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 defects. 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

| ECONOMIC VALUE | CLINICAL VALUE | BIOLOGICAL VALUE |
|----------------|----------------|-----------------|
| Low cost       | No immune reaction | Low resorption |
| Jefnina opcija | Nema imunog odbacivanja | Mala resorpcija |
| Reduce graft inventory | Painless procedure | Excellent osseous ankyloses |
| Smanjuje potrebu za drugim materijalom | Bezbolna procedura | Izvanredna osteointegracija |
| Reduce number of visits | Easy and simple process | Osteogenic |
| Smanjuje broj poseta | Jednostavan proces | Osteogenetski potencijal |
| Recycle teeth – Green Dentistry | "doggy bag" graft for future use | Slow release of GF over a long time |
| Reciklaža – zelena stomatologija | Gift koji se može i kasnije koristiti | Otpušta faktore rasta produkso vreme |
| Količina grafa / 3× veća | bacteria free / no disease transmission | Hard "cortical like" graft quality |
| Easy to explain | Quicker prosthetic restoration | Dobar kvalitet grafa |
| Jednostavna | Brža protestksa rehabilitacija | Attract progenitor cells and contains stem cells |

**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 equipment 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 mineralized dentin matrix 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 trabonory defects was also measured during the extraction of the impacted wisdom tooth.

![Figure 1](image-url)
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.

| Tooth number | #68 | #34 | #35 |
|--------------|-----|-----|-----|
| In position 2 mm below limbus alveolaris | 9 mm | 10 mm | 9 mm |
| 4 mm below limbus alveolaris | 8 mm | 8 mm | 9 mm |

Table 2. Intraoperative measurements with Bone measuring calipers

Table 3. Measurements 6 months postoperatively with Bone measuring calipers

| Tooth number | #68 | #34 | #35 |
|--------------|-----|-----|-----|
| In position 2 mm below limbus alveolaris | 9 mm | 7 mm | 6 mm |
| 4 mm below limbus alveolaris | 8 mm | 8 mm | 8 mm |

Figure 5. Panoramic imaging 3 months after pocket preservation with ADG

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...
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).

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 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 referred 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
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 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 grafa indikovanog u različitim delovima vilične kosti

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UVOD

Različiti biomaterijali (autograft, allograft, ksenograft ili aloplastični materijali) korišćeni su da bi stimulirali ili poboljšali koštanu regeneraciju posle ekstrakcije zuba. Autoena kost je i dalje zlatni standard kod koštane augmentacije, kao jedna opcija koja ispunjava kriterijume osteogeneze, osteokondukcije i osteoindektivnosti [1, 2]. Iako toga, treba pomenuti njene nedostatke zbog ograničene dostupnosti, nepredvidive rane resorpcije i osteointegracije dentalnih implantata [4].

Prvi dokumentovani materijal o regenerativno-osteointegrativnom postupku autolognog dentinskog grafa prikazan je u studiji koju su sprovede Yeo mans i Urist 1967. god. Sve potreban materijal za taj postupak je na tržištu. Autogeni zubi autolognog dentinskog grafa pripremljeni su za imedijantni graft materijal zbog svojih osteointegrativnih karakteristika i podaci pokazuju da su izvrsni osteogenetski materijali. Neposredno posle ekstrakcije treba autogeni zubi smatrati zlatnim standardom zahvaljujući njenim osteoinduktivnim karakteristikama.

MATERIJAL I METODE RADA

Materijal za eksperimente dobijen je od autolognih zuba kumoci iz paznje koštanih defekata od 8 do 20 godina starosti. U period od šest meseci posle ekstrakcije klinička i radiološka merenja okrivljuju za izgradnju koštanih površina. Radiološki indikativni i klinički postoperativni rezultati pokazuju da je ADG izvanredno kvalitetan, kao saznavano sa ranom osteointegracijom. Prikazani rezultati upućuju na informaciju da se ADG može koristiti kao material za restavraciju koštanih defekata.

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

Rezultati

Neposredno posle ekstrakcije, ADG je u celosti identičan autolognom koštanom graftu. Autogeni zubi autolognog dentinskog grafa pripremljeni su za imedijantni graft materijal zbog svojih osteointegrativnih karakteristika i podaci pokazuju da su izvrsni osteogenetski materijali. Neposredno posle ekstrakcije treba autogeni zubi smatrati zlatnim standardom zahvaljujući njenim osteoinduktivnim karakteristikama. Prikazani rezultati upućuju na informaciju da se ADG može koristiti kao material za restavraciju koštanih defekata.
Klinički parametri

Klinička merenja se izvođe postoperativno prvog, trećeg, sedmomog, petnaestog dana i nakon tri meseca da bi se utvrdilo za-rastanje rane. Na ovim pregledima pacijenti dobijaju upitnik da ocene prisustvo bola, trizmusa, otoka, 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 intrakoštanih defekta posle ekstrakcije implantat. Cilj je formiranja i stabilizacije bolesne alveolarnog regije uz pomoć odgovarajućeg periodontalnog džepa premašuje 7 mm, dok je IBDs (infrakoštanog defekt) kod 32,1% veći od 4 mm [6].

Promene na koštanim i mekim tkivnim strukturama postoji potpuno pokrivanje infrakoštanog defekta nastalog distalno od drugog donjeg kutnjaka, meren graduiranom sondom šest koncem 4/0, koji se uklanja nakon 7–14 dana [5]. Posle intervencije, svi pacijenti su primjenili proplinjanje koštanih supstituta – 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 dimenzionalnih 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 implanta-tima.

Postavljanje autogenog dentinskog grafa 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 mezi-alnim inklirani, 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 građuiranim sondom šest meseci posle prezervacije ADG-om iznosi 1 mm, što znači da postoji potpuno pokrivanje infrakoštanog defekta nastalog postoperativno i 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 (infrakoštan defekt) kod 32,1% veći od 4 mm [6].

Primena autolognog dentinskog grafa za augmentaciju koštanog defekta u vilčnoj kosti

Pacijent, 50 godina, žali se na neznatni bol i otok u levoj maksilarnoj regiji. Na iste simptome ukazuje dve godine (udruženo sa periodičnim egzacerbacijama bolesti, usled kojih je tretiran simptomatskom i antibiotskom terapijom. Vršena su i posebne komplikacije.

Other indications for use of mineralized dentin graft in augmentation of different indication areas in the jaw bones
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 patološke mezijalno od hirurške regije IMMT jeste primena koštanog grafa sa ciljem zaštite distalne strane drugog mandibularnog kutnjaka. Upotreba komercijalno raspoloživih koštanih grafova podiže cenu izvoza grafa za prezentaciju alveola i za ostale koštane aplikacije, jer se nakon 60 dana zapaža stvaranje velike količine koštanog tkiva, a nakon 90 dana i male količine lamelarnih kosti.

Resorpcija ADG čestica je spora (zbog mineralizovane strukture), što omogućava dugoročno i postepeno stvaranje lamelarnih kosti. Studije su pokazale da se formirana kortikospongija pokazuje uspešno održavanje implantata u postopeku u narednih pet godina.

Kao što su pokazali naši slučajevi, primena autolognog dentinskog grafa značajno minimizira resorpciju rezidualnog koštanog grebena. Ovo potvrđuje teza Vitorinija i saradnika, koji zaključuju da je rezervacije koštanog grebena značajno bolji tretman od slučaja bez rezervacije, gde postoji manji gubitak vertikalne i horizontalne dimenzije kosti. On naročito ističe potrebu zaštite koštanog grebena u krivicama i bez potrošnog gubitka koštanih komponenti. Resorpcija koštanog grebena bez autolognog grafa bez koštane augmentacije posle prirodnog zarastanja ekstrakcije ne 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 srednjim od 1,67 mm [11, 12].

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, procjenjuje se da samo u SAD od 20 miliona ekstrahovanih zuba godišnje 30% su izvađeni zbog periodontalnih pokretljivosti, a 10% izvađenih zuba su impaktirani zubi. Uglavnom ove zube smatramo biošćkim otpadom koje ne izdaje nove biološke aktivnosti. To je zbog nedovršenih koštanih grafova koji nisu uključeni u proces odvajanja koštanih tkiva. Drugim rečima, biošćki otpad postaje biošćan material.

Schropp i saradnici smatraju da se 50% svih redukcija horizontalnih i vertikalnih dimenzija dešava prvih 12 meseci - 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 ekstrakcije ne 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 srednjim od 1,67 mm [11, 12].

Ukupno zapaženo je da zapažena koštanog grebena ovako u augmentiranih slučajevima alveolarnog grebena. Ovo potvrđuje i teza Vitorinija i saradnika, koji zaključuju da je prezervacija alveolarnog grebena značajno bolji tretman od slučaja bez prezervacije, gde postoji manji gubitak vertikalne i horizontalne dimenzije kosti. On naročito ističe potrebu zaštite koštanog 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 anatomске struktura kao što su maksilarni sinus i mandibularni kanal.

Zapaža se ankilotična kost stvorena u kontaktu sa dentinskom matriksom. Ovo potvrđuje i teza Vitorinija i saradnika, koji zaključuju da je prezervacija koštanog grebena značajno bolji tretman od slučaja bez prezervacije, gde postoji manji gubitak vertikalne i horizontalne dimenzije kosti. On naročito ističe potrebu zaštite koštanog 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 anatomске struktura kao što su maksilarni sinus i mandibularni kanal. Zapaža se ankilotična kost stvorena u kontaktu sa dentistom proizvodi veoma stabilan alveolarni greben, koji bi se inače resorbiroao 3-6 meseci nakon ekstrakcije. Ovaj grafit stihi 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].