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# Major considerations on the gingival graft on dental implant: a concise systematic review

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## Abstract

Modern implant dentistry uses gingival grafts to promote tissue regeneration around dental implants, ensuring the stability and aesthetics of oral rehabilitation. This study addresses the main types of gingival grafts used, including connective-subepithelial grafts, free gingival tissue grafts, and allogeneic grafts, comparing their clinical indications, advantages, and disadvantages. The connective-subepithelial graft stands out for offering superior aesthetic results, being indicated in visible areas, but requires a donor area, which can increase patient discomfort. Free gingival tissue grafts are effective in increasing keratinized gingiva, essential for peri-implant health, while allogeneic grafts, obtained from tissue banks, eliminate the need for additional surgery, becoming a less invasive option. In addition to the characteristics of the grafts, the study also explores the biomaterials used, such as autogenous, xenogeneic, and allogeneic, analyzing their biocompatibility, osteoconduction, and resorption rate properties, which influence graft integration. Autogenous grafts have high biocompatibility and osteoinductive capacity, while xenogeneic and allogeneic grafts have advantages in terms of accessibility and reduced procedures. The cost and accessibility of graft procedures are important factors in choosing the treatment since the value varies according to the type of graft and the technique applied. Procedures with autogenous grafts tend to be more expensive due to the need for additional surgery, while xenogeneic and allogeneic grafts, which are more accessible, present a balance between cost and effectiveness, especially in health systems with limited coverage. This study provided a comprehensive overview of the indications and limitations of the types of gingival grafts, offering support for the choice of treatments that reconcile health, aesthetics, and cost-effectiveness.

**Keywords:** Bone graft. Gingival grafts. Implant dentistry. Biomaterials.

## Introduction

The loss of gingival tissue around dental implants represents one of the greatest challenges for aesthetic and functional rehabilitation in implant dentistry, a specialty that has been advancing with gingival grafting techniques to promote the stability and longevity of implants [1,2]. Gingival grafts are highly complex procedures that aim to restore the volume and quality of peri-implant tissues, contributing significantly to periodontal health and the longterm success of implants. This type of procedure becomes even more important in cases where there is an absence or insufficiency of keratinized tissue, a condition that can generate retractions and compromise the biological protection and aesthetics of the implant [3].

Among the available approaches, autogenous, xenogeneic, and allogeneic grafts have distinct characteristics, each with specific advantages regarding biocompatibility, integration, and immunological response. The choice between these biomaterials depends on criteria such as the patient's clinical

condition, the treatment objective, and financial limitations since the costs and accessibility of the techniques vary widely. In patients with unfavorable systemic conditions, such as diabetes and smoking, careful selection of the biomaterial and technique is essential to minimize the risk of rejection and peri-implant inflammation [3-5].

In addition to the biocompatibility and stability of grafts, the affordability of these procedures is also a growing concern, since the high cost of some biomaterials and the need for additional procedures, as in the case of autogenous grafts, can restrict patient access to these treatments [4-9].

Therefore, this study aimed to analyze the main types of gingival grafts used in implant dentistry, with emphasis on their clinical indications, biomaterial properties, and affordability, to offer a comprehensive view of best practices and challenges in rehabilitating peri-implant tissues.

## Methods

### Study Design

This study followed the international systematic review model, following the PRISMA (preferred reporting items for systematic reviews and meta-analysis) rules. Available at: http://www.prisma-statement.org/?AspxAutoDetectCookieSupport=1. Accessed on: 01/20/2025. The AMSTAR 2 (Assessing the methodological quality of systematic reviews) methodological quality standards were also followed. Available at: https://amstar.ca/. Accessed on: 01/20/2025.

### Search Strategy and Search Sources

The literature search process was carried out from November 2024 to January 2025 and developed based on Web of Science, Scopus, PubMed, Lilacs, Ebsco, Scielo, and Google Scholar, covering scientific articles from various periods to the present day. The following descriptors (DeCS /MeSH Terms) were used: *Bone graft. Gingival grafts. Implant dentistry. Biomaterials*, and using the Boolean "and" between MeSH terms and "or" between historical findings.

### Study Quality and Risk of Bias

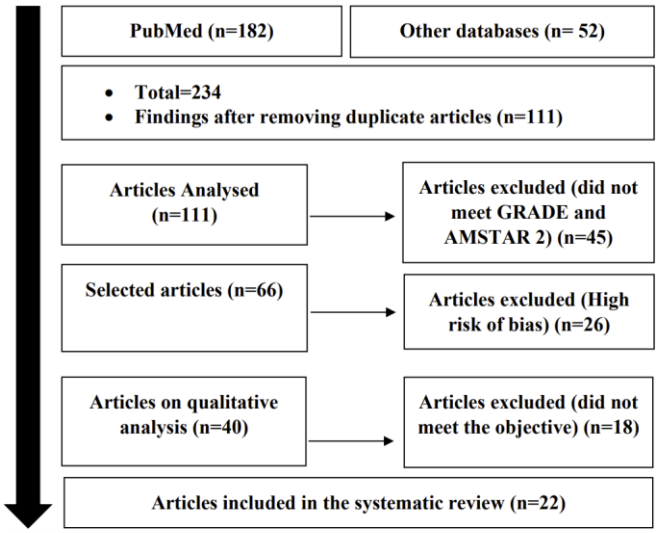
Quality was classified as high, moderate, low, or very low regarding the risk of bias, clarity of comparisons, precision, and consistency of analyses. The most evident emphasis was on systematic review articles or meta-analysis of randomized clinical trials, followed by randomized clinical trials. Low quality of evidence was attributed to case reports, editorials, and brief communications, according to the GRADE instrument. The risk of bias was analyzed according to the Cochrane instrument by analyzing the Funnel Plot graph (Sample size versus Effect size), using Cohen's d test.

## Results and Discussion

### Summary of Findings

As a corollary of the literature search system, a total of 234 articles were found that were submitted to eligibility analysis, 40 articles were evaluated in full and 22 final studies were selected to compose the results of this systematic review. The studies listed were of medium to high quality (Figure 1), considering the level of scientific evidence of studies such as meta-analysis, consensus, randomized clinical, prospective, and observational studies. Biases did not compromise the scientific basis of the studies. According to the GRADE instrument, most studies presented homogeneity in their results, with $X^2$=78.9%>50%. Considering the Cochrane tool for risk of bias, the overall assessment resulted in 26 studies with a high risk of bias and 45 studies that did not meet GRADE and AMSTAR-2.

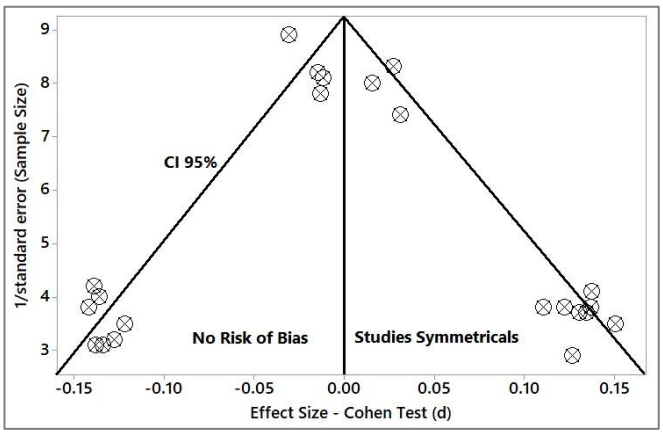
Figure 1. Flowchart showing the article selection process.




Source: Own Authorship.

Figure 2 presents the results of the risk of bias of the studies using the Funnel Plot, showing the calculation of the Effect Size (Magnitude of the difference) using Cohen's Test (d). Precision (sample size) was determined indirectly by the inverse of the standard error (1/Standard Error). This graph had a symmetrical behavior, not suggesting a significant risk of bias, both among studies with small sample sizes (lower precision) that are shown at the base of the graph and in studies with large sample sizes that are shown at the top.

Figure 2. The symmetrical funnel plot does not suggest a risk of bias among the studies with small sample sizes that are shown at the bottom of the graph. Studies with high confidence and high recommendation are shown above the graph (n=22 studies).




Source: Own Authorship.

## Major Approaches and Clinical Findings

### Types of gingival grafts in implant dentistry

Gingival grafts in implant dentistry are procedures that aim to restore the gingival tissue around dental implants, promoting not only periodontal health but also the aesthetics and functionality of the treated region. These grafts are especially important to ensure the stability of peri-implant tissues, preventing complications such as gingival retraction and bone loss. Among the main types of grafts, the following stand out: connective-subepithelial grafts, free gingival tissue, and allogeneic grafts, each with specific characteristics that meet different clinical needs and patient preferences. The choice of the type of graft is made based on factors such as the amount of tissue available, the area to be grafted, and the aesthetic or functional objective of the procedure [1-3].

In implant dentistry, gingival grafts are essential for the aesthetic and functional recovery of peri-implant tissues. Among the most common options, the following stand out: connective-subepithelial grafts, free gingival tissue grafts, and allografts. The connective-subepithelial graft is a widely used technique and consists of removing connective tissue from the palatine region to be implanted in the recipient site. This technique provides favorable aesthetics, especially in visible areas, as it allows for a color similar to the natural gingiva. In addition, the connective graft is advantageous because it has a higher survival rate and a lower incidence of gingival retraction [4-6].

The free gingival tissue graft is removed in its entirety, including the epithelium and the underlying layer of connective tissue, and is mainly indicated for augmenting keratinized tissue. However, this technique may result in a different color from the surrounding gingiva, which compromises the aesthetic result in some situations [7-10].

Allografts, derived from tissue banks, represent a less invasive alternative since they do not require the removal of tissue from the patient himself. This technique is especially indicated in patients who prefer to avoid harvesting palatal tissue [11-13]. However, the integration of these grafts may be slower, and the risk of rejection may be a limiting factor, although technological advances have reduced this incidence [14].

### Advantages and disadvantages of each technique in different clinical cases

The connective-subepithelial graft is widely indicated when seeking an aesthetic approach, especially in areas where the gum is exposed when smiling or speaking. This graft is considered the "gold standard" for cases of gingival recession, as it offers excellent integration with the surrounding tissue and results in a more natural coloration. In addition, it provides tissue thickness that helps prevent future retractions and offers resistance to peri-implant inflammation. However, harvesting connective tissue from the palate can be uncomfortable for the patient and is contraindicated in individuals with a shallow palate, as the risk of damage to blood vessels is greater, increasing the chances of hemorrhagic complications [1-3].

The free graft of gingival tissue, which includes both the epithelium and the connective tissue layer, is particularly effective for increasing the band of keratinized gingiva around implants. This increase is essential for peri-implant health since the presence of keratinized gums reduces the risk of inflammation and facilitates cleaning of the site. However, this technique can result in differences in gum color, which makes it less suitable for aesthetic areas [15]. On the other hand, its application is simplified and reduces surgical time, which can benefit patients who require less invasive procedures [4].

In turn, allografts, obtained from human donors, are an attractive alternative, especially for patients who wish to avoid palatal tissue removal surgery. These grafts are prepared in tissue banks and undergo rigorous processes to ensure their safety and integration in the patient. The main advantage of allografts is the reduction of postoperative discomfort since there is no need for a donor area in the patient himself. However, due to the lower predictability of integration, there is an increased risk of rejection and a need for closer monitoring in the postoperative period to ensure adequate tissue adaptation [14]. In summary, the choice between these techniques depends on factors

such as the patient's periodontal condition, the clinical objective, and the location of the implant. The connective-subepithelial graft stands out for its aesthetics and stability, the free graft of gingival tissue for its effectiveness in increasing the keratinized gingiva, and the allograft for its convenience and less invasiveness [3,4].

### Gingival graft in implants

Gingival grafting in implant dentistry is a widely used practice to improve the stability, aesthetics, and health of the tissues surrounding dental implants. The need for this procedure arises mainly in situations where there is a deficiency of keratinized tissue or gingival retraction, compromising the protection and durability of the implant. In addition, systemic conditions and specific characteristics of the patient, such as smoking habits or the presence of chronic diseases, directly influence the success and indications of the graft. Therefore, a careful evaluation of the indications and contraindications is essential to achieve satisfactory clinical results and reduce the risk of complications [2,3].

Gingival grafts in implant dentistry are used to ensure the stability of the tissue around the implant and improve the aesthetics and health of the peri-implant tissues. The indication for performing gingival grafts occurs mainly in patients who present loss or absence of keratinized tissue, gingival retraction, or specific aesthetic needs. According to Lima and Araújo (2021) [11], the absence of keratinized tissue around implants can increase the risk of inflammation and peri-implant complications, such as mucositis and peri-implantitis, which can compromise the long-term success of the implant.

In cases where there is a more pronounced aesthetic need, gingival grafting is essential to provide a natural and homogeneous appearance between the teeth and the implant. Patients with pronounced gingival retraction around implants are also ideal candidates for grafting, as it helps in the reconstruction of the gingival margin, preventing unwanted exposure of prosthetic components [16-21].

In addition, gingival grafting may be indicated for patients who have difficulty in cleaning due to the lack of keratinized tissue, as highlighted by Souza et al. (2020) [22]. The presence of an adequate strip of keratinized gingiva around the implant facilitates maintenance and plaque control, reducing the risk of infections.

### Factors that influence graft success

The success of gingival grafts on implants depends on several factors, among which the quantity and quality of the available keratinized tissue stand out. The literature highlights that keratinized tissue contributes to protection against masticatory forces and facilitates hygiene, essential elements for maintaining peri-implant health. A minimum amount of keratinized tissue around the implant is crucial to avoid retractions and increase implant longevity [13].

The surgical technique and the professional's skill also directly influence the graft result. According to Moreira and Lima (2022) [14], techniques such as the conjunctival-subepithelial graft are preferred because they offer better aesthetic results and are associated with a high success rate.

However, these techniques require surgical precision and are only recommended for professionals with experience in periodontics and implant dentistry. Another important factor is the patient's systemic condition, as diseases such as diabetes and smoking can negatively impact healing and graft integration. Studies by Gonçalves and Mendes (2022) [10] indicated that diabetic patients have a higher risk of complications and graft rejection due to changes in the healing process. Therefore, a careful assessment of the patient's systemic conditions is essential to predict possible complications and adapt treatment as necessary.

### Biomaterials used in grafts in implant dentistry

The biomaterials used in grafts play an essential role in bone regeneration and implant stability. Among the most commonly used options are autogenous, xenogeneic, and allogeneic grafts, each with characteristics that directly affect graft integration and long-term implant success. The choice between these biomaterials is made based on criteria such as biocompatibility, osteoconduction, and the need for bone regeneration, aiming to ensure that the implant is functionally and aesthetically integrated with the patient's bone tissue [1-4].

The choice of biomaterial for grafts is crucial to ensure the success and stability of the implant. The main types of biomaterials used are autogenous, xenogeneic, and allogeneic grafts, each with specific characteristics that influence the biological response and integration of the graft into the tissue. Autogenous biomaterials are tissues collected from the patient, usually from intraoral regions, such as the palate, or extraoral regions, such as the mandibular ramus [7].

Because they come from the same individual, these grafts have high biocompatibility and significantly reduce the risk of rejection and disease transmission. In addition, autogenous grafts favor bone regeneration, as they contain endogenous cells and growth factors, promoting rapid and effective

integration [19]. However, a disadvantage of this type of graft is the need for a donor area, which can cause pain and discomfort to the patient.

Xenogeneic biomaterials, on the other hand, are obtained from other species, such as cattle or pigs, and undergo purification processes that eliminate cells and proteins that could cause rejection [13]. These grafts offer a structure similar to human bone, providing mechanical support and facilitating bone formation over time. However, the resorption rate of xenogeneic grafts can be slower, and they require a longer period for complete integration [6]. Although they are a good alternative in terms of availability, there is a slight chance of immunological reaction. Allogeneic biomaterials are human tissues obtained from donors and processed in tissue banks. They represent a practical solution, as they eliminate the need for a second surgical area for collection, reducing patient discomfort. These materials have a composition and structure similar to the patient's tissues, which favors osteoconduction and facilitates integration into the recipient tissue [12]. However, due to the preservation and decellularization processes they undergo, they may have a lower amount of growth factors compared to autogenous grafts, which may delay regeneration [9].

### Biomaterial properties that influence graft stability

The stability and integration of a graft depend on several biomaterial properties, such as biocompatibility, osteoinduction, osteoconduction, and resorption rate. Autogenous grafts are considered standard due to their high biocompatibility and osteoinductive capacity, that is the ability to stimulate bone formation through native growth factors [19]. This characteristic accelerates the integration of the graft into the recipient bone, promoting a stable union.

Xenogeneic grafts have excellent osteoconductive capacity, providing a structural matrix that guides bone growth. However, their absence of viable cells and growth factors, resulting from the purification processes, limits their osteoinductive capacity [6]. Additionally, the lower resorption rate makes them suitable for patients requiring prolonged bone support.

For allografts, biocompatibility is also high, and their matrix favors osteoconduction, but the decellularization process reduces native osteoinductive factors. This can impact the speed of integration and the initial development of bone cells around the implant [12]. On the other hand, they offer a good solution for patients seeking a less invasive procedure with reduced recovery time.

### Costs and accessibility of gingival grafting procedures in implant dentistry

Gingival grafting procedures in implant dentistry play a crucial role in ensuring the stability and aesthetics of dental implants. However, the choice of graft type and surgical technique can significantly impact treatment costs and its accessibility for patients. Values vary according to the type of graft — autogenous, xenogeneic or allogeneic — and the complexity of the technique used. This topic is of interest to both professionals and patients, as it involves an analysis of the cost-benefit associated with each method and its viability in different socioeconomic contexts [20].

### Costs of different types of grafts and techniques

Autogenous grafts are considered the gold standard in implant dentistry due to their high success rate and biological compatibility. However, the costs associated with these grafts tend to be higher, mainly due to the need for an additional surgical procedure to collect the material, which can increase recovery time and the complexity of the surgery [8]. In addition, the cost is influenced by the need for specific equipment and specialized labor, which can limit the access of this type of graft to patients with lower purchasing power.

Xenogeneic and allogeneic grafts, on the other hand, are more affordable alternatives, as they do not require a donor area from the patient himself. Xenogeneic grafts, usually of bovine or porcine origin, undergo sterilization processes that slightly increase the cost of the material but are still a relatively economical option [16]. Allogeneic grafts, derived from tissue banks, represent a viable solution in terms of cost, eliminating the need for additional surgery. However, these biomaterials have a variable cost depending on the origin and quality of the preservation treatment [5].

The accessibility of gingival grafts in implant dentistry is directly linked to the cost of the procedure and the availability of materials in public and private health systems. In countries where the health system partially covers dental treatments, the use of autogenous grafts may be limited to patients who can afford additional costs. According to research by Santos and Costa (2022) [18], patients who have access to health insurance with partial coverage for implant dentistry tend to opt for xenogeneic or allogeneic grafts, which offer a good balance between cost and effectiveness, especially for cases that do not require a high degree of tissue customization.

Xenografts, despite being more affordable, may have limitations in terms of integration time and predictability of results. However, due to their lower cost, these grafts are widely used and offer an advantageous cost-benefit ratio for many patients [15].

Allografts, on the other hand, have gained ground as an intermediate alternative, providing greater accessibility without sacrificing the quality of results, and are considered a good cost-benefit option for those seeking a less invasive treatment [4,5].

## Conclusion

It was concluded that modern implant dentistry, when dealing with the loss of gingival tissue around dental implants, demands judicious use of grafting techniques to achieve longterm stability and success. The various approaches, including autogenous, xenogeneic, and allogeneic grafts, offer personalized alternatives to meet the aesthetic and functional needs of each patient. The choice of the type of graft and biomaterial, whether in terms of origin or surgical technique, directly impacts tissue integration, immune response, and healing, with autogenous grafts standing out for their superior biocompatibility. In contrast, allogeneic and xenogeneic grafts contribute to less invasive and accessible approaches. The success of gingival grafts in implant dentistry depends on a thorough analysis of the systemic and local conditions of each patient, in addition to an understanding of the regeneration capacity and the influence of external factors, such as smoking and chronic diseases. Furthermore, the costs and accessibility of these procedures are relevant factors for their widespread and sustainable implementation. Cost-benefit analysis is essential, allowing patients to make informed and financially viable decisions without compromising the quality and predictability of results. Therefore, the continuous development of innovative techniques and biomaterials allows implant dentistry to adapt to different clinical and economic demands, promoting safe, accessible, and efficient treatments. This evolution reflects the field's commitment to offering alternatives that comprehensively meet the patient's needs, reconciling health, aesthetics, and economic viability.

## CRediT

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## Conflict of Interest

The authors declare no conflict of interest.

## Similarity Check

It was applied by Ithenticate@.

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It was performed.



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