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Preservation or reconstruction of the Peri-implant bone- A Review

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Abstract

The main biological and biophysical process that has made dental implant therapy predictably successful for replacing missing teeth is Osseointegration. Teeth extraction is done for several purposes, often without any consideration for the preservation of the alveolar ridge. Alveolar bone post-extraction changes have been estimated to cause a 50% decrease in alveolar bone buccolingual width, and a further loss in height. This review will go through various techniques of ARP and bone regeneration techniques and explore the best way to obtain the best outcomes after implant placement.

Keywords: Dental implant therapy, Peri-implant bone, Socket preservation.

INTRODUCTION

Dentistry has seen impressive developments in dental restorative products, procedures, and methods that are expected to be effective in long-term tooth loss management [1]. The main biological and biophysical process that has made dental implant therapy predictably successful for replacing missing teeth is Osseointegration. In implant placement, the primary objective is to achieve and sustain an intimate bone-to-implantation connection. The alveolar bone around the tooth socket undergoes resorption after a tooth has been removed. However, after tooth extraction, loss of bone width and depth will affect how successful the implant will be. Teeth extraction is done for several purposes, often without any consideration for the preservation of the alveolar ridge. Bone remodeling starts after this and lasts for several months. Alveolar bone post-extraction changes have been estimated to cause a 50% decrease in alveolar bone buccolingual width, and a further loss in height has also been recorded [2]. If there is an insufficient bone volume in the restorative-ideal location to house an implant, reconstruction of the alveolar ridge can be needed either before or concomitant with the placement of the implant. Alternatively, the alveolar ridge preservation (ARP) strategy may be preferable to consider at the time of tooth extraction [3]. This review will go through various techniques of ARP and bone regeneration techniques and explore the best way to obtain the best outcomes after implant placement.

Peri-implant bone

The alveolar bone covering the structure of an implant is the peri-implant bone. The level of peri-implant bone has been used to determine the effectiveness of dental implants as one of the parameters. The protection of the integrity of gingival margins and interdental papillae is an essential prerequisite [4]. Sufficient bone must be present before implant placement. For treatment planning for implants, this phase is fundamental [5].

Socket preservation or alveolar ridge preservation (ARP)

Alveolar ridge preservation (ARP) is a technique for guided bone regeneration (GBR) aimed at regulating the resorption of post-extraction ridges. Bone autografts, allografts, xenografts, alloplasts, and membranes of different origins are existing ARP protocols [6].

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Any materials or procedures that increase the amount of bone or soft tissue after exodontia have the potential to enhance or at least ease the delivery of treatment [7]. The primary goal starts with the extraction of an atraumatic tooth. Every effort is made to maintain the bone and soft tissue surrounding it with an emphasis on being careful not to fracture the fragile buccal plate. Preservation of sockets greatly decreases the loss of ridge width and height after tooth removal [8].

In addition to hard tissue preservation approaches, the ability to maintain the contour of soft tissue is also an important consideration in the esthetic field, particularly in cases with thin labial plate, socket grafting can help maximize bony fill within the extraction socket and maintain the vertical bone height and help stabilize the marginal tissue [9].

Membrane assisted surgical technique

In a case published by Abi Nader et al, the extraction site was grafted with osteoconductive bone graft after the tooth had been carefully removed with forceps. On the buccal part of the extraction socket, a resorbable collagen membrane was positioned and sutured as primary closure to the palatal flap, with an exposed membrane remaining at the occlusal part of the extraction socket. This technique has seen good bony healing [10]. In the reconstruction of large bone defects, ceramic titanium dioxide (TiO_2) is a promising material for non-resorbable synthetic bone grafts or scaffolds. A highly porous structure of the TiO_2 scaffold allows excellent conditions for the initial attachment of osteoblast and proliferation of human mesenchymal stem cells [11]. Directed bone regeneration using polytetrafluoroethylene (PTFE) membranes is a simple alternative treatment that results in good alveolar bone maintenance for mediate/late implant placement [12].

The cytoplast ridge preservation technique This technique ensures the protection of the post-extraction process of the socket and it is important to understand the technique to achieve a better ridge preservation outcome. A sufficient amount of healthy bone is very much required to ensure the effectiveness of the implant put in place. This membrane of PTFE contributes to achieving the same [13].

Flapless technique For patients with ample keratinized gingival tissue and bone volume at the implant receiver site, the idea of flapless implant surgery has been introduced. In a flapless procedure, a dental implant is mounted without reflecting a flap through the mucosal tissues. The reasons for using the flapless technique are to reduce the risk of postoperative loss of peri-implant tissue and to resolve the difficulty of handling soft tissue during or after surgery [14].

Socket shield technique In 2010, Hürzeler MB et al developed the Socket shield method in which the third and fourth mandibular pre-molar of a beagle dog was hemisected and approximately 1 mm coronal to the buccal bone plate was preserved by the buccal fragment of the distal root [15]. Based on this Hürzeler report, Bäumer D *et al* (2017) performed a case series of 10 consecutive implant replacement patients with the clinical technique between the maxillary first premolars, where the buccal portion of the root is retained to preserve the periodontal ligament and bundle bone [16].

An easy & predictable Socket Preservation Technique was identified by Timothy Kosinski using a highly crystalline osteoconductive bioactive resorbable calcium apatite bone graft called OsteoGen. It is a non-ceramic bone graft material used in preparation for potential implant placement to predictably preserve ridge height [17].

Bone reconstruction

To fix different degrees and locations of bone defects, bone regeneration is important. They always need treatment involving bone regeneration, regardless of whether large bone defects are caused by trauma, infection, tumor excision, skeletal necrosis or periodontitis, inadequate implant bone, and osteoporosis [18]. For the reconstruction of alveolar ridge deficiencies, a broad range of surgical procedures, such as directed bone regeneration (GBR) by the use of resorbable and non-resorbable membranes, intra- and extra-oral block grafting, and distraction osteogenesis, can be applied [19]. Various techniques can be used to achieve proper bone regeneration.

Guided bone regeneration

The use of barrier membranes in the treatment of alveolar ridge defects is often referred to as 'membrane-covered bone regeneration' by Directed Bone Regeneration (GBR). It helps to distinguish the hard tissue compartment from the soft tissue compartment (bone, bone marrow, and bone defect), allowing bone regeneration by creating space. It also stabilizes the blood coagulum efficiently and thereby allows for quicker healing to occur. Before or at the same time as implant placement, this approach can be used [20].

Block bone grafting technique

To rebuild significant defects in the vertical and horizontal dimensions of the alveolar ridge, block grafting approaches can be used. For ridge augmentation, autogenous block grafting procedures remain the gold standard. However, the morbidity of the donor site associated with graft harvest has concentrated on the use of allogeneic grafting materials [22,23]. The attractive techniques are edentulous ridge augmentation using intraorally extracted bone blocks from the mandibular symphysis and the ramus buccal shelf [21].

Ridge expansion (split) technique

The technique of split ridge/ridge expansion refers to the development of a linear groove with rotary burs or a piezosurgery device in the center of the ridge and deepening this groove with an osteotome chisel. The lingual or palatal cortical bone is used as a reference and the chisel is forced into the cancellous portion of the bone by careful tapping with a mallet. With adequate mobile segment stability, proper interpositional grafting, and soft tissue protection, comparable results can be achieved with alternative techniques [20].

Sinus augmentation

The lateral window technique modifying the Caldwell-Luc procedure also called the hinge osteotomy technique, originally defined by Tatum, then first published by Boyne and James, is the most widely used technique used to reach the maxillary sinus. Using a circular bur on the lateral wall of the sinus, a window is then formed before the sinus membrane's bluish hue presents itself. The sinus membrane is raised from the bony floor using specially crafted sinus elevation curettes and is released anteriorly, posteriorly, and medially to produce a tension-free elevation to reduce the risk of perforation. The trap door (window) is medially intruded to form the new sinus floor and the space created below it is then grafted to provide the implant placement base. Then the flap is repositioned and closed. To allow graft maturation, implants are inserted either simultaneously with the graft (one-stage) or after a delayed period of up to 8 months (two-stage) [23]. In sites with sufficient alveolar crest distance, the initial bone height of at least 5 mm, and relatively flat sinus floor anatomy, maxillary sinus elevation using the trans alveolar method may be suggested [20].

Distraction osteogenesis

Distraction Osteogenesis (DO) uses the phenomenon in which new bone fills the void defect formed by slowly separating two pieces of bone under tension. On the fundamental concepts involved in distraction, which include a latency period of 7 days for initial soft callus formation, a distraction phase during which the 2 bone segments undergo incremental gradual separation at a rate of ~ 1 mm per day to stretch the developed soft callus, and a consolidation phase, the distraction of

the segment can be performed in a vertical and/or horizontal direction [23].

Tent- Pole technique

In 2002, Marx et al, using corticocancellous bone grafting with dental implants to treat badly resorbed mandibles shorter than 6 mm, advanced the method of soft tissue matrix expansion. 4 to 6 dental implants were mounted using this transcutaneous submental method to serve as "tent poles" to maintain the height of the overlying mucosal soft tissue and prevent it from sagging around the iliac crest graft.

Bone ring technique

Using this technique, three-dimensional bone augmentations with immediate dental implant placement can be performed. Bone rings can be extracted from the chin or iliac crest regions by using trephine burs corresponding to the extraction socket diameters. Using dental implants to repair the defective bone at the crestal portion in a 3D fashion, the harvested rings can then be secured to the extraction socket [23].

DISCUSSION

Our patients are often present for therapy but have insufficient bone to accommodate dental implants. One of the key reasons for the lack of adequate bone required for implant placement is bone resorption after tooth extraction. The dentist should concentrate care efforts on ridge protection whenever possible to avoid the incidence of ridge defects. This is particularly important in the dental arches' anterior aesthetic region [22]. In support of site preparation for implant therapy, the literature is extensive, not only in the esthetic zone but throughout the mouth. At the time of extraction, physicians have long recognized the advantages of maintaining the ridge to minimize the resorptive phase and in many cases to prevent an additional surgical operation to increase a defective ridge. The evidence behind these claims was provided by this review and all the peri-implant bone preservation and reconstruction techniques that are widely used today have been seen. The clinician has several options for the preservation and reconstruction of the peri-implant bone, but it can be concluded that the greatest progress is seen when caution is taken at the time of extraction to maintain all the walls of the alveolar socket by minimal trauma [23].

CONCLUSION

Dentists are now practicing in the era of endosseous dental implants. They are here to stay, and the success rate will only get better over time. Therefore it is of utmost importance to dentists and patients that nothing can prevent or negate the effective placement of implant fixtures in short or long-term therapeutic procedures at any point in the future. Dentists must follow a professional policy or ideology that, regardless of the methods used to reconstruct tissues, they must avoid doing anything that at any point in the future will discourage the successful use of dental implants.

Conflicts of Interest

The authors declare no conflict of interest.

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