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BONE RECONSTRUCTION TECHNIQUES WITH AUTOGENOUS GRAFTS: INDICATIONS AND DONOR SITE SELECTION CRITERIA

TÉCNICAS DE RECONSTRUÇÃO ÓSSEA COM ENXERTOS AUTÓGENOS: INDICAÇÕES E CRITÉRIOS DE SELEÇÃO DO SÍTIO DOADOR

TÉCNICAS DE RECONSTRUCCIÓN ÓSEA CON INJERTOS AUTÓGENOS: INDICACIONES Y CRITERIOS DE SELECCIÓN DEL SITIO DONANTE

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ABSTRACT

The long-term viability of dental implants is intrinsically linked to the presence of robust bone support. In cases of tooth loss resulting in severe resorption, ridge reconstruction becomes an indispensable step, and autogenous grafting is widely recognized as the gold standard due to its biological triad: osteogenesis, osteoinduction, and osteoconduction. This narrative review examines contemporary bone reconstruction techniques and the criteria for donor site selection, based on evidence collected from the PubMed database over the past ten years. The data indicate that, in addition to traditional autologous bone, the use of processed dental tissues (such as dentin) has emerged as an alternative with high biocompatibility and low morbidity, delivering solid clinical outcomes. In the management of horizontal defects in esthetic areas, the combination of bone chips with cortical barriers has proven effective in minimizing postoperative discomfort without compromising volumetric gain. On the other hand, cases of greater structural complexity may still require harvesting from extraoral sites. In summary, the success of regeneration lies in the clinician's ability to select the technique that best balances the patient's volumetric demand with biological preservation, reaffirming the superiority of the individual's own tissue in achieving high-quality and stable newly formed bone.

Keywords: Autogenous Bone Graft. Dental Implants. Bone Reconstruction. Donor Site. Processed Human Dentin.

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RESUMO

A viabilidade a longo prazo dos implantes dentários está intrinsecamente ligada à presença de um suporte ósseo robusto. Diante de perdas dentárias que resultam em reabsorções severas, a reconstrução do rebordo torna-se uma etapa indispensável, sendo o enxerto autógeno amplamente reconhecido como o padrão-ouro devido à sua tríade biológica: osteogênese, osteoindução e osteocondução. Esta revisão narrativa examina as técnicas contemporâneas de reconstrução óssea e os critérios para escolha do sítio doador, fundamentando-se em evidências coletadas na base PubMed nos últimos dez anos. Os dados indicam que, além do osso autólogo tradicional, o uso de tecidos dentários processados (como a dentina) surge como uma alternativa de alta biocompatibilidade e baixa morbidade, entregando resultados clínicos sólidos. No manejo de defeitos horizontais em áreas estéticas, a combinação de chips ósseos com barreiras corticais tem se mostrado eficaz para minimizar o desconforto pós-operatório sem comprometer o ganho volumétrico. Por outro lado, casos de maior complexidade estrutural ainda podem demandar a coleta em sítios extraorais. Em suma, o sucesso da regeneração reside na capacidade do clínico em selecionar a técnica que melhor equilibra a demanda volumétrica do paciente com a preservação biológica, reafirmando a supremacia do tecido do próprio indivíduo na obtenção de um osso neoformado de alta qualidade e estabilidade.

Palavras-chave: Enxerto Ósseo Autógeno. Implantes Dentários. Reconstrução Óssea. Sítio Doador. Dentina Humana Processada.

RESUMEN

La viabilidad a largo plazo de los implantes dentales está intrínsecamente vinculada a la presencia de un soporte óseo robusto. Ante pérdidas dentarias que resultan en reabsorciones severas, la reconstrucción del reborde se convierte en una etapa indispensable, siendo el injerto autógeno ampliamente reconocido como el estándar de oro debido a su tríada biológica: osteogénesis, osteoinducción y osteoconducción. Esta revisión narrativa examina las técnicas contemporáneas de reconstrucción ósea y los criterios para la selección del sitio donante, fundamentándose en evidencias recopiladas en la base de datos PubMed durante los últimos diez años. Los datos indican que, además del hueso autólogo tradicional, el uso de tejidos dentarios procesados (como la dentina) surge como una alternativa de alta biocompatibilidad y baja morbilidad, ofreciendo resultados clínicos sólidos. En el manejo de defectos horizontales en áreas estéticas, la combinación de chips óseos con barreras corticales ha demostrado ser eficaz para minimizar el malestar postoperatorio sin comprometer la ganancia volumétrica. Por otro lado, los casos de mayor complejidad estructural aún pueden requerir la obtención de injertos en sitios extraorales. En suma, el éxito de la regeneración reside en la capacidad del clínico para seleccionar la técnica que mejor equilibre la demanda volumétrica del paciente con la preservación biológica, reafirmando la supremacía del tejido propio del individuo en la obtención de un hueso neoformado de alta calidad y estabilidad.

Palabras clave: Injerto Óseo Autógeno. Implantes Dentales. Reconstrucción Ósea. Sitio Donante. Dentina Humana Procesada.

1 INTRODUCTION

The basis for the success of any dental implant is the presence of a solid bone structure, a determining factor to ensure both the initial fixation and the functioning of the prosthesis over the years. Especially when it comes to an aesthetic region, where functional rehabilitation and the final result has become a great challenge for dentists. Numerous techniques have been suggested to increase the alveolar ridge, among which the most prominent are guided bone regeneration, en bloc grafts, ridge split osteotomy, and distraction osteogenesis (Khalid et al., 2023).

However, after the loss of a tooth, it is common for the bone in the region to undergo a gradual resorption process. This loss of volume often forces the surgeon to perform reconstruction procedures before or during the implant installation, aiming to return the ideal dimensions to the alveolar ridge (Peceliunaite et al., 2023). To solve this deficiency, science has developed several materials and techniques that seek to offer predictable results in clinical daily life. In favorable health conditions, small bone defects can regenerate spontaneously; however, extensive bone defects or major losses, pathological fractures, and bone infections due to periodontal problems or systemic diseases can influence the healing and bone regeneration process, requiring surgical intervention and the choice of a bone substitute (Ferraz, 2023).

Bone reconstruction is an essential step for rehabilitation with dental implants, especially in patients who have significant loss of the alveolar ridge due to tooth extractions, trauma, infections or periodontal diseases. In these cases, the spontaneous regeneration of bone tissue is limited, requiring surgical interventions that restore adequate bone volume and quality for implant installation and stability. Among the various options available, autogenous grafts stand out for having superior biological properties, since they have viable osteogenic cells and inducing proteins capable of stimulating the formation of new bone tissue in a predictable manner. Thus, the use of the patient's own tissues remains a widely indicated strategy in bone reconstructions, especially in defects of greater extent or clinical complexity (Ferraz, 2023).

Although there are many synthetic or animal-based substitutes, the bone taken from the patient himself, known as an autogenous graft, remains the preferred choice for more complex cases. Although these synthetic materials demonstrate clinical success to some extent, they still have certain drawbacks, such as high risks of disease transmission, potential immune reactions, and unpredictable resorption rates. Therefore,

the search for an optimal bone replacement material with predominant biocompatibility characteristic and biological properties similar to natural bone remains a focus of research in the dental field (Zhang et al., 2021).

The relevance of autogenous grafts in the context of bone reconstruction is directly related to its superior biological properties, since this tissue keeps the natural mechanisms of bone repair viable. As discussed by Ferraz (2023), the presence of osteogenic cells, combined with the release of growth factors and the ability to serve as a framework for bone neoformation, gives the autologous graft greater clinical predictability when compared to substitute materials. This characteristic becomes especially relevant in areas intended for the installation of dental implants, in which the quality and stability of the bone tissue are determinant for long-term rehabilitative success.

In addition to the intra- and extraoral bone sources traditionally used, recent studies have broadened the discussion on the use of autogenous dental tissues as a regenerative alternative. According to Zhang et al. (2021) and Peceliunaite et al. (2023), human dentin has a mineral and structural composition similar to that of alveolar bone, favoring its integration into the recipient bed and stimulating the formation of new bone tissue. At the same time, the choice of the donor site remains a critical step in surgical planning, and the extent of the defect, the volumetric need, and the morbidity associated with the procedure should be considered. While localized defects can be managed with grafts collected in intraoral regions, such as ramus or mandibular symphysis, more extensive reconstructions may require extraoral sites, as highlighted by Karkar et al. (2023) and Khan et al. (2023). In this context, clinical decision-making should seek a balance between biological performance, structural stability, and minimization of the surgical impact on the patient, guiding the selection of the most appropriate technique and donor site.

In this regard, recent literature has directed efforts to analyze not only the biocompatibility of these autogenous tissues, but also the type of surgical procedure employed, the specific characteristics of the graft used, and the associated clinical outcomes, including the complication rate and the capacity to form newly formed bone. Among these approaches, the use of autogenous human dentin has stood out as a biologically favorable surgical alternative, since its physicochemical composition similar to that of bone and the preservation of its organic matrix favor osteoconduction and tissue

integration**.** (Peceliunaite et al., 2023). Understanding these variables is essential for the appropriate indication of autogenous grafting techniques, especially when seeking to combine biological predictability with the reduction of surgical morbidity.

In view of the multiplicity of available approaches and the biological particularities associated with each graft source, it is observed that autogenous bone reconstruction requires careful planning and individualized decision-making. The anatomical variability, the extent of the defect and the need for long-term stability make it essential to understand the criteria that guide the selection of the donor site and the most appropriate reconstructive technique. Thus, it is relevant to analyze in an integrated manner the recent scientific evidence on autogenous grafts, in order to assist the dentist in the safest, most predictable and biologically favorable therapeutic choice for each clinical situation.

2 METHODOLOGY

The present study is characterized as a narrative review of the literature, with a qualitative approach and descriptive character, developed from the analysis of scientific articles previously indicated as a theoretical basis for the elaboration of the work. The methodological proposal consisted of describing, interpreting and synthesizing the scientific evidence related to bone reconstruction techniques with autogenous grafts, as well as the criteria adopted for the selection of donor sites in different clinical contexts.

The material analyzed consisted of national and international scientific articles, written in Portuguese and English, which address the application of autogenous grafts in bone reconstruction procedures, especially in the areas of implantology, oral and maxillofacial surgery and related surgical areas, with a time lapse of the last ten years. The studies used as a basis include literature reviews, clinical research, and evaluative studies, in which biological, technical, and clinical aspects of the use of autologous bone are discussed, as well as autogenous alternatives, such as the use of processed dental tissues.

The analysis of the articles was carried out through critical reading and interpretation of the contents, considering information such as the type of graft used, origin of the donor site, surgical technique described, clinical indications, and reported advantages and limitations. The information extracted was organized in a descriptive and comparative way, enabling the construction of a narrative synthesis coherent with the proposed objectives, without statistical analysis.

3 RESULTS AND DISCUSSION

The literature shows that the effectiveness of bone reconstruction depends directly on the regenerative potential of the chosen material. Autologous bone is superior to synthetic substitutes because it does not trigger adverse immune reactions and promotes faster incorporation into the recipient bed (Ferraz, 2023). A relevant innovation is the use of extracted autogenous dental tissues, which work as an excellent filling material. Systematic studies indicate that these grafts have clinical success rates comparable to traditional bone grafts, offering the advantage of eliminating morbidity from a second surgical site for bone harvesting (Peceliunaite et al., 2023; Zhang et al., 2021).

For the patient, this approach makes the treatment less invasive and more comfortable, as it avoids a second surgery to remove bone, reducing pain, recovery time, and postoperative risks. By using a material from the body itself, there is better biological acceptance and predictable healing, maintaining success rates similar to traditional techniques (Peceliunaite et al., 2023; Zhang et al., 2021). Another perspective that puts it in check is the reduction of surgical time and stress of the procedure, such a statement becomes vital when intertwined with the patient's recovery, therefore, the impact on their daily routine is minimized.

As for the manipulation technique, the use of bone chips collected intraorally has been widely applied. In aesthetic defects in the anterior region, the association of a cortical barrier — based on the concepts of the shell technique — filled with autologous bone chips, allows a significant horizontal gain, restoring the thickness necessary for implantology (Karkar et al., 2023). This approach prioritizes areas such as the mandibular ramus or the symphysis, minimizing postoperative discomfort.

Therefore, the choice of the donor site is not random, but rather guided by the volumetric need and the type of bone required by the recipient defect, aiming at positive perspectives for the prognosis of patients based on appropriate techniques for each case.

Table 1

Synthesis of the selection criteria based on the literature reviewed, correlating the origin of the graft with its ideal clinical application

Donor site	Nature of the fabric	Main indication	Main advantage	Source
Mandibular	Cortico-spongiosum	Bulky block	Large medullary	Ferraz (2023)

symphysis		defects	bone volume	
Mandibular ramus	Cortical predominance	Thickness gain (shell)	Low resorption and morbidity	Karkar et al. (2023)
Dental tissue	Mineralized matrix	Honeycomb preservation	No second surgical site	Zhang et al. (2021)
Extraoral sites	Cortico-spongiosum	Extensive reconstructions	High volumetric availability	Khan et al. (2023)

In complex reconstructions, such as orthopedic or extensive maxillomandibular losses, the use of grafts from sites such as the proximal tibia has been shown to be vital for mechanical stability (Khan et al., 2023). However, the regeneration of rigid tissues for implant support still finds in autologous tissue the best answer in terms of bone quality and long-term crest maintenance (Thoma et al., 2023). Thus, the selection must balance the demand of the defect with biological preservation, prioritizing intraoral sites whenever the available volume is sufficient.

According to Khan et al. (2023), structural allografts are useful because they provide initial support and mechanical resistance in larger defects, but they are associated with a higher risk of complications and a longer recovery period, this perspective, even if analyzed in the medical field, can be transferred to the dental field. In contrast, autogenous bone grafting prioritizes gradual integration into the patient's bone, better preserves bone structure - not requiring excessive bone resection - and tends to favor biological consolidation, making it a more conservative alternative in the long term.

The clinical decision between using an autogenous graft or a synthetic/collagen matrix also involves the evaluation of long-term volumetric stability. Although soft tissue substitutes and collagen matrices have advanced, rigid tissue regeneration for implant support still finds in autologous tissue the best response in terms of bone quality and crest maintenance over years of follow-up (Thoma et al., 2023). Thus, the selection of the donor site must balance the volumetric need of the defect with the minimization of complications, prioritizing intraoral sites whenever the available volume is sufficient for the clinical demand.

Although autogenous grafting is the gold standard, the literature warns that clinical success depends on risk management at the donor site. Complications such as edema, postoperative discomfort and, in specific cases of mandibular collection, temporary paresthesias, are factors that influence the surgeon's decision (Karkar et al., 2023). To mitigate these risks and enhance graft biology, the use of platelet aggregates, such as Platelet-Rich Fibrin (L-PRF), has been incorporated. The use of L-PRF together with bone chips not only accelerates revascularization, but also improves material manipulation and clot stability, optimizing the tissue repair process (Ferraz, 2023; Thoma et al., 2023). Therefore, digital planning and association with modern biomaterials are pillars that complement the classic autogenous technique, aiming at a less invasive and more predictable surgery.

However, it is worth noting that despite the consonance of the authors Ferraz (2023) and Thoma et al. (2023), with regard to the use of Platelet-Rich Fibrin (L-PRF), there is also a line defended by Myron et al. (2017) that emphasizes its application and efficacy aimed at soft tissues and periodontal repair. In this respect, this statement does not exclude its use in the surgical area, but highlights its use in a complementary way. The extraction of mandibular third molars, for example, the application of L-PRF may not exert the function of significant bone volume increase, however, in post-surgical evaluation, osteomyelitis was reduced by almost ten times compared to natural healing. Therefore, it is noticeable that the use of L-PRF acts as a reducer of the infection rate.

The reduction in periodontal probing depth and gain in the clinical level of insertion are related to the use of L-PRF aimed exclusively at defective repairs in the intraosseous region, this justification is corroborated by the fact that L-PRF is superior when compared to osteosynthesis with fiberglass in a study highlighted by Miron et al. (2017). The autologous origin, low cost and even ease of use highlighted its application in the dental clinical experience, which results in scar improvement in the postoperative period, not only in the periodontal structures, but also in the clinical evolution of patients.

4 CONCLUSION

Based on a critical analysis of recent literature, this study reaffirms the **autogenous graft** as the gold standard and irreplaceable biological foundation in contemporary bone reconstruction surgery. Its supremacy stems from the complete triad of regenerative mechanisms — **osteogenesis, osteoinduction and osteoconduction**

— that guarantee the formation of a newly formed bone with predictability, quality and long-term stability, essential for the success of implantology.

Technical evolution has highlighted the incorporation of **autogenous alternatives**, such as processed human dentin, which emerges as a promising strategy. By combining high biocompatibility and composition similar to that of alveolar bone, this approach minimizes surgical morbidity, as it eliminates the need for a second bone collection site.

Clinical decision-making, therefore, requires **individualized and careful planning**. The selection of the donor site should balance the volumetric need for the defect (with preference for intraoral sites, such as the symphysis and mandibular branch, for cases of lesser to moderate extent) with biological preservation and minimization of postoperative complications.

Finally, the continuous improvement of techniques, which includes the association of biomaterials such as **Platelet-Rich Fibrin (L-PRF)** to enhance healing and reduce the risk of infections, consolidates autologous grafting at the center of regenerative approaches. The integration between scientific knowledge and technical domain is essential to offer safe, functional and aesthetically satisfactory rehabilitation in oral and maxillofacial surgery and implant dentistry.

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