12 months. In both cases we performed completely removing of the cyst lesion (enucleatio in toto) and by protocol the patients received antibiotic therapy in a period from 7-10 days. In one case, the bone substituents were applied – xenograft (Geistlich Bio-Oss® -spongiosa bone granules 0,25-1 mm) and collagen resorptive membrane (Geistlich Bio-Gide® 25x25 m), to cover the augmented bone defect. **Results:** Following the regeneration by using radiological examination after 12 months, we noticed differences in the bone density and presence of mineralized trabecular bone. In the case when we used GBR technique, there was higher bone density and the bone defect was completely filled with new mineralized bone. In the other case, we detected spontaneous bone healing with new trabecular bone, with a presence of smaller number of new trabeculas and radiolucent zone, indicating that the mineralization of the bone was not completed. **Conclusion:** Using the graft materials in large bone defects supports the spontaneous bone regenerative process and enables faster restoration of the anatomo-morphological structure and functionality part of the bone. **Key words:** radicular cyst, cystectomy, GBR, spontaneous bone regeneration

Апстракт

Цел: Целта на овој труд е да се спореди коскениот дензитет и нејзината регенерација со и без користење на GBR техинка, по цистектомија и истата да се проследи рентгенографски. **Материјал и метод :** Клиничкиот приказ вклучува двајца пациенти од машки пол, на возраст од 40 и 30 години со радикуларна циста во пределот на мандибуларен десен и максиларен лев квадрант.Случаите се проследени клинички и рентгенолошки во период од 12 месеци. Во двата случаи е направено коплетно отсранување на цистичната лезија (enucleatio in toto) и протоколарно пациентите примаа антибиотска терапија во времетраење од 7-10 дена. Користени се коскените супституенти - ксенографт (Geistlich Bio-Oss®(спонгиознен коскен супституент со гранули 0,25 – 1 mm / 0,5 = 1cc) и колагена ресорптивна мембрана (Geistlich Bio-Gide® 25x25 m). **Резултати:** Радиолошкото проследување на коскената регенерација по 12 месеци, резултираше со различен коскен дензитет и присуство на минерализирани табекули. Во приказниот случај каде се употреби GBR техника, беше присутен поголем коскен дензитет и коскениот дефект беше целосно исполнет со нова минерализирана коска. Во другиот приказен случај, каде имаме спонатана коскена регенерација има присуство на помал број нови трабекули и радиолусцента зона, која наведува дека минерализацијата на коската е некомплетна. **Заклучок:** Употребата на коскените графтови во големи коскени дефекти, ја поддржува спонтаната коскена регенерација и овозможува побрзо враќање во првобитната состојба на анатомо-морфолошките структура и функционалноста на коската. **Клучни зборови:** радикуларна циста, цистектомија, GBR , спонтана коскена регенерација

Introduction

Cysts in the orofacial region are of great clinical importance, according to the high frequency of occurrence and the possibility of their extension that can cause anatomical and pathological disturbances. Kramer1 in 1974 defines them as pathologic cavity having fluid, semifluid, or gaseous content but not always is lined by epithelium. WHO classificate them in two types: epithelium and non-epithelium cyst lesions. In the group of epithelium are: developmental (odontogenic and non-odontogenic) and inflammatory cysts.

Inflammatory cyst lesions are developed from the odontogenic epithelium under direct influence of the inflammation and continuous irritation of bacterial nature. Radicular cyst1 is the most common pathological

lesion among the odontogenic cysts of inflammatory nature, and its origin in cell rests of Malassez which are remnants of Hertwig's root sheath and is a product of the odontogenic epithelial layer. The reason of the appearance is the inflammation of the pulp or necrosis, retained roots, dental trauma and cavity's. They are asymptomatic and slow grow in a direction of a less resistance, where they cause elongation of the buccal cortical plate and possible asymmetry of the alveolar ridge. They have wide age range from 21-59, more often located in the maxilla 60% in the frontal region (Shear, 1992)[2]. Their treatment is surgical which means fully removal of the cyst lesion (enucleatio in toto), or marsupialization. The aim of the treatment is fully anatomic and functional regeneration of the malfunction in the jaw bones.

The bone regeneration is a process depending on the physiological time of the osteogenesis balanced by remodeling. It goes through several phases: inflammatory–proliferative phase (1-14 days), reticular bone tissue (2-6 weeks), callus formation (6-8 months), fully maturation of the bone and remodeling. In the transformation of the non-differential osteogenic cells special role play BMP (Bone Morphogenetic Proteins) and growth factor[3].

Postoperative bone regeneration is mostly based on a spontaneous creation of functional vital bone, and depends on various factors like the size defect, the degree of the vascularization, the integrity of the periost and the spongiosa bone, general health condition, age etc. Generally, as a result of a richer vascularization, regeneration in the upper jaw is faster compared to the lower jaw[9,12].

In the literature are described various techniques available for regeneration of the deficient alveolar bone. These include: the use of barrier membranes for GBR, particulate grafting materials, onlay block grafting techniques, distraction osteogenesis, ridge split techniques, the future applications of molecular factors to stimulate the rate of bone formation, and in severe defects, a combination staged approach of these techniques[6].

Guided bone regeneration (GBR) is set as an assuming, effective method for controlling the reparative osteogenesis[7,8]. The concept for GBR is described for the first time in 1959 and is based on principle of using barrier membranes for space maintenance over a defect. To ensure successful GBR[19], four principles need to be met: exclusion of epithelium and connective tissue, space maintenance, stability of the fibrin clot, and primary wound closure.

GBR procedure is indicating when we have: local alveolar ridge deficiencies (horizontal or limited vertical); osseous fill around immediate implants; dehiscence, fenestration and bone defects associated with implants; residual bone lesion; aid repair of sinus membrane perforation. In this procedure can be use non-resorbable barriers (ePTFE, titanium reinforced ePTFE, high-density PTFE or titanium mesh membranes) and bioabsorbable barrier membranes (of animal and synthetic origin). In clinical appliance bioabsorbable barrier membrane are preferred[9].

Bone grafts fall into few categories: autograft, allografts, xenografts, alloplasts and biological mediators of autologen materials. The same are used independently or combined?.

Xenografts are biocompatible and osteoconductive, produced from deproteinized bovine bone mineral, but it can sustain coral structure as well. It contains interconnective pore which cause rapid revascularization and are used as precursors of the ossification. Osteoblasts that produce a new bone, after which follows the mineralization so they are deposited on the surface on the granules. In the latest period they are combined with bio substrates-growth factors.

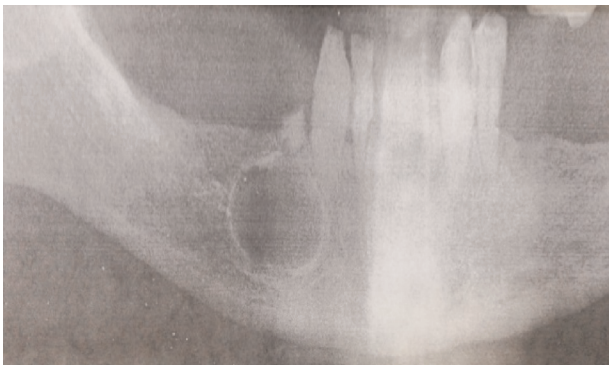
The aim of this study is to reveal the voluminous bone changes and regeneration with or without the application of the GBR technique after enucleation of the medium cyst size formation using orthopantomography. In one of our cases, we used a xenograft and collagen membrane, and in the other, we followed the spontaneous bone regeneration.

Case presentation

Case no. 1

Patient of the age of 47 registered at the Clinic of oral surgery at the Dental clinic Center in Skopje, cause of the presence of a retained root (picture no.1) in the lower

Picture 1. *Presence of a retained root in the lower jaw with registered partial and terminal anodontia.*

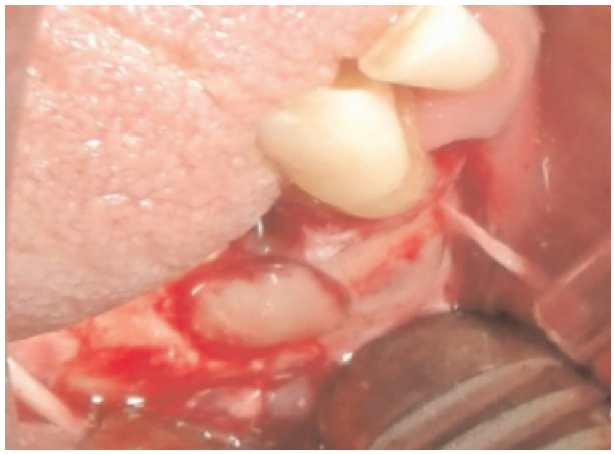


Picture 2. *Radiographic examination before the surgery*

Picture 3. *Crestal with vertical incision*

Picture 4. ***Present vestibular cortical lamina with dehiscence, and the process of osteotomy.***

jaw with no subjective symptom. With the clinical examination were registered partial and terminal anodontia and elongation of the alveolar ridge in region 44. After radiographic examination (picture no. 2), Cystis radicularis 44 were diagnosed. The size of the cyst measured on the orthopantomography was 35 x 38 mm.



Picture 4. *Present vestibular cortical lamina with dehiscence, and the process of osteotomy.*

Picture 5. *Size of the bone defect before using the GBR technique.*

The surgical intervention was made according to the protocols and the basic surgical principles for treatment of pathological lesion, enucleation of the cyst in general. After the extraction of the tooth 44, crestal incision was made with vertical incision (picture no.3). Osteotomy started from vestibular cortical lamina with dehiscence (picture no. 4), and after the exposition of the cyst, we completely removed it (enucleatio in toto).

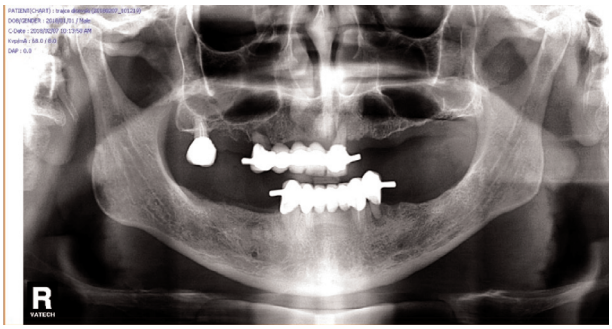
After the cystic enucleation, we applied the Carnoy's solution in the bone defect. The Carnoy's solution consists of 6 ml ethanol, 3 ml chloroform, 1 ml acid acetic and 1 gr of ferric chloride. The advance of using this solution is its ability to demark and fixate the cystic tissue and the haemostatic effect. As for the size of the bone defect (picture no. 5), we recommended GBR technique of the augmentation of the bone to the patient i.e. application of a bone substituent and barrier collagen resorptive membrane.

Picture 6. *Comparing the size of the pathological material with dental scalpel.*

Picture 7. *Applying of bone graft materials with barrier membrane (GBR technique).*

Picture 8. *Post-surgical period (1 day after). No presence of hematoma or edema.*

Geistlich Bio-Oss® (natural, non-antigenic, porous bone mineral matrix, granules 0,25-1 mm/0,5=1cc),



Picture 9. *Radiology examination after one year of guided bone regeneration.*

applied according to Nyman protocol for preparation (picture no.7). The cyst (picture no.6) was sent for pathohistological examination, which confirmed the previous clinical diagnose. Post-surgical period was without the presence of hematoma, edema or neurosensory disorder of the type of repeated paresthesia/anesthesia of n.alveolaris inferior (picture no. 8). In the radiographic examination made after 12 months we could notice that the bone lesion was completely filled with bone (picture no.9)

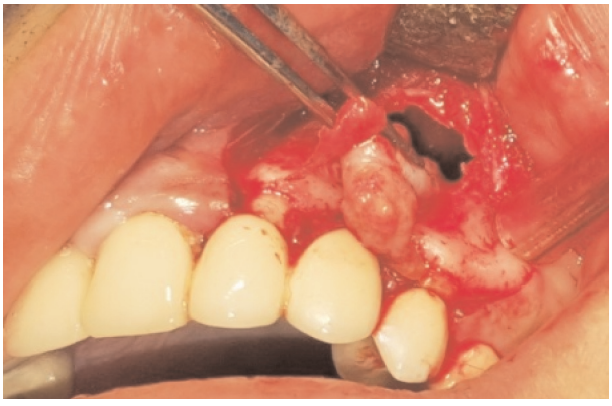
Case no. 2

Patient of age of 32 registered at the Clinic for oral surgery on the Dental Clinic Center in Skopje, with subjective symptoms (pain). With the anamnesis we obtained elaborated fixed-prosthetic construction on the upper jaw four years ago. During the clinical examination an intraoral fistulae was detected that persisted more than one month, gingival recession on the 22 and 24 with presence of the color change and the inflammation of the gingivae. With palpation an elongation was detected on the alveoli ridge in region of 23, and during the horizontal and vertical percussion of the teeth 22 and 24, was no pain detected. The radiographic examination confirmed the missing of the left canine and the presence of pathological lesion that matched the residual cyst-Cystic residuals with a size of 40 x 40 mm, with pathohistological examination after enucleation.

Picture 1. *Radiographic examination before the surgery*

Picture 2. *Present vestibular cortical lamina with dehiscence*

Picture 3. *Process of osteotomy and exposed cyst lesion, using trapezoidal flap design.*



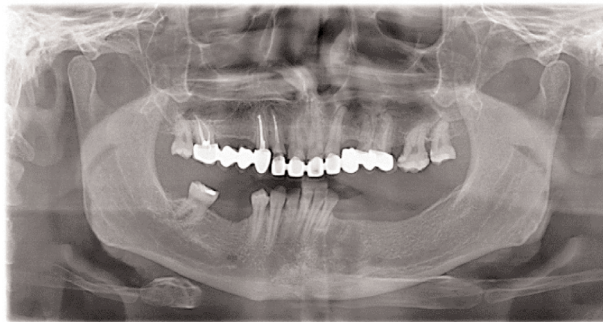
Picture 4. *Process of complete enucleation of the cyst lesion..*

A trapezoidal flap design was made and osteotomy followed, with enucleatio in toto. Apart from the case no. 1, we didn't use bone substituent and the osseous defect

Picture 5. *Bone defect size after complete enucleation of the cyst.*

Picture 6. *Comparing the size of the pathological material with dental mirror.*

Picture 7. *Post-surgical period (1 day after), without presence of hematoma or edema.*



Picture 8. *Radiology examination after one year of spontaneous bone regeneration..*

was recovering according to spontaneous regeneration. After observing the patient for 12 months period, we could see the bone regeneration on the operative field.

Discussion

The therapeutic goal of any extirpative surgical procedure is to remove the entire lesion and leave no cells that could proliferate and cause the recurrence of the lesion10. The surgical treatment of cysts is discussed without regard to the type of cyst, except for the types that warrant special consideration. Decompression and marsupialization of the cysts11 of the jaw were first suggested by Partsch in the German literature in 1892 and in many parts in the world they are still described as Partsch I and II procedure. Marsupialization (Partsch I) can be used either as the sole therapy for the cyst or as a preliminary step in management, with enucleation deferred until later. On the other hand, enucleation is the treatment of choice for removal of cysts of the jaws and should be used with any cyst of the jaw that can be safely removed without unduly sacrificing adjacent structures. The bone regeneration after cystectomy in normal cases is depending on: the shape, size and location of the cysts, surgical methods, age, and health status of the patients.

Spontaneous and guided bone regeneration is a topic of discussion of many authors. Rubio E. and Mombrú C., present the success of spontaneous bone regeneration after cystectomy. According to them it is preserved from the periost and the morphological elements of the peripheral part of the bone defect. The periost shows a fully osteogenic potential and its cambial layer contains number of non-differential osteogenic cells. At the moment of injury of the bone tissue, these non-differential cells turn into functional osteoblast capable to produce bone (Fawcett, 1986). At the same time, in the peripheral bone defect starts proliferative phase of the blood vessels to end up in the difference of the peripheral fibroblasts in the functional osteoblasts that produce the osteoid matrix that mineralizes later. The 18 patients were divided according to their age, histopathology diagnosis, postoperative control time, and percentage of bone regeneration. 20 patients (66,6%) had 100% bone regeneration after 6 months of cystic enucleation. In the remaining six patients, bone regeneration was approximately with an average of 65,43%. In cases where one of both bone plates (buccal or palatine / lingual) was destroyed by the lesion, bone regeneration was clearly lower. The measurement was made by using Pro-Nemotec program and Nemoceph Densitometric Tool—at the point of intersection (PI) of the lines mentioned earlier pre-operative and 6 months post-intervention. According to this study, histology of the cyst, the size doesn't have any significant effect on the bone regeneration, until the bone lamina is present even after the cyst enucleation[12].

In a clinical prospective randomized controlled trial by Santamaría no statistically differences have been found between bone regeneration with and without the use of membranes (GBR) after enucleation of inflammatory radicular cysts in 30 patients[13].

Chiapascohave reported 81,30% reduction of the residual cavity and 91% increase in bone density, at 24 months of control in a study of 27 patients with cysts larger than 40 mm without the use of bone grafting materials[14].

In particular, it has been established that if one or both bone plates (buccal and lingual or palatal) are destroyed by the lesion, the area would not completely fulfill with bone, but it will leave a residual fibrous scarthat will manifested by a radiolucency[13,14.]

In our case that we use GBR technique, we have 100% bone regeneration with good mineralization of the new formed bone. Compering with the case no.2 where we did not use GBR technique, the final results its slow process of regeneration where we have partial bone regeneration, with good results of it in the distal part of the lesion and with less in the mesial part where we have lack of mineralization and maturation in progress after 12 months of observation. The small osteogenic potential and slow mineralization are the reasons for slow and incomplete bone regeneration that it's going more like reparation than process of regeneration.

After all, the bone tissue has a limited regeneration. In large mandibular defects if no augmentation materials are used, the process of healing takes a long period of time and often ends without full success. Ciapinski D, Niedzielska I, Witowski A. in their study explained the need of filling the defect with materials that have ability to activate all basis mechanism of bone regeneration: osteoconduction, osteoinduction and osteogenesis[15].

The guide of GBR includes: creation of proper chamber, the flow of blood clot, perforation of cortico-spongy part for the increase of vascular, cellular and molecular elements needed for the regeneration process and the use of barrier membrane for the prevention of invasion from tissue that can impede the regeneration. The completed defect covers with the collagen resorbs barrier membrane that enhances the graft retention in the settled position[3].

Lalabonova H.and Daskalov H.,the aim of their article is to report a case of delayed complication occurring 8 years after the performed cystectomy of the maxilla. They explain the importance of implicated factors that

affect negatively in the reparatory process of osteogenesis, like the presence of devitalized teeth on adjacent closure, the size of the cyst and the adjacent closure of anatomic-morphologic structures (nasal and sinus cavity) which can be possible source of infection in the postoperative cavity. The multiple recurrences of the cysts after their enucleation indicate poor regenerative capacity of the body which resulted in the formation of cicatricle tissue. They recommend the use of GBR in cases of large bone defects that usually occur after enucleation of jaw cysts, even though maxilla has a great potential and capacity for spontaneous regeneration, by which at the end they use the method and results positively[16].

In the examination in the last 15 years the application of biologic mediators are included which accelerate the human bone regeneration[3,17]. Thus, Pappalardo S. and Guarnieri R. in their study used these principles for enhancing the osteoconductive property of a new highly purified bovine allograft (Laddec®) by addition of autologous PRP in regeneration of osseous defects of jaws caused by cystectomy. Radiographic assessments of present study indicated that this association induced a faster new bone growth in the cystic cavities. It was observed that the defect was filled by 56% at the first month, and after a time interval of 6 months postoperatively the defect was filled by 92%, showing a significant increase in vertical height on postoperative successive periapical radiographs[17].

Many studies show the importance and benefits of using biological materials in the development of the tissue i.e. regeneration potential. Autologous plasma as a great growth factor source from different origins (cytokine, morphogen and mitogen) attains the soft tissue and the bone healing when a rapid regeneration is needed, i.e. PRP allows the organism to use the advantage for normal physiological healing for fast injury recovery, so the application is related to effective tissue reparation and regeneration. FR many times are showed like proteins that firstly cause proliferation and differentiation from mesenchymal stem cells in osteoblasts, and then proliferation in the human cells which depending on their concentration of PRP increase, that clinically results with increased bone regeneration that later on with a stimulation for a mitogen activity of human trabecular cells leads to healing of bone tissue[3].

A combined therapeutic approach consisting of filling the defect with augmentation material, covering it with a barrier membrane and closing the wound is considered by the majority of authors as the best way of treating intraosseous defects in the jaws. In the control group where the bone defect is not treated with bone substituent, later is mainly completed with bone marrow where trabecular bone is detected in a significant small number vs. comparing to both examination groups in which GBR technique is used. They are less vascularized, that is the other confirmation of slow dynamic of the reparatory process[18].

Conclusion

Bone regeneration is slow process that depends of the time and it takes few months i.e. a year. Spontaneous bone regeneration of bone defects after the enucleation depends on the size of defect, histological type, health state and age of the patient. If we have lack of some of these conditions, the possibility for spontaneous bone regeneration decreases. GBR technique regarding the osseous defects in the jaws is superior and helps for producing more mineral structure, higher density and faster regeneration than spontaneous one. Regarding to this, the pursuits is faster back up of anatomy-morphological structure and functional part of the bone.

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