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Use of mineralized dentin graft in augmentation of different indication areas in the jaw bones

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SUMMARY

Introduction Extracted teeth are still considered clinical waste and therefore are being discarded. It is evident that obtained and prepared autogenous dentin graft (ADG) may be used for guided bone regeneration (GBR) due to its similar biochemical characteristics to human bone.

The aim was to present a novel procedure in a clinical setting that employs freshly extracted teeth that are processed into a bacteria-free particulate dentin, and then grafted immediately into the extraction sites or bone deffects. Monitoring the clinical and radiological parameters (vertical and horizontal dimensional changes on the alveolar ridge and vertical dimension of intrabony defects at the distal aspect of the second molar after extraction of third molar) for a period of 6 months, proved rapid healing capacity of ADG on the bone and soft tissue structures in the jawbones.

Material and methods Clinical measurements were performed using a questionnaire for monitoring the postoperative clinical manifestation, bone measuring calipers for measuring horizontal changes of the alveolar ridge and graduated probe for measuring vertical dimensional changes, also paraclinical-radiological examinations to follow-up bone density.

Results During the follow up period of six months, clinical measurements of post-extraction dimensional changes of the alveolar ridges showed minimal horizontal and vertical bone resorption with preserved alveolar ridge volume, with an accelerated bone regenerative process without special postoperative complications.

Conclusion Dentin particulate grafted immediately after extractions should be considered as gold standard due to its osteogenetic, osteoinductive and osteoconductive effects on bone tissue regeneration.With the use of mineralized dentin matrix we get maximum utilization of our own biological potential without the use of other artificial graft materials.

Keywords: autologous dentin graft; bone substitutes; socket preservation; Smart dentin grinder

INTRODUCTION

Different biomaterials (autograft, alograft, ksenograft or aloplastic) have been used to stimulate or improve bone gain in post-extraction sites. Autogenous bone continues to be considered as golden standard in bone augmentation, as it is the only option that fulfills the criteria of osteogenesis, osteoconduction and osteoinduction [1, 2]. Nevertheless, it suffers several disadvantages due to its limited availability, unpredictable early resorption and associated morbidity at the donor site. To avoid disadvantages of other graft materials, an alternative idea came to use their own extracted teeth to obtain a graft material that is completely identical to the bone autologous graft. Autogenous dentin graft (ADG) prepared chairside may be used for guided bone regeneration (GBR) because both alveolar bone in maxillofacial region and teeth embryologically are derived from the same neural crest cells and have similar biochemical contents and characteristics to human bone [3].

The tooth as a complex organ is rich source of stem progenitor cells, collagen fibers, metal ions, growth and development factors (BMPS, IGF, PDGF, TGF, etc). Dentin is present in 85% of the total tooth mass, in essence dentin is an acellular matrix unlike bone containing osteocytes. Although tissue structures of bone and dentin are different, the ratio of components is similar (mineral 70%, collagen 20%, body fluid 10% by weight) [4].

The first documented evidence of regenerative-osteoinductive potential of autologous dentin graft was provided by the study of Yeomans and Urist in 1967 who discovered that dentin contains BMP's and growth factors. This research was forgotten for nearly half a century until implant dentistry showed interest in optimal extraction site management. The first clinical case used in human body was sinus lifting – described in 2003 by Korean scientist Masaru Murata. From 2008 it has been used mainly for guided bone regeneration (GBR) in dental implants' osteointegration [4]. Recycled teeth "GREEN DENTISTRY" can make the best overall graft material with best economical, clinical and biological value that are shown in the Table 1.

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Table 1. Recycled teeth as graft material
Tabela 1. Reciklirani zubi kao graft materijal

ECONOMIC VALUE Ekonomska vrednost	CLINICAL VALUE Klinička vrednost	BIOLOGICAL VALUE Biološka vrednost
Low cost Jeftina opcija	No immune reaction Nema imunog odbacivanja	Low resorption Mala resorpcija
Reduce graft inventory Smanjuje potrebu za drugim materijalom	Painless procedure Bezbolna procedura	Excellent osseous ankyloses Izvanredna osteointegracija
Reduce number of visits Smanjuje broj poseta	Easy and simple process Jednostavan proces	Osteogenic Osteogenetski potencijal
Recycle teeth – Green Dentistry Reciklaža – zelena stomatologija	"doggy bag" graft for future use Graft koji se može i kasnije koristiti	Slow release of GF over a long time Otpušta faktore rasta produženo vreme
Graft volume / 3× more Količina grafta / 3× veća	bacteria free / no disease transmission Nema bakterija, nema prenošenja zaraznih bolesti	Hard "cortical like" graft quality Dobar kvalitet grafta
Easy to explain Jednostavna	Quicker prosthetic restoration Brža protestska rehabilitacija	Attract progenitor cells and contains stem cells Privlači progenitorske ćelije

MATERIALS AND METHODS

Protocol and procedure for obtaining and preparation of mineralized dentin matrix

The process from tooth extraction until grafting takes approximately 15 minutes. All needed equipement for this procedure is shown on Figure 1.Vital teeth without root canal fillings that are extracted due to advanced periodontal bone loss or other indications like wisdom teeth extraction or orthodontics indications, are prepared for immediate grafting. Immediately after extraction, any dental restorations or endodontic fillings should be removed. Also carious lesions, remnants of periodontal ligament (PDL) and calculus should be removed using low or high speed handpiece and a tungsten burs or manually with a curette. Clean teeth are dried by air syringe and sterile gauze, put into a grinding sterile chamber of a 'Smart Dentin Grinder'®. SDG is capable in 3 seconds to grind the roots and then by vibrating movements of the grinding chamber for 20 seconds the particles less than 1200 μm fall through a sieve to a lower chamber that keeps particles between 300-1200 μm. In the collecting drawer chamber dentin particles between 300-1200 μm are collected with various quantity of 1-2.5+ mg depending on which tooth serves as a source of receiving dentin graft material.

The particulate dentin from the drawer is immersed in basic alcohol for 5–10 minutes in a small sterile glass container. The basic alcohol cleanser consists of 0.5M of NaOH and 20% alcohol. This solution removes and dissolves all organic waste and eliminates all types of bacteria, viruses etc. At the end of procedure hydration and neutralization of pH value = 7.2 with PBS – sterile phosphate buffered saline (the same procedure repeated twice for 1 min) is performed.

Obtained and purified dentin particles are applied in the desired alveolar region with the help of a special instrument - a carrier or a plastic instrument, the graft material is gently pressed with a compressor to condense in the alveolar socket. Once this is done, a spongy fibrin-Gelatamp is placed on the top to protect applied graft material (ADG). This is followed by suturing with non-resorbable thread 4/0, that is removed after a period of 7–14 day [5]. After surgery, all patients undergo one-week antibiotic therapy Amoxicillin cum ac.clavullonic 1000 mg, 1 tablet every 12 hours as well as non-steroidal anti-inflammatory analgesics, or Clindamycin 300 mg, 1 capsule every 8 hours. Patients are advised to irrigate the surgical wound daily with 0.2% chlorhexidine solution for 15 days.

Clinical parameters

Patients were evaluated at 1, 3, 7, 15 days and 3 months, postoperatively to assess wound healing. At these appointments, patients were given a questionnaire to evaluate postoperative pain, trismus, swelling and used of NSAID. It was also important to describe possible postoperative complications: infection, swelling, paresthesia, hematoma, dehiscence, etc. Measurement of the horizontal dimensions of the alveolar ridge was performed with a special instrument-Bone measuring calipers at 2 and 4 mm below the limbus alveolaris. Measurement of the index of apical-epithelial migration – AEM, clinical loss of attachment (distance from the enamel-cement border to the bottom of the sulcus) in the adjacent tooth (distal surface of the second molar) was done with a periodontal probe. The depth of the formed intrabony defects was also measured during the extraction of the impacted wisdom tooth.

Figure 1. Required equipments and materials for obtaining autologous mineralized dentin graft
Slika 1. Potrebna oprema i materijal za pripremu autolognog mineralizovanog dentinskog grafta

Figures 2, 3, 4. Clinical presentation of alveolar preservation with ADG
Slike 2, 3, 4. Klinički prikaz prezervacije alveolarnog grebena pomoću autolognog dentinskog grafta

These clinical measurements of dimensional changes in the alveolar ridge are performed intraoperatively and over a period of 3 and 6 months postoperatively.

Paraclinical-radiographic examination

Panoramic radiographs were performed 3 and 6 months postoperatively to evaluate bone regeneration and exclude pathologies that might have occurred from surgery. Software Image J (version 1.36b issued by the American National Institutes of Health) was used to analyze ROI (numerical area of interest) values from 0-250 in 1 pixel of the image. Also, with the help of digital panoramix, measurements of vertical bone defects were performed distally from second molar.

CASE PRESENTATIONS

Alveolar ridge preservation immediately after extraction of teeth 34, 35, 48

58-year old patient in good general health was interested in placement of dental implants. Multiple teeth were extracted with simultaneous immediate preservation of the post-extraction alveoli in order to preserve necessary dimensions of alveolar ridge. During this procedure, the alveolar socket of extracted teeth were filled with bone substitute – ADG (Figures 2, 3, 4). This allows primary stability of hard and soft tissues to the level of the limbus alveolaris, thus preventing buccal alveolar collapse of the preserved alveole. Clinical measurements were performed after 6 months with the help of a bone measuring instruments in position 1) 2mm below the limbus alveolaris (Table 2), and in position 2) 4 mm below the limbus alveolaris (Table 3). Both measurements showed a minimum of 1-2 mm of bone reduction of the alveolar ridge, while in the lower part of the alveolar ridge there was no visible dimensional change (Figure 5). Clinically, there was no significant postoperative symptomatology (pain, swelling, trismus) or any special complication.

After the tooth extraction, remodeling of bone and soft tissue structures is an inevitable physiological process that occurs in the residual alveolar ridge. Due to that fact, maintaining the volume of alveolar ridge by preserving socket immediately after tooth extraction plays an important role in implant therapy.

Table 2. Intraoperative measurements with Bone measuring calipers
Tabela 2. Intraoperativna merenja pomoću specijalnih kalipera

Tooth number **Broj zuba**	**#48**	**#34**	**#35**
In position 2 mm below limbus alveolaris *2 mm ispod limbus alveolarisa*	9 mm	8 mm	8 mm
4 mm below limbus alveolaris *4 mm ispod limbus alveolarisa*	10 mm	8 mm	9 mm

Table 3. Measurements 6 months postoperatively with Bone measuring calipers
Tabela 3. Merenja 6 meseci postoperativno pomoću specijalnih kalipera

Tooth number **Broj zuba**	**#48**	**#34**	**#35**
In position 2 mm below limbus alveolaris *2 mm ispod limbus alveolarisa*	9 mm	7 mm	6 mm
4 mm below limbus alveolaris *4 mm ispod limbus alveolarisa*	9 mm	8 mm	8 mm

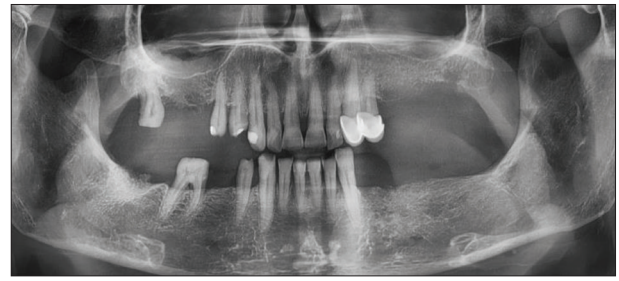


Figure 5. Panoramic imaging 3 months after pocket preservation with ADG
Slika 5. Ortopan tri meseca posle aplikacije autolognog dentinskog grafta

Autogenous dentin grafting of osseous defects distal to mandibular second molars after extraction of impacted mandibular molar – 38

Patient was willing to participate in the study, in good general health, without periodontal disease, and had at least one impacted molar tooth that was mesially inclined in relation to the second molar whereas the roots of the tooth 38 were in direct contact with mandibular canal (Figure 6, 7, 8).

After a period of 6 months, the index of AEM-apical epithelial migration of the adjacent tooth distal to the second molar during preservation with ADG measured with a graduated probe showed a value of 1 mm, ie. there was

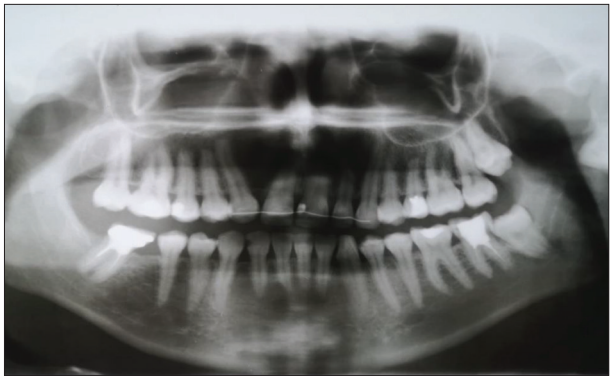
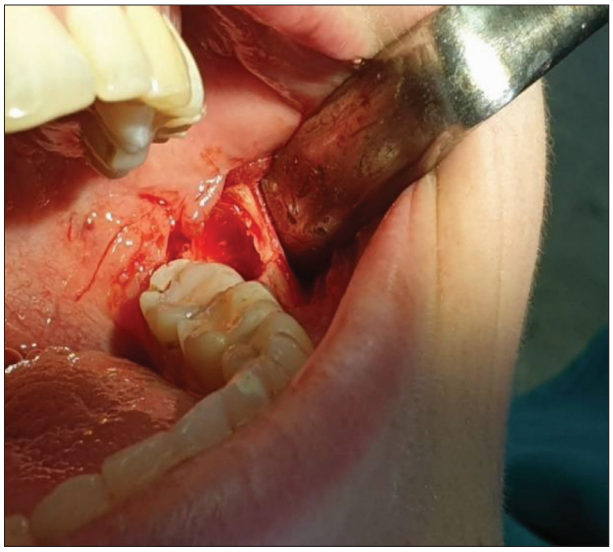


Figure 6. Pre-operative RTG imaging (mesially inclined 38)
Slika 6. Preoperativni ortopan (mezijalno impaktiran umnjak)

Temporary paraesthesia of the left lower lip was observed postoperatively for a period of 3 weeks. Kugelberg and colleagues found that 2 years after surgery, 43.3% of cases exhibited probing pocket depths exceeding 7 mm, and 32.1% showed IBDs (infrabone defects) of more than 4 mm [6].

Use of autologous dentin graft in augmentation of bone defects in jaw bone

50 years old patient admitted with insignificant swelling and pain in the left maxillary region complained of the same symptomatology for 2 years (associated with the teeth 22 and 23) with periodic exacerbations of the



Figures 7, 8. Intraoperative presentation of the preservation of osseous defect distal to the mandibular 2nd molar
Slike 7, 8. Intraoperativna prezentacija očuvanja koštanog defekta distalno od mandibularnog drugog kutnjaka

Figure 9. 6 months postoperatively, preservation of osseous defect distal to mandibular 2nd molar after extraction of impacted mandibular molar (#38)
Slika 9. Šest meseci postoperativno, prezervacija defekta kosti distalno od donjeg levog drugog kutnjaka posle ekstrakcije donjeg impaktiranog umnjaka (#38)

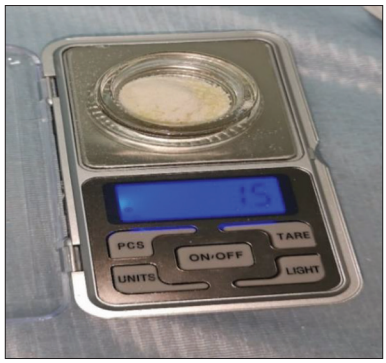
complete coverage of the defect created by osteotomy of the impacted mandibular molar. There was no damage to the periodontium of the adjacent tooth 37 or sensitivity. The roof of the mandibular canal was covered with autologous dentin graft (Figure 9).

disease. He was treated many times symptomatically with antibiotics and drainage of swelling without removing the cause - radicular cyst. And the second cystic area was in position of tuberositas maxillaris lateralis sinistra that was asymptomatic.

Complete cyst enucleation was performed in the left frontal region (maxilla) and cystic membrane-method according to Partch II by completely filling the osseous defect with obtained mineralized dentin graft (1.5 mg) was performed. The cyst in the tuber maxillae was completely removed without being augmented with any graft material (Figures 10–13).

In the period after 3 months, a control digital panoramic X-ray was made, where with the help of a special Software – Image J (version 1.36b issued by the American National Institutes of Health) the density of newly formed bone with numerical values from 0-255 grey in 1 pixel of an image was measured. A value of 0 refered to the black color of the X-ray image (brightness), while 255 refers to the white color, complete x-ray absorption (shading) [7]. In our specific case, augmented osseous defect showed a solid bone density of 178 gray, which indicated faster process of osteointegration and regeneration of new

Figures 10, 11. Total enucleation of the radicular cyst and ADG augmentation
Slike 10, 11. Totalna enukleacija radikularne ciste i augmantacija kosti ADG-om



Figures 12, 13. Obtained mass of ADG from extracted teeth
Slike 12, 13. Dobijena masa ADG/a od izvađenih zuba

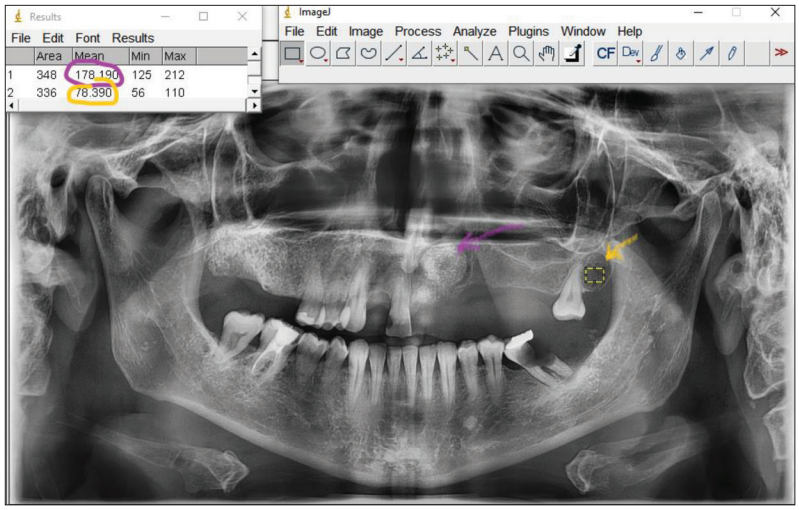


Figure 14. 3 months postoperatively RTG presentation of augmented osseous defect in the left maxillary region
Slika 14. Tri meseca postoperativno na ortopanu nadograđen koštani defekat u levoj maksilarnoj regiji

bone tissue, while the non-augmented osseous defect shows higher luminosity of 77 grey (Figure 14).

DISCUSSION

A treatment option to reduce the risk of future periodontal pathology mesial to the IMMT surgical site is the use of osseous grafting to preserve distal aspect of the second mandibular molar. Use of commercially available osseous grafting products, however, increases the cost of treatment for the patient, which may lead to their rejection. An ADG has been documented as a reliable graft source when socket preservation is being performed and for other osseous grafting applications, as it has been noted that large amounts of new woven bone formation were generated after 60 days of healing, and small amounts of lamellar bone were seen after 90 days.

Resorption of the ADG particles is slow (because of mineralized structure); therefore, lamellar bone is formed with stability of the resulting bone over time. Studies have supported that formed cortico-cancellous bone was maintained successfully with an implant after an average follow-up of 5 years.

The use of autologous dentin graft significantly minimizes the resorption of the residual alveolar ridge as seen in our cases. This is confirmed by the thesis of Vittorini et al. who concluded that preservation of alveolar ridge is significantly better treatment than without preservation, where there is minimal loss of vertical and horizontal bone. He specifically pointed out the need to preserve alveolar ridge in highly aesthetic zones where the thickness of the buccal lamina was less than 1.5 mm – 2 mm, and in cases where anatomical structures such as maxillary sinus and mandibular canal are in close proximity.

On the follow up, the bone ankylosed to dentin produced very stable alveolar ridge that otherwise would be resorbed during 3-6 months after extraction. This grafted site preserved the alveolar ridge both functionally and esthetically. It can be utilized for implant insertion after 3 months in the maxillary posterior region, changing it from D3 bone into D1 bone [7].

Impacted third molar extraction surgery is a very common procedure for prophylactic orthodontic or therapeutic oral surgery [8]. The frequency of impaction lies between 66% and 77% [9]. Statistically, it's estimated that 20 million teeth are extracted each year just in the USA, 30% of teeth are extracted because of periodontal support and mobility, and 10% of extracted teeth are wisdom teeth (impacted). In most instances these extracted teeth are discarded as biological waste instead to take advantage of the fantastic properties they possess. Standard surgical extraction of impacted third molar could lead to a compromised periodontal status of the adjacent second molar, which might necessitate additional future surgical treatment.

According to Schropp et al, about 50% of the overall reduction in horizontal and vertical dimensional changes occurs in the first 12 months after augmentation, of which the first 2/3 of resorption occurs in the first 3 months after extraction (3.8 mm) [10]. The reduction width of the alveolar ridge without bone augmentation during the process of natural healing of the extraction wound ranges between 2.6 - 4.6 mm while the height of the ridge decreases by 0.4 - 3.9 mm, while horizontal resorption shows average value of 3.87 mm with simultaneous reduction of vertical dimensions with an average value of 1.67 mm [11, 12].

Extracted teeth can no longer be considered as medical waste material due to the fact that in a short period of time graft material with great safety and significant biological importance can be obtained. With the use of mineralized dentin matrix we get maximum utilization of our own biological potential without the use of any other artificial graft materials.

CONCLUSION

The use of grafting at the time of surgical extraction of impacted third molars can aid in the prevention of site resorption during healing and has been documented to help formation of osseous tissues on the distal aspect of the adjacent second molar.

It is a cost-effective approach for the patient and allows the surgeon to employ autologous bone grafting material, which is often preferable, for GBR (guided bone regeneration).

Clinical process of bone and soft tissue healing is accelerated and with calm clinical flow without more pronounced oedema and pain with relatively preserved vertical and horizontal dimensions of alveolar ridge.

Postoperative X-ray shows early formation of the new bone (trabeculae) with excellent osteointegration of dentinal graft in the osseous defects in jawbones.

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Primena mineralizovanog dentinskog grafta indikovanog u različitim delovima vilične kosti

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KRATAK SADRŽAJ

Uvod Ekstrahovani zubi se još uvek smatraju kliničkim otpadnim materijalom i kao takvi neupotrebljivim. Međutim, jasno je da dobijeni i pripremljeni autogeni dentinski graft (ADG) može biti iskorišćen u vođenoj regeneraciji kosti zbog biohemijskih karakteristika sličnih ljudskoj kosti.

Ciljevi ovog rada su: prikaz novog postupka u kliničkim uslovima kojim se koriste sveže ekstrahovani zubi prerađeni u sterilne dentinske čestice i odmah zatim iskorišćeni kao graft na mestu ekstrakcije ili koštanog defekta; kontrola kliničkih i radioloških promena u periodu od šest meseci na postekstrakcionim defektima na alveolarnom grebenu; dokazati visok potencijal ADG-a u cilju regeneracije čvrstih i mekih tkivnih struktura u viličnim kostima; merenje vertikalnih i horizontalnih dimenzionih promena na alveolarnom grebenu, kao i merenje vertikalne dimenzije intrakoštanih defekta distalno od drugog kutnjaka nakon ekstrakcije trećeg kutnjaka.

Metode Klinička merenja su sprovedena uz pomoć upitnika za kontrolu postoperativnih kliničkih manifestacija, kalipera (osteometra) za merenje šupljine kosti i horizontalnih promena na alveolarnom grebenu, graduiranom sondom za merenje vertikalnih dimenzionih promena. Takođe, sprovedena su i paraklinička, odnosno radiološka ispitivanja da bi se pratio koštani denzitet.

Rezultati U periodu od šest meseci posle ekstrakcije, klinička merenja pokazuju minimalnu horizontalnu i vertikalnu resorpciju kosti uz očuvane dimenzije alveolarnog grebena i ubrzani proces koštane regeneracije bez značajnih postoperativnih komplikacija.

Zaključak Dentinske čestice iskorišćene kao graft odmah nakon ekstrakcije treba smatrati zlatnim standardom zahvaljujući njihovim osteogenetskim, osteoinduktivnim i osteokonduktivnim učincima na regeneraciji koštanih tkiva. Primenom mineralizovanog dentalnog matriksa maksimalno koristimo svoje sopstvene biološke potencijale bez upotrebe drugih arteficijalnih graft materijala.

Ključne reči: autologni dentinski graft; koštani supstituenti; prezervacija alveole; Smart dentin grinder

UVOD

Različiti biomaterijali (autograft, alograft, ksenograft ili aloplastični materijali) korišćeni su da bi stimulisali ili poboljšali koštanu regeneraciju posle ekstrakcije zuba. Autogena kost je i dalje zlatni standard kod koštane augmentacije, kao jedina opcija koja ispunjava kriterijume osteogeneze, osteokondukcije i osteoindukcije [1, 2]. I pored toga, treba pomenuti njene nedostatke zbog ograničene dostupnosti, nepredvidive rane resorpcije i postoperativnog morbiditeta. Da bi se izbegle slabosti drugih graft materijala, pojavila se alternativna ideja korišćenja sopstvenih ekstrahovanih zuba za dobijanje graft materijala, koji je u celosti identičan autolognom koštanom graftu. Autogeni dentinski graft (ADG) pripremljen za vreme tretmana može se koristiti pri vođenoj regeneraciji kosti jer embriološki obe alveolarne kosti u maksilofacijalnoj regiji i zubi potiču od istih ćelija nervne kreste i poseduju slične biohemijske sadržaje i karakteristike kao i ljudska kost [3].

Zubi kao kompleksni organ jesu bogat izvor matičnih progenitorskih ćelija, kolagenih vlakana, metalnih jona, faktora rasta i razvoja (BMPS, IGF, PDGF, TGF itd.). Dentin je prisutan u 85% totalne zubne mase i on je u osnovi acelularni matriks različit od osteocita sadržanih u kostima. Iako su tkivne strukture kosti i dentina različite, odnos komponenti je sličan (70% minerala, 20% kolagena, 10% telesne tečnosti) [4].

Prvi dokumentovani materijal o regenerativno-osteoinduktivnom potencijalu autolognog dentinskog grafta prikazan je u studiji koju su sproveli Yeomans i Urist 1967. g., kojom se u dentinu otkrivaju faktor razvoja BMP i faktori rasta. Ovo istraživanje je skoro pola veka bilo zaboravljeno sve do interesa dentalne implantologije za optimalno i dugotrajno očuvanje alveolarnog grebena. Prvi klinički slučaj upotrebe autolognog dentinskog grafta kod čoveka opisan je od strane korejskog naučnika Masaru Murata 2003. g. pri izvođenju sinus lift operacije. Od 2008. god. se uglavnom koristi za vođenu regeneraciju kosti u osteointegraciji dentalnih implantata [4].

Reciklirani zubi „Green dentistry" mogu ponuditi najbolji graft materijal sa stanovišta ekonomskih, kliničkih i bioloških vrednosti, što je prikazano u Tabeli 1.

MATERIJALI I METODE RADA

Protokol i procedura dobijanja i pripreme mineralizovanog dentinskog matriksa

Celokupni postupak od ekstrakcije zuba do postavljanja grafta traje oko 15 minuta. Sva potrebna aparatura prikazana je na Slici 1. Vitalni zubi ekstrahovani radi uznapredovalog periodontitisa ili ortodontskih indikacija pripremljeni su za imedijantni graft materijal. Neposredno posle ekstrakcije uklanjaju se zubne restauracije i endodontska punjenja, kao i ostaci karioznih lezija na periodontalnom ligamentu i zubnog kamenca pomoću ultrazvuka ili ručnim instrumentima. Očišćeni zubi se suše pusterom i sterilnom gazom i stavljaju se u sterilnu komoru za mlevenje zuba „Smart dentin grindera" (SDG-a). SDG može samleti korene za samo tri sekunde i zatim se vibrirajućim pokretima za 20 sekundi izbacuje kroz sito partikle manje od 1200 μm u donju komoru, koja čuva partikle između 300–1200 μm. U fioci za sakupljanje bile su dentinske partikle između 300–1200 μm sa različitim kvantitetom – od 1 do 2,5+ mg, u zavisnosti od toga koji zub služi kao izvor graft materijala.

Partikulirani dentin iz fioke se potopi u bazičnom alkoholu 5–10 minuta, u malom sterilnom i staklenom sudu. Ovaj rastvor sastoji se od 0,5M NaOH i 20% etanola i njime se obezmašćuje i rastvara sav organski otpad i eliminišu se svi tipovi bakterija,

virusa itd. Na kraju postupka vrši se hidratacija i neutralizacija pH vrednosti do 7,2 uz pomoć PBS-a (fosfat-pufrani salin). Postupak se ponavlja dva puta u trajanju od jednog minuta.

Dobijene i očišćene dentinske čestice stavljaju se u željenu alveolarnu regiju uz pomoć specijalnog instrumenta-nosača ili plastičnim instrumentom. Graft materijal se nežno pritisne nabijačem kako bi se zgusnuo u alveolarnoj čašici. Nakon toga, da bi se zaštitio aplicirani graft materijal (ADG), odozgo se postavlja spongiozni fibrin-Gelatamp, i na kraju ušiva se neresorptivnim koncem 4/0, koji se uklanja nakon 7–14 dana [5]. Posle intervencije, svi pacijenti se podvrgnu jednonedeljnoj antibiotskoj terapiji, koja podrazumeva Amoxicillin cum ac.clavullonic 1000 mg, jedna tableta svakih 12 sati, kao i nesteroidne antiinflamatorne analgetike, ili Clindamycin 300 mg, jedna kapsula svakih osam sati. Pacijenti se savetuju da 15 dana svakodnevno ispiraju hiruršku ranu 0,2% rastvorom hlorheksidina.

Klinički parametri

Klinička merenja se izvode postoperativno prvog, trećeg, sedmog, petnaestog dana i nakon tri meseca da bi se utvrdilo zarastanje rane. Na ovim pregledima pacijenti dobijaju upitnik da ocene prisustvo bola, trizmusa, otoka i upotrebu analgetika, a od važnosti je i da daju opis mogućih postoperativnih komplikacija: infekciju, otok, paresteziju, hematom, dehiscenciju itd. Merenje horizontalnih dimenzija alveolarnog grebena izvodi se specijalnim instrumentom – Bone measuring calipers (osteometar) na 2. i 4. mm ispod limbusa alveolarisa.

Merenje indeksa apikalno-epitelne migracije – AEM, tj. klinički gubitak pripoja (razdaljina između gleđno-cementne granice i dna sulkusa) kod susednog zuba (distalno od drugog kutnjaka). Drugim rečima, meri se dubina formiranog intrakoštanog defekta posle ekstrakcije impaktiranog umnjaka i istovremeno prati se koštani defekt nakon augmentacije autogenim dentinskim graftom. Merenje periodontalnog džepa izvodi se pomoću graduirane periodontalne sonde. Ova klinička merenja dimenzionih promena alveolarnog grebena izvode se intraoperativno i u periodu od 3 i 6 meseci postoperativno.

Paraklinička ispitivanja – radiografija

Panoramska radiografija uradi se trećeg meseca posle operacije da bi se ocenila regeneracija kosti i da bi se isključile moguće komplikacije uzrokovane hirurškim postupkom. Ortopantomogram se uradi postoperativno 3. i 6. meseca zbog merenja denziteta kosti uz pomoć softvera ImageJ (verzija 1,36b, izdata od strane Američkog nacionalnog instituta za zdravlje), koji se koristi za analizu ROI (regija od interesa) sa vrednostima od 0 do 255 greja u jednom pikselu slike. Takođe, pomoću digitalnog panoramiksa izvode se i vertikalna merenja vertikalnih koštanih defekta distalno od drugog kutnjaka.

PRIKAZ SLUČAJA

Imedijantna zaštita alveolarnog grebena posle ekstrakcije zuba (34, 35, 48)

Pacijent, 58 godina, dobrog opšteg zdravlja, zainteresovan je za ugradnju implantata. Iz tog razloga izvedena je multipna ekstrakcija, a istovremeno i imedijantna prezervacija alveola sa ciljem zaštite neophodnih dimenzija alveolarnog grebena. Za vreme ovog postupka, alveolarna čašica ekstrahovanog zuba popunjava se koštanim supstitutom – ADG-om (slike 2, 3, 4). Ovo omogućava primarnu stabilnost čvrstih i mekih tkiva do nivoa limbusa alveolarisa i sprečava bukalni kolaps zaštićene alveole. Klinička merenja su vršena nakon šest meseci pomoću instrumenta za merenje kosti (Bone measuring instrument) u poziciji 1 tj. 2 mm ispod limbusa alveolarisa (Tabela 2), i u poziciji 2 tj. 4 mm ispod limbusa alveolarisa (Tabela 3). Obe merne tačke pokazuju minimalnu koštanu redukciju alveolarnog grebena od 1 do 2 mm, dok u donjim delovima alveolarnog grebena nema vidljivih dimenzionih promena (Slika 5). Klinički nema naglašene postoperativne simptomatologije (bolovi, otok, trizmus), kao ni posebnih komplikacija.

Promene na koštanim i mekim tkivnim strukturama posle ekstrakcije zuba su neizbežan fiziološki proces koji se javlja na rezidualnom alveolarnom grebenu. Upravo zbog te činjenice održavanje volumena alveolarnog grebena pomoću imedijantne prezervacije alveole igra važnu ulogu u terapiji implantatima.

Postavljanje autogenog dentinskog grafta u koštanim defektima distalno od drugog donjeg kutnjaka posle ekstrakcije impaktiranog donjeg umnjaka – 38

Kod pacijenta u dobrom opštem zdravstvenom stanju, saglasnih da učestvuju u studiji, bez periodontalnih oboljenja, postoji najmanje jedan impaktirani umnjak mezijalno inklinirani, a koreni zuba 38 su u direktnom kontaktu sa mandibularnim kanalom (slike 6, 7, 8).

Indeks apikalno-epitelne migracije – AEM susednog zuba distalno od drugog kutnjaka, meren graduiranom sondom šest meseci posle prezervacije ADG-om iznosi 1 mm, što znači da postoji potpuno pokrivanje infrakoštanog defekta nastalog posle osteotomije impaktiranog donjeg umnjaka. Nema oštećenja na periodoncijumu susednog zuba 37, kao ni povećane osetljivosti na njemu. Mandibularni kanal je pokriven sa imedijatno pripremljenim autolognim dentinskim graftom (Slika 9). Temporarna parestezija donje leve usne praćena je postoperativno u periodu od tri nedelje. Kugelberg i saradnici su otkrili da dve godine posle operacije kod 43,3% slučaja dubina džepa premašuje 7 mm, dok je IBDs (infrakoštani defekt) kod 32,1% veći od 4 mm [6].

Primena autolognog dentinskog grafta za augmentaciju koštanog defekta u viličnoj kosti

Pacijent, 50 godina, žali se na neznatni bol i otok u levoj maksilarnoj regiji. Na iste simptome ukazuje dve godine (udruženo sa zubima 22, 23) sa periodičnim egzacerbacijama bolesti, usled kojih je tretiran simptomatskom i antibiotskom terapijom. Vršena je i drenaža otoka. Pritom uzrok ovog stanja – radikularna cista, nije bio uklonjen. Druga cista u delu *tuberositas maxillaris lateralis sinistra* je asimptomatska.

Urađena je kompletna enukleacija ciste i cistične membrane u levoj frontalnoj regiji maksile metodom Partch ll uz kompletno popunjavanje koštanog defekta dobijenim mineralizovanim dentinskim graftom (1,5 mg). Cista u tuberu maxillae je kompletno uklonjena bez augmentiranja bilo kojim graft materijalom (slike 10–13).

Kontrolni digitalni panoramski snimak urađen je posle tri meseca i uz pomoć specijalnog softvera – Image J (verzija 1,36b, izdata od strane Američkog nacionalnog instituta za zdravlje) sa numeričkim vrednostima 0–255 greja u jednom pikselu slike meri se denzitet novoformirane kosti. 0-vrednost odgovara crnoj boji na RTG snimku (prosvetljenje), dok 255 odgovara beloj boji, potpuna x-ray apsorpcija (senke) [7].

U našem konkretnom slučaju, augmentirani koštani defekat pokazuje solidan koštani denzitet od 178 greja, što ukazuje na brži proces osteointegracije i regeneracije novog koštanog tkiva, dok neaugmentirani koštani defekat pokazuje viši luminozitet od 77 greja (Slika 14).

DISKUSIJA

Mogućnost smanjenja rizika od buduće periodontalne patologije mezijalno od hirurške regije IMMT jeste primena koštanog grafta sa ciljem zaštite distalne strane drugog mandibularnog kutnjaka. Upotreba komercijalno raspoloživih koštanih graftova podiže cenu tretmana, što za pacijenta može biti razlog za odbijanje dodatnog postupka. ADG predstavlja pouzdan izvor grafta za prezervaciju alveola i za ostale koštane graft aplikacije, jer se nakon 60 dana zapaža stvaranje velike količine novog koštanog tkiva, a nakon 90 dana i male količine lamelarne kosti.

Resorpcija ADG čestica je spora (zbog mineralizovane strukture), što omogućava dugoročno i postepeno stvaranje lamelarne kosti. Studije su pokazale da se formirana kortikospongiozna kost uspešno održava implantatom u proseku u narednih pet godina.

Kao što su pokazali naši slučajevi, primena autolognog dentinskog grafta značajno minimizira resorpciju rezidualnog alveolarnog grebena. Ovo potvrđuje i teza Vitorinija i saradnika, koji zaključuju da je prezervacija alveolarnog grebena značajno bolji tretman od slučajeva bez prezervacije, gde postoji manji gubitak vertikalne i horizontalne dimenzije kosti. On naročito ističe potrebu zaštite alveolarnog grebena u visoko estetskim zonama, gde je debljina bukalne lamine manja, od 1,5 mm do 2 mm, i u slučajevima gde su u neposrednoj blizini anatomske strukture kao što su maksilarni sinus i mandibularni kanal.

Zapaža se da ankilotična kost stvorena u kontaktu sa dentinom proizvodi veoma stabilan alveolarni greben, koji bi se inače resorbirao 3–6 meseci nakon ekstrakcije. Ovaj graft štiti alveolarni greben kako u funkcionalnom tako i u estetskom smislu. Može se koristiti posle tri meseca za inserciju implantata u posteriornoj maksilarnoj regiji, menjajući D3 kost u D1 [7].

Hirurška ekstrakcija trećeg impaktiranog umnjaka izvodi se često u ortodonciji iz profilaktičkih razloga ili u oralnoj hirurgiji iz terapeutskih razloga [8]. Učestalost impakcije kreće se između 66% i 77% [9]. Statistički, procenjuje se da samo u SAD od 20 miliona ekstrahovanih zuba godišnje 30% su izvađeni zbog periodontalne pokretljivosti, a 10% izvađenih zuba su impaktirani zubi. Uglavnom ove zube smatramo biološkim otpadom umesto da iskoristimo prednosti njihovih fantastičnih karakteristika. Standardna hirurška ekstrakcija impaktiranog trećeg kutnjaka može kompromitovati periodontalni status susednog drugog kutnjaka i tako ubuduće iziskivati dodatnu hirurišku intervenciju.

Schropp i saradnici smatraju da se 50% svih redukcija horizontalnih i vertikalnih dimenzija dešava prvih 12 meseci posle augmentacije, od kojih 2/3 resorpcije u prva tri meseca posle ekstrakcije (3,8 mm) [10]. Redukcija širine alveolarnog grebena bez koštane augmentacije posle prirodnog zarastanja ekstrakcione rane kreće se između 2,6 mm i 4,6 mm, visina grebena opada od 0,4 mm do 0,9 mm, horizontalna resorpcija ima srednju vrednost od 3,87 mm sa istovremenom redukcijom vertikalne dimenzije sa srednjom vrednošću od 1,67 mm [11, 12].

Ekstrahovani zubi ne mogu se i dalje smatrati medicinskim otpadom upravo zbog činjenice da u kratkom periodu mogu poslužiti za dobijanje izuzetno bezbednog graft materijala sa visokom biološkom važnošću. Primenom mineralizovanog dentinskog matriksa maksimalno iskorišćavamo naš sopstveni biološki potencijal bez upotrebe drugih arteficijalnih graft materijala.

ZAKLJUČAK

Upotreba grafta odmah posle hirurške ekstrakcije impaktiranog umnjaka može pomoći u prevenciji resorpcije za vreme zarastanja rane i to je dokazano stvaranjem koštanih tkiva na distalnoj strani susednog drugog kutnjaka.

Finansijski je dostupna pacijentu i to omogućava hirurgu da primeni autologni koštani graft materijal kao najbolji izbor za vođenu regeneraciju kosti.

Klinički proces zarastanja koštanih i mekih tkiva je ubrzan sa mirnim tokom bez naglašenog otoka i bolovima, sa relativno sačuvanim vertikalnim i horizontalnim dimenzijama alveolarnog grebena.

Na postooperativnom RTG snimku vidi se rano stvaranje nove kosti – trabekule uz odličnu osteointegraciju dentinskog grafta u koštanim defektima viličnih kosti.