

Grado en ODONTOLOGÍA

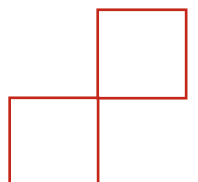
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**The impact on the esthetic outcomes of
immediate dental implant placement in anterior
areas with or without soft tissue graft:
A systematic review**

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INDEX

1. ABSTRACT	1
2. RESUMEN	3
3. KEYWORDS	6
4. INTRODUCTION	8
4.1 Generalities	8
4.2 Immediate dental implants	9
4.3 Importance of soft tissue management	12
4.4 Types of soft tissue graft	14
5. JUSTIFICATION AND HYPOTHESIS	19
5.1 Justification	19
5.2 Justification SDG	20
5.3 Hypothesis	21
6. OBJECTIVES	23
7. MATERIAL AND METHOD	25
7.1 Identification of PICO question	25
7.2 Selection criteria	26
7.3 Information sources and search strategy	27
7.4 Studies selection process	28
7.5 Data extraction	28
7.6 Quality assessment	29
7.7 Data synthesis	29
8. RESULTS	31
8.1 Study selection. Flowchart	31
8.2 Analysis of the characteristics of the reviewed studies	35
8.3 Assessment of the methodological quality and risk of bias	38
8.4 Synthesis of results	41
9. DISCUSSION	48
9.1 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using PES	49
9.2 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using WES	51
9.3 Limitation of the study and future lines of research	53
10. CONCLUSION	57

11.BIBLIOGRAPHY	59
12.ANNEXES	70

1. ABSTRACT

Introduction: One of the primary challenges of immediate dental implants is the risk of soft tissue recession and the compromised esthetic result, especially in the anterior sector of the upper maxilla. To solve this problematic, soft tissue graft, such as autogenous connective tissue grafts and biomaterials, have been introduced as an adjuvant technique to increase peri-implant tissue stability, improving esthetic results and reducing the risk of long-term complications. The objective was to evaluate the esthetic outcomes in terms of Pink Esthetic Score (PES) and White Esthetic Score (WES) in immediate dental implants using soft tissue graft compared to immediate implants without soft tissue graft.

Material and method: An electronic search was carried out in the PubMed, Web of Science and Scopus databases on immediate implants placement with and without the use of soft tissue graft technique and the esthetic outcomes on the anterior sector of the upper maxilla, until November 2024.

Results: Out of 187 articles, 9 studies were included in this systematic review, comparing immediate implants with and without connective tissue grafts and Pink Esthetic Score (PES). Six articles used both PES and White Esthetic Score (WES). Grafted implants showed slightly better esthetic outcomes with a total weighted average of: PES 8,35 in grafted group and 8,11 in non-grafted group and WES 8,02 in grafted group and 7,76 in non-grafted group, with minor differences and some variability. Risk of bias was generally moderate to high. Overall, connective tissue grafting offered modest esthetic improvements.

Conclusion: Immediate implants with connective tissue grafts showed better soft tissue esthetic outcomes (higher PES), particularly beneficial in patients with thin gingival biotype. While WES was only slightly higher in grafted cases, with grafting supporting and improving the overall esthetic integration of the prosthetic crown.

2. RESUMEN

Introducción: Uno de los principales desafíos de los implantes dentales inmediatos es el riesgo de recesión de los tejidos blandos y el compromiso del resultado estético, especialmente en el sector anterior del maxilar superior. Para solucionar esta problemática, se han introducido los injertos de tejido blando, como los injertos autógenos de tejido conectivo y los biomateriales, como una técnica adyuvante para aumentar la estabilidad de los tejidos periimplantarios, mejorar los resultados estéticos y reducir el riesgo de complicaciones a largo plazo. El objetivo fue evaluar los resultados estéticos medidos con el Pink Esthetic Score (PES) y White Esthetic Score (WES) en implantes dentales inmediatos con el uso de injerto de tejido blando en comparación con implantes inmediatos sin injerto de tejido blando.

Material y métodos: Se realizó una búsqueda electrónica en las bases de datos PubMed, Web of Science y Scopus sobre la colocación de implantes inmediatos con y sin el uso de la técnica de injerto de tejido blando y los resultados estéticos en el sector anterior del maxilar superior, hasta noviembre de 2024.

Resultados: De un total de 187 artículos, en esta revisión sistemática se incluyeron 9 estudios, los cuales compararon implantes inmediatos con y sin injertos de tejido conectivo utilizando el Pink Esthetic Score (PES). Seis artículos evaluaron ambos índices: PES y WES (White Esthetic Score). Los implantes con injerto mostraron resultados estéticos ligeramente mejores, con un promedio ponderado total de: PES 8,35 en el grupo con injerto y 8,11 en el grupo sin injerto, y WES 8,02 en el grupo con injerto y 7,76 en el grupo sin injerto, con diferencias menores y cierta variabilidad. El riesgo de sesgo fue en general de moderado a alto. En conjunto, el uso de injertos de tejido conectivo ofreció mejoras estéticas modestas.

Conclusión: Los implantes inmediatos con injertos de tejido conectivo mostraron mejores resultados estéticos en los tejidos blandos (mayor PES), siendo especialmente beneficiosos en pacientes con biotipo gingival delgado. Aunque el WES fue solo ligeramente más alto en los casos con injerto, el uso del injerto contribuyó a mejorar la integración estética general de la corona protésica.

3. KEY WORDS

- I. Immediate dental implants
- II. Immediate dental implants placement
- III. Immediate implants
- IV. Postextraction dental implants
- V. Aesthetic zone
- VI. Anterior sector
- VII. Maxilla
- VIII. Connective tissue graft
- IX. Soft tissue graft
- X. Gingival graft
- XI. Free gingiva graft
- XII. Dental esthetic

4. INTRODUCTION

4.1 Generalities

Dental implants have been an effective and efficient solution over the years since their discovery and evolved significantly over time (1).

Before the advent of dental implants, the only options for replacing missing teeth were removable prostheses such as complete, partial and skeletal dentures, as well as fixed bridges. However, all these solutions could lead to increased bone loss and consequent soft tissue recession due to the lack of stimulation to the alveolar ridge that would normally be provided by natural teeth. Recent research focused on improving dental implant designs, materials and techniques, leading to favor better osseointegration and long-term success rates (2).

Such considerations are particularly important in younger and relatively young patients, especially when tooth loss occurs in the anterior region of the maxilla, commonly referred to as the aesthetic zone (3).

Patients requiring extraction of anterior maxillary teeth due to periodontal disease, trauma, vertical fractures or cysts that cannot be removed without extracting the affected tooth, often face a waiting period of 3 to 6 months for socket healing before implant placement (3). During this period, these individuals frequently experience discomfort, a loss of confidence, diminished social interaction, sadness and hesitation to smile or laugh in public (3). Dental implants significantly improve patient oral health and quality of life and the result leads to influencing the satisfaction level (4).

To address this issue, immediate post-extraction implant placement has been proposed as an option to shorten the duration of the rehabilitation process (5,6). Numerous studies have examined the placement of implants in fresh extraction sockets and consistently report some degree of bone resorption and soft tissue recession. These results are caused by factors such as implant position, the thickness of the buccal bone plate and the quality and type of bone. In order to overcome these effects and enhance the aesthetic results of immediate post-extraction implant placement, additional procedures such as bone grafting and/or soft tissue grafting can be performed. These interventions, individually or in

combination, have shown to significantly improve the aesthetic outcomes of rehabilitation with immediate post-extraction implants (5).

While traditional dental implant approaches have significantly advanced the field of oral rehabilitation, immediate post-extraction implants combined with soft tissue grafting offer promising potential to address esthetic challenges, particularly in the anterior maxilla. This approach not only reduces treatment time but also aims to preserve bone and soft tissue, enhancing patient satisfaction and outcomes (1–6).

4.2 Immediate dental implants

Immediate implants placement is a technique that consists in inserting a dental implant in a fresh socket immediately after tooth extraction. This procedure allows to reduce the number of surgical steps and shorten the treatment time (7).

The procedural steps for this technique include:

- Tooth extraction: atraumatic extraction of the tooth typically necessary due to decay, fracture, periodontal disease (7);
- Site preparation: thorough cleaning the socket from debris, granulation tissue and residual infection (7);
- Implant placement: the dental implant is inserted into the socket and it is fundamental to achieve the primary stability which might be difficult due to the absence of bone healing after removal of the tooth (7);
- Bone graft: in some cases, bone graft material is used to fill the gap between the implant and the bone walls and at the same time promoting bone regeneration (7);
- Suture: the soft tissue is repositioned and suture around the implant. A healing abutment is placed in order to shape the gum around the implant and to promote optimal peri-implant mucosa. The use of customized healing abutment further enhances soft tissue management and esthetic outcomes (8);
- Healing period: typically lasts between 3 to 6 months but it can vary depending on patient characteristics. It is when the healing phase allows the osseointegration to occur, where the bone fuses with the implant (3,7).

4.2.1 Advantages

Immediate dental implants offer several advantages compared to delayed implant technique including reduced treatment time, preservation of alveolar bone and improved patient satisfaction.

Advantages:

- Reduced treatment time: immediate implants are placed immediately after tooth extraction and without the need to wait for the socket to heal and bone formation, reducing the number of surgical intervention (9);
- Preservation of the alveolar bone: immediate implant placement minimizes post extraction bone resorption, helping to maintain the height and width of the alveolar ridge (10);
- Improve patient satisfaction: this type of procedure reduces the number of surgical interventions and the time that patients have to wait till the end of the teeth rehabilitation, decreasing the discomfort and promoting the acceptance by the patients (10).

4.2.2 Complications

Post extraction implant placement also presents several challenges including the achievement of primary stability and the management of potential esthetic complications (11). So careful patient selection and surgical expertise are crucial for optimal results (7).

Main complications:

- Primary stability: it can be difficult to achieve primary stability because the procedure does not allow time for socket healing and new formation of bone, so this lack of bone contact might lead to mobility and failure of the implant (7);
- Soft tissue and hard tissue remodeling: after the extraction of a tooth, both the hard and soft tissues undergo remodeling which can result in peri-implant soft tissue defect and if it's not properly managed it can compromise the esthetic result (12);

- Esthetic complications: when an immediate dental implant is placed into a socket with buccal bone defects may cause gingival recession and esthetic issues particularly in patients with a thin periodontal biotype (13);
- Surgical complications: this technique has been associated with a higher incidence of surgical complication including infection and gingival recession (14);
- Higher implant failure rate: immediate implants may face a higher risk of failure due to the difficulty in predicting the future level of supporting tissues, such as bone and soft tissue, and the problem in achieving the primary stability (7).

4.2.3 Differences between immediate and delayed implants

Dental implant placement can be divided into three different techniques: immediate, delayed and conventional, each of them with different characteristics and clinical considerations.

In terms of survival rates, scientific studies evidence no significant difference between immediate and delayed implant protocols (15). However, for bone healing there's more crestal bone level reduction in immediate implants placement then compared to delayed placement (10). Regarding loadings protocols, while immediate loading of implants can be successful under certain conditions, delayed loading is generally considered more predictable (16).

Choosing the appropriate method requires careful consideration of the one of these methods is important to taking into account patient clinical features, bone quality, type of soft tissues biotype, esthetic requirements and overall treatment goals, to ensure optimal results, both functional and aesthetic.

4.2.4 Aesthetics areas in implantology: challenges and considerations

Aesthetic areas, in particularly the anterior maxilla, present unique challenges in the implantology field due to a combination of anatomical, biological and aesthetic considerations.

The anterior maxilla is the central aspect of a patient's smile, making the minimum error or discrepancies in the position of the implant, soft tissues contours or prosthetic design immediately noticed. Additionally, patients expect the implant-supported prosthesis to match the adjacent natural teeth in terms of color, shape and alignment (17).

Another challenge in this region is the thin and fragile nature of the buccal bone which is prone to resorption following tooth extraction. This resorption can compromise the stability and the appearance of the soft tissues leading to flattening and recession of the gingival contour. The gingival biotype in the esthetic zones is commonly thin and fragile, increasing the risk of soft tissue recession and the consequent exposure of implant components (18).

In addition, the anterior maxilla has an anatomy that complicates implants placements, including the proximity to the nasal cavity and incisive canal, the irregularities of the alveolar ridge after the tooth extraction and limited vertical and horizontal bone dimensions. These factors need a precise presurgical planning and advance imaging techniques such as Cone Beam Computed Tomography (CBCT) (19).

The interdental papilla is crucial in order to achieve a natural appearance of the implant. The lack of papilla leads to the formation of black triangles which are difficult to correct. Maintaining or reconstructing the papilla requires precise implant position and an adequate soft tissue support (20).

From a psychosocial perspective, the anterior maxilla significantly impacts on patient's smile and overall facial esthetic and consequently influences the self-confidence, social interactions and quality of life (21).

4.3 Importance of soft tissue management

The peri-implant soft tissues play an essential role in the aesthetic, biological, and functional outcomes of dental implants. Proper soft tissue management is crucial for both the short-term and long-term success of implant-supported restorations.

4.3.1 Biological function of peri-implant soft tissue

Soft tissues surround the implant and provide a barrier that plays a significant role in protecting underlying bone and implant components from external factors such as microbial invasion and trauma (22,23).

- Protection against microbial invasion: peri-implant soft tissues help protecting the underlying bone from microbial infection. Healthy gingival tissues create a natural barrier preventing the entry of harmful bacteria and pathogens that could lead to peri-implant disease like peri-implantitis. So, a proper seal between the implant and soft tissue is important to prevent infection and inflammation leading to implant failure (22).
- Control of inflammation: proper soft tissue management helps in minimizing the inflammation around the implant. Inflammatory response due to poor tissues health or incorrect implant positioning can lead to soft tissue breakdown, bone loss or even implant failure. So, in order to minimize such complications, soft tissues management and maintenance is important (23).

4.3.2 Aesthetic significance of soft tissue contour, volume and colour

The surrounding soft tissues directly influence the final appearance of the implant restoration, especially in the anterior maxilla which is highly visible.

- Soft tissue contour: achieving a well contoured gingiva provides a natural appearance being similar to the surrounding natural teeth, enhancing the esthetic outcome. Irregular soft tissue contour can lead to poor cosmetic results and compromise the overall appearance (24).
- Soft tissue volume: adequate volume of soft tissue around the implant is essential for the stability of the gingival contour and prevention of recession. Insufficient volume of soft tissue leads to the exposure of the structure of the implant and lack of esthetic. So, tissue augmentation procedures such as connective tissue graft are used in order to maintain or increase the volumes of soft tissue (25).

- Soft tissue color: gingival tissues should match the natural colour of the adjacent gums. This type of tissue in presence of poor circulation, infection or inflammation can appear pale or discolored but also the colour of the under lying neck of the implant can affect the esthetic outcome (26). The use of gingiva colored ceramic has been proposed to improve the results in cases of soft tissue defects (27).

4.3.3 Relationship between soft tissue and long-term implant stability

Long term stability of dental implants is closely related to soft tissues health. The health and thickness of the peri-implant soft tissues provide mechanical support to the implant and act as a barrier, protecting the underlying bone from factors that could lead to bone resorption or implant mobility. Additionally, well maintained soft tissues prevent bone loss by promoting stable tissue integration and maintaining the osseointegration of the implant (28,29). Additionally, healthy peri-implant soft tissue prevents the appearance of peri-implantitis, which is an inflammatory disease affecting the soft tissues and bone around the implant. Chronic peri-implantitis can result in bone loss, implant failure and compromised aesthetic outcome. Effective soft tissue management techniques such as regular cleaning, maintenance and possibly soft tissue grafting are essential to minimize the risk of peri-implantitis (30).

4.4 Types of soft tissue graft

Soft tissue augmentation is important in implantology and periodontal dentistry to enhance gingival thickness, cover exposed roots and improve the esthetic result of treatments. Several techniques and materials are used for soft tissue augmentation and each of them presenting benefits and limitations. Understanding the advantages and disadvantages of these methods helps clinicians optimize treatment plans for patients improving esthetic and functional outcomes.

4.4.1 Autogenous graft

An example of autogenous graft would be connective tissue graft (CTG), a technique that use the patient's own tissues typically obtained from the palate, to augment deficient soft tissue areas. This method has been widely used in periodontal and implant surgeries due to its ability to enhance soft tissue volume and quality.

The main benefits of autogenous grafts are:

- High biocompatibility and integration of the graft at the recipient site due to the use of the patient's palatal soft tissue, this reduces the risk of rejection and immune response, leading to faster and more predictable healing (31);
- Predictable outcome in increasing tissue thickness and root coverage, making them an ideal choice for treating gum recession and implant-related complications (31,32).

However, autogenous grafts do present some limitation, which should be considered when planning the treatment:

- Donor site morbidity: the palatal donor site can lead to postoperative pain, discomfort, and swelling. Patients may experience discomfort during the recovery period, especially in cases requiring large tissue samples (33);
- Limited availability of donor tissue: in some patients, especially those with limited palate tissue or those who require an important soft tissue augmentation, the available donor tissue may not be sufficient and lead to multiple procedures or the use of alternative methods (33);
- Increased surgical time and complexity: autogenous tissue requires additional surgical time and increases the complexity of the procedure. The need to manage both the donor and recipient sites can make the procedure more challenging for clinicians, especially in cases involving extensive augmentation (31,32).

4.4.2 Biomaterials: collagen matrices

Collagen matrices are biomaterials commonly used as an alternative to autogenous grafts for soft tissue regeneration in implantology and periodontal surgery. These matrices are often derived from porcine sources and provide a scaffold for cellular infiltration, vascularization in order to provide tissue integration.

The advantages of collagen matrices include:

- Eliminating the need for a second surgical site: unlike autogenous grafts, which require a donor site typically the palate, collagen matrices do not require tissue from another part of the patient's body. This reduces patient morbidity and discomfort while also shortening surgical time (34);
- Unlimited availability and consistent quality: collagen matrices are available in standardized forms and quantities, providing a reliable and reproducible material for soft tissue augmentation. Their consistency and availability eliminate the limitations imposed by autogenous tissue such as donor site restrictions and variability in tissue quality (31);
- Promotion of tissue integration: collagen matrices provide a structure for the infiltration of fibroblasts, endothelial cells and other tissue-regenerative cells, promoting proper integration and stability of soft tissue. This leads to improved healing and regeneration of the peri-implant soft tissues (35).

4.4.3 Emerging technique in soft tissues management

The advancement in soft tissue augmentation have focused on improving the efficiency, predictability and minimal invasive treatments.

Some of the emerging techniques include:

- **Volume-stable collagen matrix:** made to maintain their volume after placement, these matrices provide stable support for soft tissue regeneration and preventing resorption volume-stable collagen matrices ensure sustained tissue augmentation and improved long-term outcomes (36);

- **Minimally invasive technique:** these techniques aim to reduce the surgical trauma and improve patient comfort by using smaller incisions and less invasive approaches. Innovations like flapless procedures and advanced suturing techniques are being developed to improve clinical outcomes while minimizing patient discomfort and recovery time (37,38);
- **Biologically active materials:** incorporating growth factors and other bioactive agents into grafting materials has been a promising strategy to accelerate tissue healing and improve tissue integration. By stimulating cell proliferation, collagen production and vascularization, these biologically active materials enhance the regeneration of soft tissues and give a more predictable and robust healing (39).

Autogenous connective tissue grafts is the gold standard for soft tissue augmentation due to their high biocompatibility and predictability, while the development of biomaterials like collagen matrices offers promising alternatives (33). Collagen matrices, with their advantages of eliminating the need for a second surgical site and providing a stable scaffold for tissue regeneration, present a significant solution, particularly in cases where donor tissue is limited or unavailable (31,34,35). Moreover, the innovations in emerging techniques, such as volume-stable matrices, minimally invasive procedures and the use of biologically active materials, continue to enhance the effectiveness and predictability of soft tissue grafting. These innovations are transforming the soft tissue augmentation providing patients with less invasive, more efficient and highly effective options for improving both functional and esthetic outcomes in implantology and periodontal fields (36–39).

5. JUSTIFICATION and HYPOTHESIS

5.1 Justification

Modern dentistry tries to improve the functional and esthetic results of the provided treatments especially in implantology. Immediate implants are famous for their potential benefits like reducing treatment time and preserving alveolar bone and gingival tissue. However, the success of this type of treatment depends not only on the function but also on the esthetic outcome as an important factor for patients' expectations. The Pink Esthetic Score (PES) and the White Esthetic Score (WES) are commonly used to evaluate esthetic results in implant rehabilitation providing an objective measure of the treatment result.

There is a controversy in the literature regarding the impact of using soft tissue grafts in immediate implants and the results on PES and WES scores. Although some studies published about this topic, there is no clear consensus on whether the use of soft tissue grafts is improving esthetic outcomes or whether similar results can be achieved without these additional procedures. This leaves a gap in knowledge that raises questions about the necessity of including soft tissue grafts in all immediate implant procedure.

This systematic review aims to try to fill this gap in the literature by analysing and comparing esthetic results in immediate implants with and without soft tissue grafts measured using PES and WES. Through this research, it is expected to provide robust and updated evidence that can: guide clinical practice, optimize treatments, contribute to scientific knowledge and benefit for patients and professionals.

5.2 Justification SDG

This systematic review contributes to the Sustainable Development Goal (SDG) number 3 (good health and well-being) which is about “ensure healthy lives and promote well-being for all at all ages”, established on September 2015. This review aims to achieve universal health coverage by promoting access to high-quality treatments, evidence-based dentistry as well as improving the overall quality of life through new advances in oral health.

Oral health is a fundamental component of general health and well-being. Dental implants play a critical role in improving patients' quality of life by restoring the basic and at the same time important oral functions such as mastication and phonation, but also aesthetics and self-confidence. However, achieving the esthetic outcome is not only a matter of aesthetics, but it also impacts on the psychological aspect of well-being, social interactions and patient satisfaction. By studying the evidence on soft tissue grafting in immediate implants, this review tries to clarify whether this procedure is necessary to improve treatment outcomes or if easier and less invasive approaches can deliver comparable results.

This review also respects the principle of “reducing health inequalities”, which is another key point of the SDG 3 by providing evidence to achieve esthetic success, it can help reduce inequalities in access to advanced dental treatments. Therefore, this study contributes to making high-quality dentistry more equitable and accessible, improving oral health globally.

In conclusion, this systematic review supports SDG 3 by providing universal access to high-quality, evidence-based oral health care, increasing well-being and preventing health disparities in dental treatments. By examining the role of soft tissue grafts in the esthetic results of immediate implants, this review provides valuable perspectives that can guide clinical decision-making, improve treatment protocols and contributes to a more inclusive and equitable system in line with the principles of sustainable development goals.

5.3 Hypothesis

The hypothesis of this systematic review is that in patients receiving immediate dental implant placement, the use of soft tissue grafts in the anterior sector of the upper maxilla results in superior esthetic outcomes measured by the Pink Esthetic Score (PES) and the White Esthetic Score (WES), compared to the use of immediate dental implants without soft tissue grafts.

This difference is hypothesis is made by the fact that the graft's ability to increase soft tissue volume, contour and integration, leading to improve the harmony with the surrounding gingival tissue and prosthetic rehabilitation.

6. OBJECTIVES

6.1 Principal objective

- 1- Evaluate the Pink Esthetic Score (PES) in immediate dental implants placed with soft tissue graft compared to immediate implants placed without soft tissue graft in the anterior sector of the upper maxilla.

6.2 Secondary objective

- 1- Evaluate the White Esthetic Score (WES) related to the prosthetic crowns placed on immediate dental implants with soft tissue graft technique compared to the crowns placed on immediate implants without soft tissue graft in the anterior sector of the upper maxilla.

7. MATERIAL AND METHOD

This systematic review was carried out following the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) (40) guideline recommendations.

7.1 Identification of PICO question

The "PICO" strategy was employed to develop a focused and relevant research question, allowing the search to be centred on the selected topic. In order to formulate the PICO question, the focus was on adult patients requiring an immediate implant due to a tooth loss in esthetic region on the anterior sector of the upper maxilla with the use of soft tissue grafts. This systematic review aims to evaluate the aesthetic results of immediate dental implant placement with and without the use of soft tissue grafting, measured by the Pink Esthetic Score (PES).

The PICO question was made by the following parts:

- **P** (population) : Adult patients requiring single-tooth replacement in the in the anterior maxillary region;
- **I** (intervention) : Immediate dental implant placement following tooth extraction and soft tissue graft;
- **C** (comparison) : Immediate dental implant placement following tooth extraction without soft tissue graft;
- **O** (outcomes) :
 - O1** : Pink Esthetic Score (PES) as a measure of soft tissue esthetics;
 - O2** : White Esthetic Score (WES).

By using this structure, a complete and specific research question was formulated: "In adult patients requiring single-tooth replacement in the in the anterior maxillary region, does immediate dental implant placement with soft tissue graft, compared to immediate dental implant placement without soft tissue graft, result in superior soft tissue aesthetic outcomes as measured by the Pink Esthetic Score?"

7.2 Selection criteria

7.2.1 Inclusion criteria

The inclusion criteria for this systematic review were:

- **Type of study:** randomized control trials, prospective and retrospective cohort studies and case series. Published until November 2024.
- **Type of patient:** adult patients that need an immediate implant due to a tooth loss in the anterior sector of the upper maxilla.
- **Type of intervention:** placement of immediate dental implant in the anterior sector of the upper maxilla with or without the use of soft tissue grafts for restoring the esthetic due to tooth loss.
- **Type of outcomes variables:** studies that analysed the aesthetics outcomes by evaluating the Pink Esthetic Score (PES) as principal variable and the White Esthetic Score (WES) as secondary variable, following immediate dental implant placement in esthetic regions. The studies have to focus on the impact of this procedure on both soft tissues and prosthetic dental crown aesthetics, particularly in the anterior part of the upper maxilla where the esthetic plays a crucial role in the overall result.

7.2.2 Exclusion criteria

The exclusion criteria for this systematic review were: in vitro experimental studies, animal experimental studies, case reports, reviews, letters and comments to the editor. In addition, studies about immediate implants placed in the mandible, posterior sector of the maxilla, guided bone surgery and only bone grafting.

7.3 Information sources and search strategy

Three databases were used for performing the research, which are: PubMed, Web of Science and Scopus.

An automated search was carried out in the three databases mentioned above (PubMed, Scopus and Web of Science) using the following keywords: “immediate dental implants”, “immediate dental implants placement”, “immediate implants”, “postextraction dental implants”, “aesthetic zone”, “anterior sector”, “maxilla”, “connective tissue graft”, “soft tissue graft”, “gingival graft”, “free gingiva graft”, “dental esthetic”. These keywords were combined using the Boolean operators AND and OR. Furthermore, a manual search was carried out for articles on immediate implants in aesthetic areas that were not available in the previously mentioned databases.

The search in PubMed was as follows: (((((((("immediate dental implants") OR (immediate dental implants placement)) OR ("immediate implants")) OR (postextraction dental implants)) AND (aesthetic zone)) OR (anterior sector)) OR (maxilla[MeSH Terms])) AND (connective tissue graft)) OR (soft tissue graft)) OR (gingival graft)) OR (free gingiva graft)) AND (dental esthetic[MeSH Terms])

The search in Web of Science was as follows: (((ALL=("immediate dental implants" OR immediate dental implants placement OR "immediate implants" OR postextraction dental implants)) AND ALL=(aesthetic zone OR anterior sector OR maxilla)) AND ALL=(connective tissue graft OR soft tissue graft OR gingival graft OR free gingiva graft)) AND ALL=(dental esthetic)

The search in Scopus was as follows: (TITLE-ABS-KEY ("immediate dental implants" OR immediate AND dental AND implants AND placement OR "immediate implants" OR postextraction AND dental AND implants) AND TITLE-ABS-KEY (aesthetic AND zone OR anterior AND sector OR maxilla) AND TITLE-ABS-KEY (connective AND tissue AND graft OR soft AND tissue AND graft OR gingival AND graft OR free AND gingiva AND graft) AND TITLE-ABS-KEY (dental AND esthetic))

In Table 1, included in the Annex section, presents a summary of the searches conducted in each of the consulted databases.

In PubMed/Medline the search was done focusing on “All fields” and “MeSH terms”, while on Web of Science with “topic” and on Scopus using “Title, Abstract, Keyword”.

7.4 Studies selection process

A three-stage selection process was carried out. The selection of studies was conducted independently by two reviewers (DP, ELWS). In the first step, the titles were filtered to eliminate irrelevant publications, those not related to the topic and duplicate publications. In the second step, the abstracts were screened and studies were selected based on the type of study, the type implants, the type of intervention, the number of patients and outcome variables. In the third step, the full text was reviewed and data were extracted using a pre-established data collection form to confirm the studies' eligibility.

7.5 Data extraction

The following information was extracted from the studies and presented in a table, based on the criteria: authors with the year of publication, type of study (randomized controlled trials, retrospective studies, prospective studies, experimental studies), country, number of patients, age, follow-up period, number of implants, with or without soft tissue graft, type of soft tissue graft, presence or not of bone graft, evaluation of the Pink Esthetic Score (PES) and the White Esthetic Score (WES).

Principal variable:

The Pink Esthetic Score (PES) is used to assess the esthetic results of dental implant treatments in visible areas such as the anterior region of the upper maxilla. In immediate dental implants, the PES evaluates the soft tissue around the implant, its adaptation and integration with the surrounding tissues. The PES allows the measurement of the esthetic outcome after postextraction implant placement with or without the use of soft tissue grafts.

The PES score on a scale from 0 to 2 or 0 to 3 for different variables, with a maximum score of 14.

Secondary variable:

The White Esthetic Score (WES) is used to evaluate the aesthetic outcomes of the dental crown placed on a dental implant in an esthetic area such as the anterior part of the upper maxilla. The WES evaluate the appearance of the implant prosthetic crown, its integration with the surrounding natural teeth and the visual harmony with the rest of the dentition.

The WES score on a scale from 0 to 2 or 0 to 3 for different variables, with a maximum score of 14.

7.6 Quality assessment

The risk of bias assessment was conducted by two reviewers (DP, ELWS) in order to analyse the methodological quality of the included articles.

For the assessment of the quality of experimental studies (randomized clinical trials), the Cochrane 5 guideline was used (<https://www.cochranelibrary.com/es/>) (41). Publications were considered to have a “low risk of bias” if they met all criteria, “high risk of bias” if one or more criteria were not met indicating potential bias that weakens the reliability of the results and “uncertain bias” when there was lack of information or uncertainty regarding potential bias.

The Newcastle-Ottawa scale (42) was used to assess the quality of observational studies. Studies were classified as having a "low risk of bias" if they scored >6 stars and "high risk of bias" if they scored ≤ 6 stars.

7.7 Data synthesis

To summarize and compare the outcome variables across the different studies, the average values of the main variables were grouped based on the study group.

Since the average found in the analysed studies came from samples with different numbers of soft tissue grafted and non-grafted anterior areas, number of implants, PES (Pink Esthetic Score) and WES (White Esthetic Score) scores, it was necessary to calculate the weighted average.

8. RESULTS

8.1 Study selection. Flowchart

A total of 187 articles were obtained from the initial search process: Medline – PubMed (n= 83), Web of Science (n= 92) and SCOPUS (n= 11). Additionally, 1 extra article was obtained through manual search. Of these publications, 37 were identified as potentially eligible articles through the screening by title and abstract. Full-text articles were subsequently retrieved and thoroughly evaluated. As a result, 9 articles met the inclusion criteria and were included in this systematic review (Fig. 1). Information regarding the excluded articles and the reasons for their exclusion is presented in Table 2.

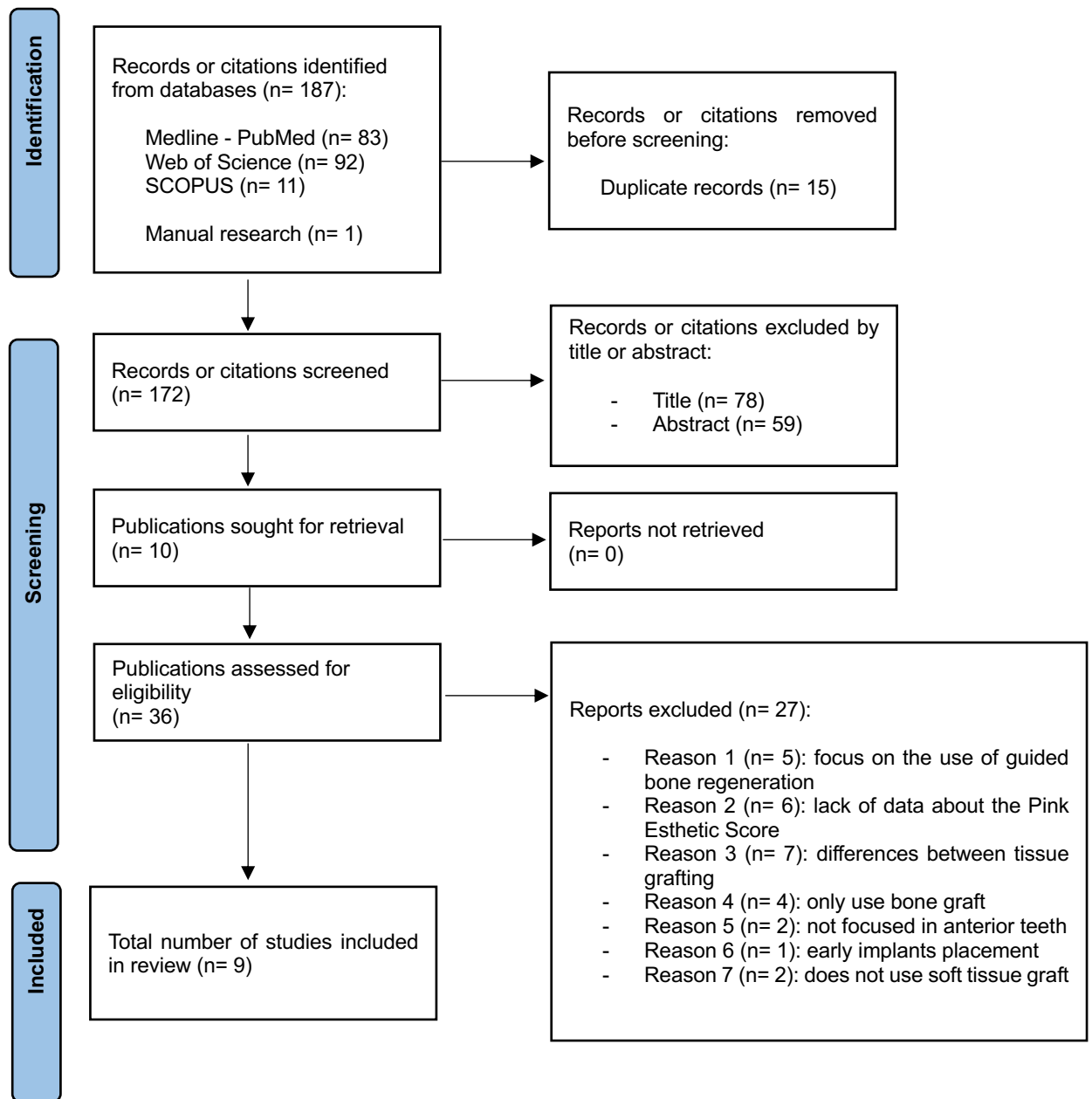


Fig. 1. Flowchart of search and titles selection process during systematic review.

Table 2: Articles excluded and exclusion reason of this systematic review.

AUTHOR AND YEAR	PUBLICATION	REASON OF EXCLUSION
Cosyn et al. 2022 (43)	J Clin Periodontol	Focused on using different types of tissue graft
Cosyn et al. 2021 (44)	J Clin Periodontol	Focused on using different types of tissue graft
Surdiacourt et al. 2025 (45)	J Clin Periodontol	Focused on using different types of tissue graft
De Bruyckere et al. 2020 (46)	Clin Oral Implants Res	Focused on guided bone regeneration
Bouckaert et al. 2022 (47)	Clin Oral Implants Res	Focused on guided bone regeneration
Farooqui et al. 2023 (48)	Int J Oral Maxillofac Implants	Focused on using different types of tissue graft
Puisys et al. 2022 (49)	Clin Implant Dent Relat Res	Focused on using different types of tissue graft
Zuiderveld et al. 2021 (50)	J Periodontol	Doesn't provide data about the PES score
Hamed et al. 2023 (51)	BMC Oral Health	Focused on bone graft
Naïem et al. 2023 (52)	Clin Oral Implants Res	Not focused in anterior teeth
Abdullah et al. 2022 (53)	Clin Implant Dent Relat Res	Doesn't study the use soft tissue graft
El Askary wt al. 2022 (54)	Clin Implant Dent Relat Res	Early implants placement

Happe et al. 2022 (55)	J Esthet Restor Dent	Focused on using different types of tissue graft
Gamal et al. 2023 (56)	Clin Oral Investig	Doesn't provide data about the PES score
Lee et al. 2020 (57)	Clin Implant Dent Relat Res	Doesn't use soft tissue graft
Rojo et al. 2018 (58)	J Clin Periodontol	Doesn't provide data about the PES score
Fettouh et al. 2024 (59)	BMC Oral Health	Focused on bone graft
Kolerman et al. 2016 (60)	Clin Oral Implants Res	Focused on guided bone regeneration
Kan et al 2023 (61)	J Esthet Restor Dent	Focused on bone graft
Enrile de Rojas et al. 2024 (62)	J Esthet Restor Dent	Doesn't provide data about the PES score
Elaskary et al. 2020 (63)	Int J Oral Maxillofac Implants	Focused on using different types of tissue graft
Boardman et al. 2016 (64)	Clin Oral Implants Res	Focused on bone graft
Stefanini et al. 2023 (12)	J Periodontol	Doesn't provide data about the PES score
Qian et al. 2023 (65)	Clin Implant Dent Relat Res	Focused on guided bone regeneration
Yoshino et al. 2014 (66)	Int J Oral Maxillofac Implants	Doesn't provide data about the PES score
De Angelis et al. 2021 (67)	Biomed Res Int	Not focused in anterior teeth
Tatum et al. 2020 (68)	Int J Periodontics Restorative Dent	Focused on guided bone regeneration

8.2 Analysis of the characteristics of the reviewed studies

A total of 9 articles were selected for inclusion in this systematic review. These studies evaluated the esthetic outcomes of immediate implant placement with and without the use of a connective tissue graft.

Of these 9 studies, 6 are randomized controlled trials (69–74), 2 are cohort studies (75,76) and 1 is a prospective study (77). All the included articles focused on comparing the use of connective tissue grafts in conjunction with immediate implants versus immediate implants alone assessing the esthetic outcomes with the use of the Pink Esthetic Score (PES) (69—77). Additionally, 6 of these studies also evaluated the esthetic appearance of the prosthetic crown of these immediate implants using the White Esthetic Score (WES) (69,71,72,73,76,77).

In total, 352 patients were assessed using the PES and 250 patients were evaluated using the WES.

Regarding the source of the connective tissue graft, 5 studies harvested the graft from the palatal area of the patients (69,73,74,75,76), while the other 4 studies obtained it from the maxillary tuberosity of the patients (70,71,72,77). Table 4.

Table 3: Characteristics of the reviewed studies.

Author and year	Type of study	Country	N° of patients (female/ male)	Age (years)	Follow-up (years)	N° of implants	WITH soft tissue graft	WITHOUT soft tissue graft	Type of soft tissue graft	Bone graft	PES	WES	Randomize
Migliorati et al. 2015 (69)	Randomized controlled trial	Italy	48 (25/23)	22-70	2	48	4	24	Connective tissue (palate)	Yes	Yes	Yes	Yes
van Nimwegen et al. 2018 (70)	Randomized controlled trial	Netherlands	60 (32/28)	19-82	1	60	0	30	Connective tissue (maxillary tuberosity)	Yes	Yes	No	Yes
Zuiderveld et al. 2024 (71)	Randomized controlled trial	Netherlands	60 (32/28)	29-64	5	60	7	27	Connective tissue (maxillary tuberosity)	Yes	Yes	Yes	Yes
Zuiderveld et al. 2018 (72)	Randomized controlled trial	Netherlands	60 (32/28)	30-64	1	60	9	29	Connective tissue (maxillary tuberosity)	Yes	Yes	Yes	Yes

Noelken et al. 2018 (75)	Cohort study	Germany	26 (12/14)	20-77	3	26	3	13	Connective tissue (palate)	Yes	Yes	No	No
Levine et al. 2022 (76)	Cohort study	Brazil	28 (20/8)	39-75	6	28	7	11	Connective tissue (palate)	Yes	Yes	Yes	No
Zuiderveld et al. 2018 (73)	Randomized controlled trial	Netherlands	60 (35/25)	18-73	1	60	0	20	Connective tissue (palate)	Yes	Yes	Yes	Yes
Abd El-Aziz et al. 2022 (74)	Randomized controlled trial	Egypt	16 (15/1)	21-46	0,8	16	8	8	Connective tissue (palate)	No	Yes	No	Yes
Nazarian et al. 2023 (77)	Prospective study	Russia	22 (10/12)	20-70	1	35	22	0	Connective tissue (maxillary tuberosity)	No	Yes	Yes	No

8.3 Assessment of methodological quality and risk of bias

For the 9 articles selected for this systematic review, the risk of bias was assessed using the Cochrane risk of bias tool (41) for randomized controlled trials and the Newcastle-Ottawa Scale (42) for observational studies.

As shown in Table 4, which presents the assessment of randomized controlled trials using the Cochrane tool (41), 4 articles were found to have an unclear risk of bias (69,71,72,73), 1 article showed a high risk of bias (70) and 1 article was assessed as having a low risk of bias (74).

Table 5 is for the risk of bias evaluation of observational studies with non-randomized control groups, using the Newcastle-Ottawa Scale (42). This article (77) presents a score of 4 stars indicating a high risk of bias (≤ 6 stars).

Table 6 presents the assessment of non-randomized cohort studies using the Newcastle-Ottawa Scale (42). One article (75) scored 7 stars indicating a low risk of bias, while the other article (76) scored 6 stars indicating a high risk of bias.

Table 4 Measuring the risk of bias of randomized studies according to the Cochrane guideline.

	Generate randomized sequence (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (detection bias)	Follow-up and exclusions (attrition bias)	Selective description (reporting bias)	Other biases
Migliorati et al. 2015 (69)	?	+	+	+	+	+
van Nimwegen et al. 2018 (70)	+	+	?	-	+	+
Zuiderveld et al. 2024 (71)	+	?	?	+	+	+
Zuiderveld et al. 2018 (72)	?	?	+	+	+	+
Zuiderveld et al. 2018 (73)	?	?	+	+	+	+
Abd El-Aziz et al. 2022 (74)	+	+	+	+	+	+

Table 5. Measurement of the risk of bias of non-randomized observational studies with the Newcastle-Ottawa scale – observational studies with a non-randomized control group.

	Definition of cases	Representativeness	Selecting controls	Definition of controls	Comparability (most important factor)	Comparability (any other variable)	Checking the exposure	Same method for both groups	Dropout rate	Total
Nazarian et al. 2023 (77)	☆	☆	-	-	-	-	☆	-	☆	4

Table 6. Measurement of the risk of bias of non-randomized observational studies with the Newcastle-Ottawa scale – observational cohort studies, no control group.

	Cohort representativeness	Selection of non-exposed cohort	Checking exposure	Demonstration of no variable presence of interest at the beginning	Comparability (most important factor)	Comparability (other factors)	Measuring results	Enough follow-up	Dropout rate	Total
Noelken et al. 2018 (75)	★	★	★	★	-	-	★	★	★	7
Levine et al. 2022 (76)	★	★	★	★	-	-	★	★	-	6

8.4 Synthesis of results

8.4.1 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using PES

Table 7 presents the Pink Esthetic Score (PES) outcomes from 9 studies selected for this systematic review evaluating immediate implant placement with and without the use of soft tissue grafting. The table presents descriptive statistics including the number of implants analyzed, PES average, standard deviation (SD) and weighted average for each study.

Some individual studies, such as van Nimwegen et al. 2018 (70) and Abd El-Aziz et al. 2022 (74), reported high PES scores regardless of grafting, while others like Levine et al. 2022 (76) and Zuiderveld et al. 2024 (71) observed lower scores, particularly in the absence of grafts.

The results show that immediate implants without soft tissue graft have a total weighted average PES of 8,11, whereas implants with soft tissue graft had a slightly higher total weighted average PES of 8,35. This suggests a marginal esthetic benefit when connective tissue grafting is employed together with immediate implants.

The total arithmetic mean of PES is 8,34 for the non-grafted group and 8,87 for the grafted group indicating a slightly higher esthetic outcomes with grafting. However, the total standard deviation (SD) is also slightly higher in the grafted group with 2,79 compared to the non-grafted group with 2.54, suggesting more variability in outcomes when grafts were used.

Median PES values showed a similar trend, with a median of 6,73 for the non-grafted group and 7,30 for the grafted group.

Table 7. Descriptive results of the Pink Esthetic Score (PES) in immediate implants with and without soft tissue graft collected by the studies.

	Immediate implants WITHOUT soft tissue graft					Immediate implants WITH soft tissue graft				
	N° implants	PES				N° implants	PES			
		Average	SD	p value	Weighted average		Average	SD	p value	Weighted average
Migliorati et al. 2015 (69)	24	6,65	1,80	<0.001	0,99	24	7,15	1,75	<0.001	0,90
van Nimwegen et al. 2018 (70)	30	11,36	1,65	0.866	2,10	30	11,28	1,67	0.866	1,78
Zuiderveld et al. 2024 (71)	27	6,40	0,70	0.350	1,07	27	6,20	0,70	0.350	0,88
Zuiderveld et al. 2018 (72)	29	6,80	1,50	0.210	1,22	29	6,40	1,50	0.210	0,98
Noelken et al. 2018 (75)	13	12,20	0,60	<0.001	0,98	13	13,00	1,20	<0.001	0,89
Levine et al. 2022 (76)	11	6,20	1,70	0.083	0,42	17	7,30	1,60	0.083	0,65
Zuiderveld et al. 2018 (73)	20	6,60	1,50	0.710	0,81	20	7,00	2,40	0.710	0,74
Abd El-Aziz et al. 2022 (74)	8	10,50	1,00	0.004	0,52	8	13,00	0,00	0.004	0,55
Nazarian et al. 2023 (77)	0	-	-	-	-	22	8,50	1,66	-	0,98
Total weighted average		8,11					8,35			

Total arithmetic average		8,34					8,87			
Total SD		2,54					2,79			
Total median		6,73					7,30			
Maximum		12,20					13,00			
Minimum		6,20					6,20			

8.4.2 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using WES

Table 8 presents the descriptive results of the White Esthetic Score (WES) for immediate implants placed with and without the use of soft tissue grafts based on 6 selected studies. It includes the number of implants, WES average, standard deviation (SD) and weighted average for each group.

Zuiderveld et al. 2024 (71) and Zuiderveld et al. 2018 (73) reported high WES scores for both groups with a modest benefit seen in the non-grafted one.

Levine et al. 2022 (76) showed a relatively low WES average in the absence of grafting, improving notably with grafts.

Interestingly, Nazarian et al. 2023 (77) only reported data for the grafted group, with a strong average score of 9.5, the highest among all studies.

The total weighted average WES is 7,76 for immediate implants without soft tissue grafts and 8,02 for those with soft tissue grafts indicating a small improvement in the esthetic outcomes when connective tissue graft is used.

In terms of the total arithmetic average, the grafted group also show a higher score of 8,10 compared to 7,60 for the non-grafted group. This reflects a consistent trend toward slightly better white esthetic outcomes when connective tissue grafting is performed.

The standard deviation (SD) is a bit lower in the graft group indicating slightly less variability in esthetic results when grafts are used.

The median WES is 7,98 for the non-grafted group and 7,84 for the grafted group, showing they are very close in range.

These results suggest that connective tissue grafting may contribute to slightly improved white esthetic outcomes in immediate implant, although the differences between the two groups are not significant.

Table 8. Descriptive results of the White Esthetic Score (WES) in immediate implants with and without soft tissue graft collected by the studies.

	Immediate implants WITHOUT soft tissue graft					Immediate implants WITH soft tissue graft				
	N° implants	WES				N° implants	WES			
		Average	SD	p value	Weighted average		Average	SD	p value	Weighted average
Migliorati et al. 2015 (69)	24	7,98	0,99	0.880	1,73	24	7,98	0,99	0.880	1,38
Zuiderveld et al. 2024 (71)	27	8,00	0,50	0.560	1,95	27	7,60	0,70	0.560	1,48
Zuiderveld et al. 2018 (72)	29	7,40	1,30	0.300	1,93	29	6,90	1,90	0.300	1,44
Levine et al. 2022 (76)	11	5,90	2,40	0.025	0,58	17	7,70	1,70	0.025	0,94
Zuiderveld et al. 2018 (73)	20	8,70	0,90	0.390	1,57	20	8,90	1,20	0.390	1,28
Nazarian et al. 2023 (77)	0	-	-	-	-	22	9,50	0,57	-	1,50
Total weighted average		7,76					8,02			
Total arithmetic average		7,60					8,10			

Total SD		1,05					0,94			
Total median		7,98					7,84			
Maximum		8,70					9,50			
Minimum		5,90					6,90			

9. DISCUSSION

This systematic review evaluates the esthetic outcomes of immediate dental implants placement in the anterior maxillary region, specifically focusing on the area extending from the first premolar on one side to the first premolar on the other side, with and without the use of soft tissue grafting techniques used to favor soft tissue volume, stability and integration around the implant site. This region, often referred to as the esthetic zone, is particularly sensitive to visual and functional results due to its high visibility during smiling and speaking, making esthetic success a crucial component of treatment planning and evaluation.

The primary objective of this review is to assess the Pink Esthetic Score (PES), a well-established index used to evaluate the esthetic integration of the peri-implant mucosa. This includes parameters such as the presence and contour of papillae, the level and curvature of the soft tissue margin and the color and texture of the peri-implant soft tissue with adjacent natural teeth. By comparing PES values between immediate implant placement with soft tissue grafts and those without, the review aims to determine whether soft tissue augmentation provides measurable improvements in the esthetic appearance of the soft tissue around the implants.

In addition to PES, it also assesses the White Esthetic Score (WES), which evaluates the visual harmony of the prosthetic crown over the implants. WES focuses on five parameters: tooth form, outline and volume, color including hue and value, surface texture, and translucency and characterization. These factors are critical in achieving a natural looking restoration that blends with the adjacent dentition. The inclusion of WES analysis allows for a more comprehensive understanding of esthetic outcomes as it covers not only the biological and grafting aspects but also the prosthetic restorative components of implants.

9.1 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using Pink Esthetic Score (PES)

The present systematic review aimed to assess the impact of soft tissue grafting on the esthetic outcomes of immediate implants, as evaluated using the Pink Esthetic Score (PES). The analysis revealed that the placement of immediate implants with soft tissue grafting was associated with a slight improvement in esthetic outcomes compared to implants placed without grafts. This was particularly evident when looking at the total weighted average PES which was 8.35 in the grafted group compared to 8.11 in the non-grafted group. Similarly, the arithmetic mean for the PES score was higher for the grafted group and the median followed a similar trend, although these differences were modest in nature. Despite the relatively small differences in scores, the findings suggest a favorable esthetic effect of connective tissue grafting in immediate implant procedures.

The results of this review are consistent with previous research that has emphasized the positive influence of soft tissue grafting on peri-implant esthetics. For instance, De Angelis et al. 2021(78) observed that the use of connective tissue grafting in the esthetic zone resulted in stable soft tissue profiles and favorable marginal bone levels, supporting the long-term benefits of grafting for improving esthetic outcomes. Similarly, Seyssens et al. 2021 (79) concluded that various types of soft tissue grafting materials, such as autogenous connective tissue grafts or xenogeneic matrices, could produce similar results and that soft tissue grafting was especially advantageous for patients with thin gingival biotypes. These studies highlight the value of soft tissue grafting in achieving more stable and aesthetically pleasing outcomes in immediate implant placement.

However, it is important to note that not all research supports these conclusions. For instance, Galve-Huertas et al. 2024 (80), in a systematic review comparing the effectiveness of porcine-derived acellular dermal matrix (pADM) and connective tissue grafts (CTG), found no significant differences after 12 months of follow-up.

Such contrasting results highlight the complexity and variability in clinical outcomes, which are influenced by a variety of factors including the patient's individual characteristics, the surgical technique employed, the type of graft material used and the timing of the outcome assessment.

The trend towards higher PES scores in the grafted group can be attributed to the biological advantages provided by soft tissue grafts, particularly connective tissue grafts (CTGs), which are known to increase mucosal thickness, improve soft tissue stability and contribute to a better contouring around implants. These improvements in soft tissue characteristics have been shown to enhance the final esthetic integration of the implant restoration (81). Additionally, empirical evidence supports that increased soft tissue thickness can reduce mid-facial recession and stabilize the marginal gingiva, leading to better PES outcomes over time (29).

These biological mechanisms may offer an explanation of why even modest differences in PES scores were consistently observed in favor of the grafted group, reinforcing the value of soft tissue augmentation in immediate implant procedures.

Among the studies included in the review, van Nimwegen et al. 2018 (70) reported the highest PES scores, regardless of whether soft tissue grafting was used, suggesting that factors other than the type of graft, such as surgical expertise, patient selection and flap management, might play a significant role in the esthetic outcomes of immediate implants. This highlights the importance of considering a comprehensive approach to treatment planning and execution.

In contrast, Levine et al. 2022 (76) reported one of the lowest PES outcomes in the non-grafted group, reinforcing the potential value of soft tissue augmentation, especially in cases with higher esthetic demands or in patients with thinner gingival biotypes.

These findings support the notion that soft tissue grafting can provide substantial improvements in the esthetic results of immediate implant placements, particularly in challenging clinical scenarios.

9.2 Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using White Esthetic Score (WES)

The results of this systematic review indicate that immediate implant placement with soft tissue grafting is associated with a slight improvement in White Esthetic Scores (WES) compared to implants without grafts. The total weighted average WES was 8,02 in the grafted group while 7,76 in the non-grafted group. In addition, the arithmetic average was higher for implants with grafting compared to non-grafted, supporting the potential benefits of soft tissue augmentation. These data suggest that the addition of connective tissue grafting may positively influence the visual integration of the implant crown with the surrounding dentition particularly in terms of achieving harmony in color, shape and texture harmony.

These results align with those of previous studies that have shown the positive impact of soft tissue grafting on WES outcomes. For instance, Seyssens et al. 2021 (79) concluded in their clinical study that soft tissue grafting helped improving the color match and contour of the peri-implant mucosa, leading to higher WES values in the esthetic zone. Similarly, a systematic review by Torra-Money et al. 2024 (82) emphasized that soft tissue augmentation, particularly using connective tissue grafts, not only improves Pink Esthetic Scores (PES) but also enhances WES outcomes by optimizing the emergence profile of the implant and improving soft tissue adaptation around the crown.

In contrast, other authors have reported minimal or non-significant differences in WES between grafted and non-grafted cases. For instance, Seyssens et al. 2021 (79) in their systematic review found no clear consensus on whether soft tissue grafting definitively improves white esthetic results, noticing the high variability among the studies with some showing improvement in WES while others did not. Additionally, the authors observed that while soft tissue grafting often improved PES scores, the improvements in WES were less consistent. They suggested that WES outcomes might be more influenced by prosthetic factors, such as the design and material of the crown, rather than soft tissue factors alone.

The modest improvement in WES observed in the grafted group may be explained by the stabilization of the peri-implant mucosa which facilitates better crown emergence profiles and more predictable soft tissue contours. Studies have shown that when soft tissue surrounding the implants is thicker and more stable, the final prosthesis tends to integrate more harmoniously with the adjacent teeth, especially in aspects like incisal edge symmetry, surface texture and color blending (83). Thicker and more stable peri-implant tissues are likely to provide better support for the crown, ensuring a more natural and esthetically pleasing result in the long term.

However, WES is also influenced by prosthetic planning and execution technique, which may explain why the differences observed in WES scores were relatively small when compared to those seen in PES. Factors such as the choice of ceramic material, the translucency of the crown and the digital design protocols may often overcome the biological effects of soft tissue augmentation when it comes to WES results (84). In fact, the quality of the prosthetic restoration is often a more decisive factor in achieving high WES scores than the presence or absence of soft tissue grafting, suggesting that both biological and prosthetic considerations should be integrated into the treatment planning process to optimize esthetic outcomes.

Among the studies included in this systematic review, Zuiderveld et al. 2018 (73) reported the highest average WES in the non-grafted group, while Nazarian et al. 2023 (77) reported the highest WES score in the grafted group, suggesting that excellent esthetic outcomes may be achievable with or without grafting when other clinical variables, such as surgical technique and patient selection, are well controlled. In contrast, Levine et al. 2022 (76) reported the lowest WES values in the non-grafted group highlighting the potential esthetic disadvantages in cases where soft tissue volume or contour is compromised.

This reinforces the notion that in cases where the soft tissue around the implant is compromised, grafting may offer significant esthetic advantages by improving tissue support, volume and contour, thus enhancing the final appearance of the implant crown.

9.3 Limitation of the study and future lines of research

This systematic review presents relevant findings regarding the esthetic outcomes of immediate dental implants with and without the use of soft tissue graft. However, several limitations were encountered during the review process that should be considered when interpreting the results.

One of the main limitations is in the methodological quality of the included studies. Several of them presented a high or unclear risk of bias, as determined by the Cochrane and Newcastle-Ottawa quality assessment tools. In particular, gaps were noted in the randomization processes, lack of blinding in the evaluation of esthetic outcomes and incomplete or inconsistently reported follow-up data. These factors introduce potential sources of bias, especially in the subjective assessment of parameters such as the Pink and White Esthetic Scores (PES and WES).

Another limitation is the small sample size in some of the included articles, which reduces statistical power and limits the generalization of their findings to the broader population. Additionally, several studies did not clearly report the number of dropouts or reasons for patient exclusion, compromising the reliability of long-term outcome data.

The heterogeneity of the methodologies used across studies also poses a significant challenge. Differences in surgical protocols, type and source of soft tissue graft (palate and maxillary tuberosity), use of bone grafting, timing of provisionalization and even implant systems make it difficult to establish uniform comparisons.

Despite these limitations, the findings of this review have important clinical implications. The consistent trend showing improved esthetic outcomes in the grafted group, although modest, suggests that soft tissue augmentation may be beneficial in patients with high esthetic demands or in clinical situations where the peri-implant soft tissue is thin or at risk of recession. Therefore, the integration of soft tissue grafts, particularly connective tissue grafts, may serve as a valuable strategy to improve esthetic predictability in the anterior maxilla.

These findings also highlight several gaps in current knowledge and suggest multiple future lines of research. There is a clear need for high quality, randomized controlled trials with larger sample sizes and standardized protocols. Such studies should aim to assess not only short term but also long term results, ideally with follow-up periods exceeding five years in order to determine the stability of the esthetic results over time.

Furthermore, research should compare different types of soft tissue substitutes including xenogeneic collagen matrices and biologically active materials in order to identify viable alternatives to autogenous grafting that minimize the morbidity. Another promising direction for future investigation involves the impact of digital workflows and prosthetic design on esthetic outcomes in grafted and non-grafted sites. As technology advances, it becomes increasingly relevant to evaluate how factors like crown material, emergence profile and digital planning may influence or mitigate the role of soft tissue augmentation.

Finally, it is essential to include patient-reported outcome measures in future studies. Aesthetic success is not only defined by objective scores like PES and WES but also by patient satisfaction and psychosocial well-being. Understanding how patients perceive their treatment results will provide a more relevant perspective.

Although this systematic review offers valuable intuition into the esthetic benefits of soft tissue grafting in immediate implant placement, its limitations, such as risk of bias, methodological variability and small sample sizes, underline the necessity for further research. Addressing these limitations will be crucial to providing stronger evidence and more definitive clinical guidelines for achieving optimal esthetic outcomes.

10. CONCLUSION

Principal objective

- 1- Immediate implants with soft tissue grafting showed higher Pink Esthetic Scores (PES) suggesting better soft tissue esthetic outcomes than those without grafts.

The results support the use of connective tissue grafts in esthetically demanding cases, especially in patients with thin gingival biotype.

Secondary objective

- 1- The White Esthetic Score was slightly higher in grafted implants, WES outcomes appear to depend more on prosthetic design but soft tissue grafting still benefit the esthetic integration.

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12. ANNEXES

ANNEX 1: Table 1: Databases summary

Database	Search	Number of articles	Date
PubMed	((((((((((("immediate dental implants") OR (immediate dental implants placement)) OR ("immediate implants")) OR (postextraction dental implants)) AND (aesthetic zone)) OR (anterior sector)) OR (maxilla[MeSH Terms])) AND (connective tissue graft)) OR (soft tissue graft)) OR (gingival graft)) OR (free gingiva graft)) AND (dental esthetic[MeSH Terms]))	83	11/24
Web of Science	((ALL=("immediate dental implants" OR immediate dental implants placement OR "immediate implants" OR postextraction dental implants)) AND ALL=(aesthetic zone OR anterior sector OR maxilla)) AND ALL=(connective tissue graft OR soft tissue graft OR gingival graft OR free gingiva graft)) AND ALL=(dental esthetic)	92	11/24
Scopus	(TITLE-ABS-KEY ("immediate dental implants" OR immediate AND dental AND implants AND placement OR "immediate implants" OR postextraction AND dental AND implants) AND TITLE-ABS-KEY (aesthetic AND zone OR anterior AND sector OR maxilla) AND TITLE-ABS-KEY (connective AND tissue AND graft OR soft AND tissue AND graft OR gingival AND graft OR free AND gingiva AND graft) AND TITLE-ABS-KEY (dental AND esthetic))	11	11/24

ANNEX 2:

PRISMA Checklist 2020

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	Frontpage
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	1-4
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	19
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	21-23
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	26
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	26-28
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	26-28
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	28
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	28-29
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	28-29
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	28-29
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	29
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	29
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study	28-29

Section and Topic	Item #	Checklist item	Location where item is reported
		intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	28-29
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	29
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	31-32
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	33-34
Study characteristics	17	Cite each included study and present its characteristics.	35-37
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	38-40
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	41-46
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	41-46
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	

Section and Topic	Item #	Checklist item	Location where item is reported
DISCUSSION			
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	48-55
	23b	Discuss any limitations of the evidence included in the review.	48-55
	23c	Discuss any limitations of the review processes used.	48-55
	23d	Discuss implications of the results for practice, policy, and future research.	53-55
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	
Competing interests	26	Declare any competing interests of review authors.	
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	

ANNEX 3:

Detailed declaration of AI use

In the preparation of the following work, an artificial intelligence tool was used to correct the grammar and syntax of the text.

- Tool: ChatGPT 4o
- Functions: Correction of the grammar and syntax of the work
- Prompts used: *Can you correct the grammar and syntax of the following text?*
- Link: <https://chatgpt.com>

The impact on the esthetic outcomes of immediate dental implant placement in anterior areas with or without soft tissue graft: A systematic review

Short title: Esthetic outcomes of immediate anterior implants with or
without soft tissue grafting: A systematic review

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Abstract

Introduction: One of the primary challenges of immediate dental implants is the risk of soft tissue recession and the compromised esthetic result, especially in the anterior sector of the upper maxilla. To solve this problematic, soft tissue graft, such as autogenous connective tissue grafts and biomaterials, have been introduced as an adjuvant technique to increase peri-implant tissue stability, improving esthetic results and reducing the risk of long-term complications. The objective was to evaluate the esthetic outcomes in terms of Pink Esthetic Score (PES) and White Esthetic Score (WES) in immediate dental implants using soft tissue graft compared to immediate implants without soft tissue graft.

Material and method: An electronic search was carried out in the PubMed, Web of Science and Scopus databases on immediate implants placement with and without the use of soft tissue graft technique and the esthetic outcomes on the anterior sector of the upper maxilla, until November 2024.

Results: Out of 187 articles, 9 studies were included in this systematic review, comparing immediate implants with and without connective tissue grafts and Pink Esthetic Score (PES). Six articles used both PES and White Esthetic Score (WES). Grafted implants showed slightly better esthetic outcomes with a total weighted average of: PES 8,35 in grafted group and 8,11 in non-grafted group and WES 8,02 in grafted group and 7,76 in non-grafted group, with minor differences and some variability. Risk of bias was generally moderate to high. Overall, connective tissue grafting offered modest esthetic improvements.

Conclusion: Immediate implants with connective tissue grafts showed better soft tissue esthetic outcomes (higher PES), particularly beneficial in patients with thin gingival biotype. While WES was only slightly higher in grafted cases, with grafting supporting and improving the overall esthetic integration of the prosthetic crown.

Keywords: immediate dental implants, immediate dental implants placement, immediate implants, postextraction dental implants, aesthetic zone, anterior sector, maxilla, connective tissue graft, soft tissue graft, gingival graft, free gingiva graft, dental esthetic.

Introduction

Dental implants have evolved as a reliable solution for tooth loss, replacing traditional prostheses that often led to bone loss due to lack of alveolar ridge stimulation (1). This is especially significant in younger patients and in the aesthetic zone of the anterior maxilla, where delays in treatment impact both function and self-esteem (2). Immediate implant placement after tooth extraction aims to shorten rehabilitation time and preserve tissue, although it presents challenges like bone resorption and esthetic compromises (3). Immediate implants, inserted directly into fresh sockets, reduce surgical stages and treatment time (4). While offering benefits like preservation of alveolar bone and improved patient satisfaction (5), they also pose risks including difficulties in achieving primary stability, soft tissue recession, and higher complication rates (4). Survival rates of immediate and delayed implants are comparable, but immediate implants may show more crestal bone loss (6,7). Aesthetic implant placement, especially in the anterior maxilla, demands precision due to anatomical complexity, thin buccal bone, and high visibility (8). Proper soft tissue management is crucial for long-term implant success, providing microbial protection, maintaining esthetic contours, and preventing complications like peri-implantitis (9). Soft tissue augmentation can involve autogenous grafts (e.g., connective tissue grafts), offering high biocompatibility but requiring a second surgical site (10). Alternatively, collagen matrices from porcine sources provide reliable, minimally invasive options for soft tissue regeneration (10). Emerging techniques focus on volume-stable matrices, minimally invasive methods, and bioactive materials to enhance tissue healing and integration (11). Collectively, these strategies aim to improve esthetic outcomes and long-term implant stability in a less invasive, more predictable manner. The aim of the present systematic review was to systematically review the following question: In adult patients requiring single-tooth replacement in the in the anterior maxillary region, does immediate dental implant placement with soft tissue graft, compared to immediate dental implant placement without soft tissue graft, result in superior soft tissue aesthetic outcomes as measured by the Pink Esthetic Score? This was done by evaluating the Pink Esthetic Score (PES) for the esthetic outcome of soft tissue and the White Esthetic Score (WES) for the esthetic appearance of the prosthetic crown, both measured with and without soft tissue graft.

Materials and methods:

This systematic review was carried out following the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) (12) guideline recommendations.

- Focus question:

The question was established according to the PICO structured question:

P (population): Adult patients requiring single-tooth replacement in the in the anterior maxillary region;

I (intervention): Immediate dental implant placement following tooth extraction and soft tissue graft;

C (comparison): Immediate dental implant placement following tooth extraction without soft tissue graft;

O (outcomes):

- **O1** : Pink Esthetic Score (PES) as a measure of soft tissue esthetics;
- **O2** : White Esthetic Score (WES).

- Eligibility criteria:

The inclusion criteria were:

- **Type of study:** randomized control trials, prospective and retrospective cohort studies and case series. Published until November 2024.
- **Type of patient:** adult patients that need an immediate implant due to a tooth loss in the anterior sector of the upper maxilla.
- **Type of intervention:** placement of immediate dental implant in the anterior sector of the upper maxilla with or without the use of soft tissue grafts for restoring the esthetic due to tooth loss.
- **Type of outcomes variables:** studies that analysed the aesthetics outcomes by evaluating the Pink Esthetic Score (PES) as principal variable and the White Esthetic Score (WES) as secondary variable, following immediate dental implant placement in esthetic regions.

The exclusion criteria for this systematic review were: in vitro studies, animal studies, case reports, reviews, letters and editor comments. Additionally, studies

focusing on immediate implants in the mandible, posterior maxilla, guided bone surgery or those involving only bone grafting were excluded.

- Information sources and data search:

An automated and manual literature searches were carried out in three databases (PubMed, Scopus and Web of Science) using the following keywords: “immediate dental implants”, “immediate dental implants placement”, “immediate implants”, “postextraction dental implants”, “aesthetic zone”, “anterior sector”, “maxilla”, “connective tissue graft”, “soft tissue graft”, “gingival graft”, “free gingiva graft”, “dental esthetic”.

The search in PubMed was as follows: (((((((("immediate dental implants") OR (immediate dental implants placement)) OR ("immediate implants")) OR (postextraction dental implants)) AND (aesthetic zone)) OR (anterior sector)) OR (maxilla[MeSH Terms])) AND (connective tissue graft)) OR (soft tissue graft)) OR (gingival graft)) OR (free gingiva graft)) AND (dental esthetic[MeSH Terms]).

- Search strategy:

A three-stage selection process was carried out. The selection of studies was conducted independently by two reviewers (DP, ELWS). In the first step, the titles were filtered to eliminate irrelevant publications, those not related to the topic and duplicate publications. In the second step, the abstracts were screened and studies were selected based on the type of study, the type implants, the type of intervention, the number of patients and outcome variables. In the third step, the full text was reviewed and data were extracted using a pre-established data collection form to confirm the studies' eligibility.

- Extraction data:

The following information was extracted from the studies based on the criteria: authors, publication year, type of study, country, number of patients, age, follow-up period, number of implants, with or without soft tissue graft, type of soft tissue graft, presence or not of bone graft, evaluation of the Pink Esthetic Score (PES) and the White Esthetic Score (WES).

- **Quality and risk of bias assessment:**

The risk of bias assessment was conducted by two reviewers (DP, ELWS) in order to analyse the methodological quality of the included articles. For the assessment of the quality of experimental studies (randomized clinical trials), the Cochrane 5 guideline was used (<https://www.cochranelibrary.com/es/>) (13) assessing low, high or uncertain risk of bias. The Newcastle-Ottawa scale (14) was used to assess the quality of observational studies. Studies were classified as having a "low risk of bias" if they scored >6 stars and "high risk of bias" if they scored ≤ 6 stars.

- **Data synthesis:**

To summarize and compare the outcome variables across the different studies, the average values of the main variables were grouped based on the study group. Since the average found in the analysed studies came from samples with different numbers of soft tissue grafted and non-grafted anterior areas, number of implants, PES (Pink Esthetic Score) and WES (White Esthetic Score) scores, it was necessary to calculate the weighted average.

Results:

- **Study selection:**

A total of 187 articles were obtained from the initial search process: Medline – PubMed (n= 83), Web of Science (n= 92) and SCOPUS (n= 11). Additionally, 1 extra article was obtained through manual search. Of these publications, 37 were identified as potentially eligible articles through the screening by title and abstract. Full-text articles were subsequently retrieved and thoroughly evaluated. As a result, 9 articles met the inclusion criteria and were included in this systematic review (Fig. 1).

- **Study characteristics:**

A total of 9 articles were selected for inclusion in this systematic review. These studies evaluated the esthetic outcomes of immediate implant placement with and without the use of a connective tissue graft. Of these 9 studies, 6 are randomized controlled trials (15-20), 2 are cohort studies (21,22) and 1 is a prospective study (23). All the included articles focused on comparing the use of

connective tissue grafts in conjunction with immediate implants versus immediate implants alone assessing the esthetic outcomes with the use of the Pink Esthetic Score (PES) (15-23). Additionally, 6 of these studies also evaluated the esthetic appearance of the prosthetic crown of these immediate implants using the White Esthetic Score (WES) (15,17,18,19,22,23). In total, 352 patients were assessed using the PES and 250 patients were evaluated using the WES. Regarding the source of the connective tissue graft, 5 studies harvested the graft from the palatal area of the patients (15,19,20,21,22), while the other 4 studies obtained it from the maxillary tuberosity of the patients (16,17,18,23). (Table 1).

- **Risk of bias:**

For the 9 articles selected for this systematic review, the risk of bias was assessed using the Cochrane risk of bias tool (13) and the Newcastle-Ottawa Scale (14). Of the randomized controlled trials, 4 articles were found to have an unclear risk of bias (15,17,18,19), 1 article showed a high risk of bias (16) and 1 article was assessed as having a low risk of bias (20) (Fig. 2). For the observational study with non-randomized control groups (23) presents a score of 4 stars indicating a high risk of bias (≤ 6 stars) and for the non-randomized cohort studies 1 article (21) scored 7 stars indicating a low risk of bias, while the other article (22) scored 6 stars indicating a high risk of bias (Fig. 3 and 4).

- **Synthesis of results:**

Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using PES

Table 2 presents the Pink Esthetic Score (PES) outcomes from 9 studies selected. Some individual studies, such as van Nimwegen et al. 2018 (16) and Abd El-Aziz et al. 2022 (20), reported high PES scores regardless of grafting, while others like Levine et al. 2022 (22) and Zuiderveld et al. 2024 (17) observed lower scores, particularly in the absence of grafts.

The results show that immediate implants without soft tissue graft have a total weighted average PES of 8,11, whereas implants with soft tissue graft had a slightly higher total weighted average PES of 8,35. This suggests a marginal esthetic benefit when connective tissue grafting is employed together with

immediate implants. The total arithmetic mean of PES is 8,34 for the non-grafted group and 8,87 for the grafted group indicating a slightly higher esthetic outcomes with grafting. However, the total standard deviation (SD) is also slightly higher in the grafted group with 2,79 compared to the non-grafted group with 2.54, suggesting more variability in outcomes when grafts were used. Median PES values showed a similar trend, with a median of 6,73 for the non-grafted group and 7,30 for the grafted group.

Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using WES

Table 3 presents the descriptive results of the White Esthetic Score (WES). Zuiderveld et al. 2024 (17) and Zuiderveld et al. 2018 (19) reported high WES scores for both groups with a modest benefit seen in the non-grafted one. Levine et al. 2022 (22) showed a relatively low WES average in the absence of grafting, improving notably with grafts. Interestingly, Nazarian et al. 2023 (23) only reported data for the grafted group, with a strong average score of 9.5, the highest among all studies. The total weighted average WES is 7,76 for immediate implants without soft tissue grafts and 8,02 for those with soft tissue grafts indicating a small improvement in the esthetic outcomes when connective tissue graft is used. In terms of the total arithmetic average, the grafted group also show a higher score of 8,10 compared to 7,60 for the non-grafted group. This reflects a consistent trend toward slightly better white esthetic outcomes when connective tissue grafting is performed. The standard deviation (SD) is a bit lower in the graft group indicating slightly less variability in esthetic results when grafts are used. The median WES is 7,98 for the non-grafted group and 7,84 for the grafted group, showing they are very close in range. These results suggest that connective tissue grafting may contribute to slightly improved white esthetic outcomes in immediate implant, although the differences between the two groups are not significant.

Discussion:

This systematic review evaluates the esthetic outcomes of immediate dental implants placement in the anterior maxillary region with and without the use of soft tissue grafting techniques used to favor soft tissue volume, stability and

integration around the implant site. The primary objective is to assess the Pink Esthetic Score (PES) by comparing the values between immediate implant placement with soft tissue grafts and those without, the review aims to determine whether soft tissue augmentation provides measurable improvements in the esthetic appearance of the soft tissue around the implants. The secondary objective is to assess the White Esthetic Score (WES), which allows for a more comprehensive understanding of esthetic outcomes as it covers not only the biological and grafting aspects but also the prosthetic restorative components of implants.

Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using PES

The results of this review are consistent with previous research that has emphasized the positive influence of soft tissue grafting on peri-implant esthetics. For instance, De Angelis et al. 2021 (24) observed that the use of connective tissue grafting in the esthetic zone resulted in stable soft tissue profiles and favorable marginal bone levels, supporting the long-term benefits of grafting for improving esthetic outcomes. Similarly, Seyssens et al. 2021 (25) concluded that various types of soft tissue grafting materials, such as autogenous connective tissue grafts or xenogeneic matrices, could produce similar results and that soft tissue grafting was especially advantageous for patients with thin gingival biotypes. These studies highlight the value of soft tissue grafting in achieving more stable and aesthetically pleasing outcomes in immediate implant placement. However, Galve-Huertas et al. 2024 (26), comparing the effectiveness of porcine-derived acellular dermal matrix (pADM) and connective tissue grafts (CTG), found no significant differences after 12 months of follow-up. Among the studies included in the review, van Nimwegen et al. 2018 (16) reported the highest PES scores, regardless of whether soft tissue grafting was used, suggesting that factors other than the type of graft, such as surgical expertise, patient selection and flap management, might play a significant role in the esthetic outcomes of immediate implants. This highlights the importance of considering a comprehensive approach to treatment planning and execution. In contrast, Levine et al. 2022 (22) reported one of the lowest PES outcomes in the non-grafted group, reinforcing the potential value of soft tissue augmentation,

especially in cases with higher esthetic demands or in patients with thinner gingival biotypes. Higher PES in the grafted group are linked to the biological benefits of connective tissue grafts (CTGs) which enhance mucosal thickness, soft tissue stability and contouring around implants. These factors improve esthetic integration and reduce mid-facial recession, leading to more stable gingival margins and improved long-term PES outcomes. This explains the consistent PES advantage seen with grafted cases, highlighting the esthetic value of soft tissue augmentation in immediate implant procedures.

Evaluation of the esthetic outcomes in immediate implants with and without soft tissue grafting using WES

These results align with those of previous studies that have shown the positive impact of soft tissue grafting on WES outcomes. For instance, Seyssens et al. 2021 (25) concluded in their clinical study that soft tissue grafting helped improving the color match and contour of the peri-implant mucosa, leading to higher WES values in the esthetic zone. Similarly, a systematic review by Torra-Money et al. 2024 (27) emphasized that soft tissue augmentation, particularly using connective tissue grafts, not only improves Pink Esthetic Scores (PES) but also enhances WES outcomes by optimizing the emergence profile of the implant and improving soft tissue adaptation around the crown. In contrast, other authors have reported minimal or non-significant differences in WES between grafted and non-grafted cases. For instance, Seyssens et al. 2021 (25) found no clear consensus on whether soft tissue grafting definitively improves white esthetic results, noticing the high variability among the studies with some showing improvement in WES while others did not. Additionally, the authors observed that while soft tissue grafting often improved PES scores, the improvements in WES were less consistent because it is influenced by the prosthetic crown characteristics. Among the studies included in this systematic review, Zuiderveld et al. 2018 (19) reported the highest average WES in the non-grafted group, while Nazarian et al. 2023 (23) reported the highest WES score in the grafted group, suggesting that excellent esthetic outcomes may be achievable with or without grafting when other clinical variables, such as surgical technique and patient selection, are well controlled. In contrast, Levine et al. 2022 (22) reported the lowest WES values in the non-grafted group highlighting the potential esthetic

disadvantages in cases where soft tissue volume or contour is compromised. The modest improvement in White Esthetic Scores (WES) in the grafted group is likely due to favor peri-implant mucosal stability, which supports better crown emergence profiles and natural-looking soft tissue contours (28). Thicker tissues improve crown support, aiding esthetic features like symmetry, texture, and color. However, WES is also heavily influenced by prosthetic factors such as material choice and design technique which may diminish the relative impact of soft tissue grafting (29). This suggests that while grafting improves esthetics, optimal WES outcomes require both biological and prosthetic planning.

This review presents several limitations such as risks of bias, small sample sizes and inconsistent methodologies. Despite these issues, it suggests soft tissue grafts may improve aesthetic outcomes, especially for patients with thin peri-implant tissue. The review calls for future research with larger, higher-quality trials, longer follow-up, comparisons of soft tissue substitutes and consideration of digital workflows and patient satisfaction to improve clinical guidelines and evidence.

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Table 1: Characteristics of the reviewed studies.

Author and year	Type of study	Country	N° of patients (female/ male)	Age (years)	Follow-up (years)	N° of implants	WITH soft tissue graft	WITHOUT soft tissue graft	Type of soft tissue graft	Bone graft	PES	WES	Randomize
Migliorati et al. 2015 (15)	Randomized controlled trial	Italy	48 (25/23)	22-70	2	48	4	24	Connective tissue (palate)	Yes	Yes	Yes	Yes
van Nimwegen et al. 2018 (16)	Randomized controlled trial	Netherlands	60 (32/28)	19-82	1	60	0	30	Connective tissue (maxillary tuberosity)	Yes	Yes	No	Yes
Zuiderveld et al. 2024 (17)	Randomized controlled trial	Netherlands	60 (32/28)	29-64	5	60	7	27	Connective tissue (maxillary tuberosity)	Yes	Yes	Yes	Yes
Zuiderveld et al. 2018 (18)	Randomized controlled trial	Netherlands	60 (32/28)	30-64	1	60	9	29	Connective tissue	Yes	Yes	Yes	Yes

									(maxillary tuberosity)				
Noelken et al. 2018 (21)	Cohort study	Germany	26 (12/14)	20-77	3	26	3	13	Connective tissue (palate)	Yes	Yes	No	No
Levine et al. 2022 (22)	Cohort study	Brazil	28 (20/8)	39-75	6	28	7	11	Connective tissue (palate)	Yes	Yes	Yes	No
Zuiderveld et al. 2018 (19)	Randomized controlled trial	Netherlands	60 (35/25)	18-73	1	60	0	20	Connective tissue (palate)	Yes	Yes	Yes	Yes
Abd El-Aziz et al. 2022 (20)	Randomized controlled trial	Egypt	16 (15/1)	21-46	0,8	16	8	8	Connective tissue (palate)	No	Yes	No	Yes
Nazarian et al. 2023 (23)	Prospective study	Russia	22 (10/12)	20-70	1	35	22	0	Connective tissue (maxillary tuberosity)	No	Yes	Yes	No

Table 2. Descriptive results of the Pink Esthetic Score (PES) in immediate implants with and without soft tissue graft collected by the studies.

	Immediate implants WITHOUT soft tissue graft					Immediate implants WITH soft tissue graft				
	N° implants	PES				N° implants	PES			
		Average	SD	p value	Weighted average		Average	SD	p value	Weighted average
Migliorati et al. 2015 (15)	24	6,65	1,80	<0.001	0,99	24	7,15	1,75	<0.001	0,90
van Nimwegen et al. 2018 (16)	30	11,36	1,65	0.866	2,10	30	11,28	1,67	0.866	1,78
Zuiderveld et al. 2024 (17)	27	6,40	0,70	0.350	1,07	27	6,20	0,70	0.350	0,88
Zuiderveld et al. 2018 (18)	29	6,80	1,50	0.210	1,22	29	6,40	1,50	0.210	0,98
Noelken et al. 2018 (21)	13	12,20	0,60	<0.001	0,98	13	13,00	1,20	<0.001	0,89
Levine et al. 2022 (22)	11	6,20	1,70	0.083	0,42	17	7,30	1,60	0.083	0,65
Zuiderveld et al. 2018 (19)	20	6,60	1,50	0.710	0,81	20	7,00	2,40	0.710	0,74
Abd El-Aziz et al. 2022 (20)	8	10,50	1,00	0.004	0,52	8	13,00	0,00	0.004	0,55
Nazarian et al. 2023 (23)	0	-	-	-	-	22	8,50	1,66	-	0,98
Total weighted average		8,11					8,35			

Total arithmetic average		8,34					8,87			
Total SD		2,54					2,79			
Total median		6,73					7,30			
Maximum		12,20					13,00			
Minimum		6,20					6,20			

Table 3. Descriptive results of the White Esthetic Score (WES) in immediate implants with and without soft tissue graft collected by the studies.

	Immediate implants WITHOUT soft tissue graft					Immediate implants WITH soft tissue graft				
	N° implants	WES				N° implants	WES			
		Average	SD	p value	Weighted average		Average	SD	p value	Weighted average
Migliorati et al. 2015 (15)	24	7,98	0,99	0.880	1,73	24	7,98	0,99	0.880	1,38
Zuiderveld et al. 2024 (17)	27	8,00	0,50	0.560	1,95	27	7,60	0,70	0.560	1,48
Zuiderveld et al. 2018 (18)	29	7,40	1,30	0.300	1,93	29	6,90	1,90	0.300	1,44
Levine et al. 2022 (22)	11	5,90	2,40	0.025	0,58	17	7,70	1,70	0.025	0,94
Zuiderveld et al. 2018 (19)	20	8,70	0,90	0.390	1,57	20	8,90	1,20	0.390	1,28
Nazarian et al. 2023 (23)	0	-	-	-	-	22	9,50	0,57	-	1,50
Total weighted average		7,76					8,02			
Total arithmetic average		7,60					8,10			
Total SD		1,05					0,94			
Total median		7,98					7,84			

Maximum		8,70					9,50			
Minimum		5,90					6,90			

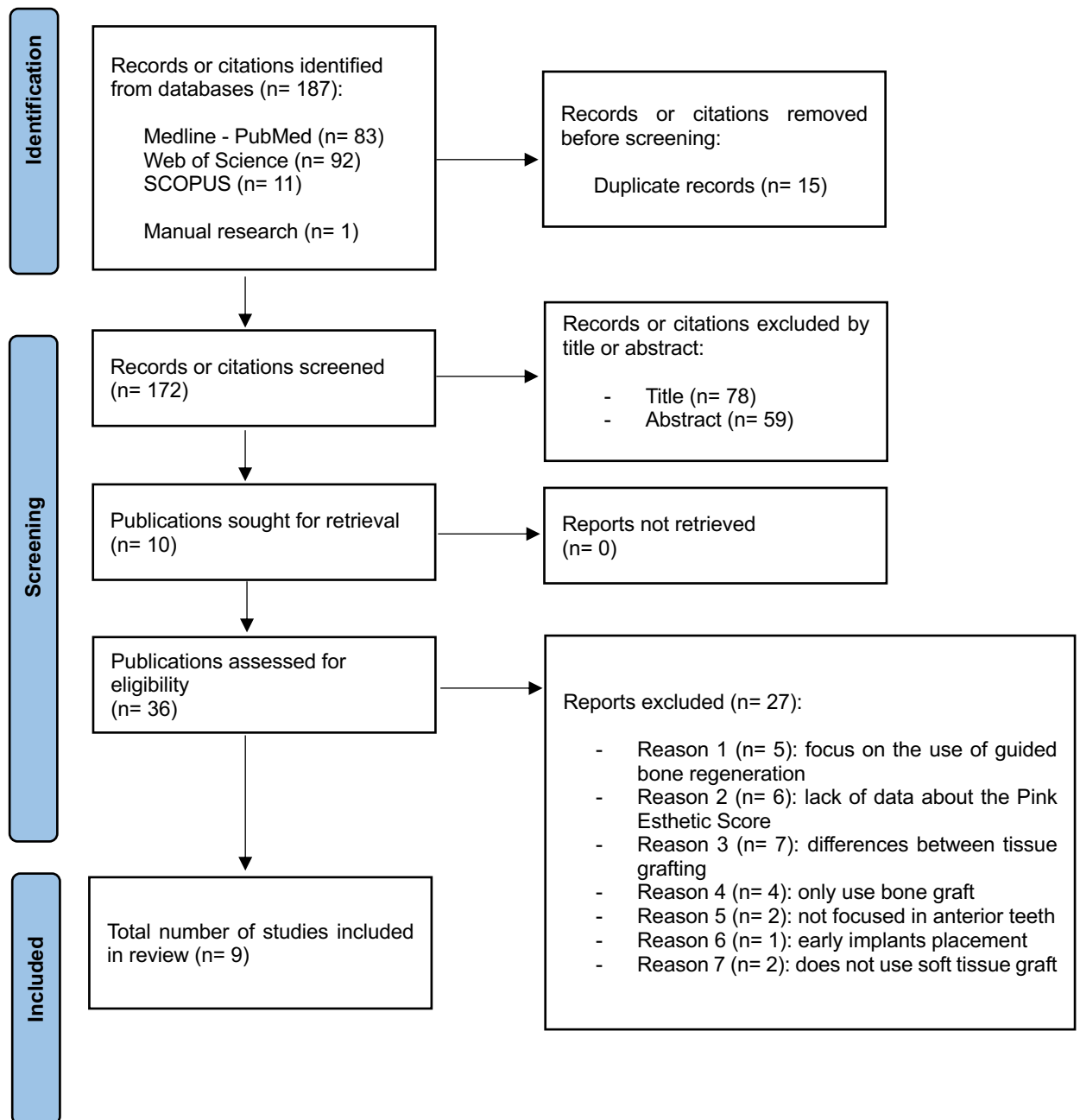


Fig. 1: Flowchart of search and titles selection process during systematic review.

	Generate randomized sequence (selection bias)	Allocation concealment (selection bias)	Blinding of outcome assessment (detection bias)	Follow-up and exclusions (attrition bias)	Selective description (reporting bias)	Other biases
Migliorati et al. 2015 (15)	?	+	+	+	+	+
van Nimwegen et al. 2018 (16)	+	+	?	-	+	+
Zuiderveld et al. 2024 (17)	+	?	?	+	+	+
Zuiderveld et al. 2018 (18)	?	?	+	+	+	+
Zuiderveld et al. 2018 (19)	?	?	+	+	+	+
Abd El-Aziz et al. 2022 (20)	+	+	+	+	+	+

Fig. 2: Measuring the risk of bias of randomized studies according to the Cochrane guideline.

	Definition of cases	Representativeness	Selecting controls	Definition of controls	Comparability (most important factor)	Comparability (any other variable)	Checking the exposure	Same method for both groups	Dropout rate	Total
Nazarian et al. 2023 (23)	☆	☆	-	-	-	-	☆	-	☆	4

Fig. 3: Measurement of the risk of bias of non-randomized observational studies with the Newcastle-Ottawa scale – observational studies with a non-randomized control group.

	Cohort representativeness	Selection of non-exposed cohort	Checking exposure	Demonstration of no variable presence of interest at the beginning	Comparability (most important factor)	Comparability (other factors)	Measuring results	Enough follow-up	Dropout rate	Total
Noelken et al. 2018 (21)	★	★	★	★	-	-	★	★	★	7
Levine et al. 2022 (22)	★	★	★	★	-	-	★	★	-	6

Fig. 4: Measurement of the risk of bias of non-randomized observational studies with the Newcastle-Ottawa scale – observational cohort studies, no control group.

El impacto en los resultados estéticos de la colocación inmediata de implantes dentales en zonas anteriores con o sin injerto de tejido blando: una revisión sistemática

Título corto: Resultados estéticos de los implantes anteriores inmediatos con o sin injerto de tejido blando: una revisión sistemática

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Resumen

Introducción: Uno de los principales desafíos de los implantes dentales inmediatos es el riesgo de recesión de los tejidos blandos y el compromiso del resultado estético, especialmente en el sector anterior del maxilar superior. Para solucionar esta problemática, se han introducido los injertos de tejido blando, como los injertos autógenos de tejido conectivo y los biomateriales, como una técnica adyuvante para aumentar la estabilidad de los tejidos periimplantarios, mejorar los resultados estéticos y reducir el riesgo de complicaciones a largo plazo. El objetivo fue evaluar los resultados estéticos medidos con el Pink Esthetic Score (PES) y White Esthetic Score (WES) en implantes dentales inmediatos con el uso de injerto de tejido blando en comparación con implantes inmediatos sin injerto de tejido blando.

Material y métodos: Se realizó una búsqueda electrónica en las bases de datos PubMed, Web of Science y Scopus sobre la colocación de implantes inmediatos con y sin el uso de la técnica de injerto de tejido blando y los resultados estéticos en el sector anterior del maxilar superior, hasta noviembre de 2024.

Resultados: De un total de 187 artículos, se incluyeron 9 estudios, los cuales compararon implantes inmediatos con y sin injertos de tejido conectivo utilizando el Pink Esthetic Score (PES). Seis artículos evaluaron ambos índices: PES y WES (White Esthetic Score). Los implantes con injerto mostraron resultados estéticos ligeramente mejores, con un promedio ponderado total de: PES 8,35 en el grupo con injerto y 8,11 en el grupo sin injerto, y WES 8,02 en el grupo con injerto y 7,76 en el grupo sin injerto, con diferencias menores y cierta variabilidad. El riesgo de sesgo fue en general de moderado a alto. En conjunto, el uso de injertos de tejido conectivo ofreció mejoras estéticas modestas.

Conclusión: Los implantes inmediatos con injertos de tejido conectivo mostraron mejores resultados estéticos en los tejidos blandos (mayor PES), siendo especialmente beneficiosos en pacientes con biotipo gingival delgado. Aunque el WES fue solo ligeramente más alto en los casos con injerto, el uso del injerto contribuyó a mejorar la integración estética general de la corona protésica.

Palabras clave: implantes dentales inmediatos, colocación inmediata de implantes dentales, implantes inmediatos, implantes dentales postextracción, zona estética, sector anterior, maxilar, injerto de tejido conectivo, injerto de tejido blando, injerto gingival, injerto de encía libre, estética dental.

Introducción

Los implantes dentales han evolucionado como una solución confiable para la pérdida dental, reemplazando a las prótesis tradicionales que a menudo provocaban pérdida ósea debido a la falta de estimulación del reborde alveolar (1). Esto es especialmente significativo en pacientes jóvenes y en la zona estética del maxilar anterior, donde los retrasos en el tratamiento afectan tanto la función como la autoestima (2). La colocación inmediata de implantes tras la extracción dental tiene como objetivo acortar el tiempo de rehabilitación y preservar los tejidos, aunque presenta desafíos como la reabsorción ósea y compromisos estéticos (3). Los implantes inmediatos, insertados directamente en alveolos frescos, reducen las etapas quirúrgicas y el tiempo de tratamiento (4). Si bien ofrecen beneficios como la preservación del hueso alveolar y una mayor satisfacción del paciente (5), también conllevan riesgos, incluidos problemas para lograr estabilidad primaria, recesión de los tejidos blandos y mayores tasas de complicaciones (4). Las tasas de supervivencia de los implantes inmediatos y diferidos son comparables, aunque los implantes inmediatos pueden mostrar una mayor pérdida ósea crestal (6,7). La colocación estética de implantes, especialmente en el maxilar anterior, exige precisión debido a la complejidad anatómica, la delgada tabla ósea vestibular y la alta visibilidad (8). Un manejo adecuado de los tejidos blandos es crucial para el éxito a largo plazo del implante, ya que proporciona protección microbiana, mantiene los contornos estéticos y previene complicaciones como la periimplantitis (9). La augmentación de tejido blando puede implicar injertos autógenos (por ejemplo, injertos de tejido conectivo), que ofrecen alta biocompatibilidad pero requieren un segundo sitio quirúrgico (10). Alternativamente, las matrices de colágeno de origen porcino ofrecen opciones confiables y mínimamente invasivas para la regeneración de tejidos blandos (10). Las técnicas emergentes se centran en matrices con volumen estable, métodos mínimamente invasivos y materiales bioactivos para mejorar la cicatrización e integración de los tejidos (11). En conjunto, estas estrategias buscan mejorar los resultados estéticos y la estabilidad del implante a largo plazo de una manera menos invasiva y más predecible. El objetivo de la presente revisión sistemática fue revisar sistemáticamente la siguiente pregunta: En pacientes adultos que requieren el reemplazo de un solo diente en la región anterior del maxilar, ¿la colocación

inmediata de implantes dentales con injerto de tejido blando, en comparación con la colocación inmediata de implantes sin injerto de tejido blando, resulta en mejores resultados estéticos de los tejidos blandos, medidos por el Pink Esthetic Score? Esto se llevó a cabo evaluando el Pink Esthetic Score (PES) para el resultado estético del tejido blando y el White Esthetic Score (WES) para la apariencia estética de la corona protésica, ambos medidos con y sin injerto de tejido blando.

Materiales y métodos:

Esta revisión sistemática se llevó a cabo siguiendo las recomendaciones de la guía PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (12).

- Pregunta PICO:

La pregunta fue establecida de acuerdo con el formato estructurado PICO:

P (Población): pacientes adultos que requieren la sustitución de un solo diente en la región anterior del maxilar superior;

I (Intervención): colocación inmediata de implantes dentales tras la extracción dental con injerto de tejido blando;

C (Comparación): colocación inmediata de implantes dentales tras la extracción dental sin injerto de tejido blando;

O (Resultados):

- **O1:** Pink Esthetic Score (PES) como medida de la estética de los tejidos blandos;
- **O2:** White Esthetic Score (WES).

- Criterios de elección:

Los criterios de inclusión fueron:

- **Tipo de estudio:** ensayos controlados aleatorizados, estudios de cohortes prospectivos y retrospectivos y series de casos. Publicados hasta noviembre de 2024.
- **Tipo de paciente:** pacientes adultos que necesiten un implante inmediato debido a la pérdida de un diente en el sector anterior del maxilar superior.

- **Tipo de intervención:** colocación de implante dental inmediato en el sector anterior del maxilar superior, con o sin el uso de injertos de tejido blando para restaurar la estética tras la pérdida dental.
- **Tipo de variables de resultado:** estudios que analizaron los resultados estéticos evaluando el Pink Esthetic Score (PES) como variable principal y el White Esthetic Score (WES) como variable secundaria, tras la colocación inmediata del implante dental en zonas estéticas.

Los criterios de exclusión para esta revisión sistemática fueron: estudios in vitro, estudios en animales, reportes de casos, revisiones, cartas y comentarios al editor. Además, se excluyeron los estudios enfocados en implantes inmediatos en la mandíbula, en el sector posterior del maxilar, cirugía ósea guiada o aquellos que involucraban únicamente injertos óseos.

- **Fuentes de información y estrategia de búsqueda:**

Se realizaron búsquedas bibliográficas automáticas y manuales en tres bases de datos (PubMed, Scopus y Web of Science) utilizando las siguientes palabras clave: “implantes dentales inmediatos”, “colocación de implantes dentales inmediatos”, “implantes inmediatos”, “implantes dentales postextracción”, “zona estética”, “sector anterior”, “maxilar”, “injerto de tejido conectivo”, “injerto de tejido blando”, “injerto gingival”, “injerto de encía libre”, “estética dental”.

La búsqueda en PubMed fue la siguiente: (((((((("immediate dental implants") OR (immediate dental implants placement)) OR ("immediate implants")) OR (postextraction dental implants)) AND (aesthetic zone)) OR (anterior sector)) OR (maxilla[MeSH Terms])) AND (connective tissue graft)) OR (soft tissue graft)) OR (gingival graft)) OR (free gingiva graft)) AND (dental esthetic[MeSH Terms]).

- **Proceso de selección de los estudios:**

Se llevó a cabo un proceso de selección en tres etapas. La selección de los estudios fue realizada de forma independiente por dos revisores (DP, ELWS). En la primera etapa, se filtraron los títulos para eliminar publicaciones irrelevantes, no relacionadas con el tema y duplicadas. En la segunda etapa, se revisaron los resúmenes y se seleccionaron los estudios en función del tipo de estudio, el tipo de implantes, el tipo de intervención, el número de pacientes y las variables de resultado. En la tercera etapa, se revisó el texto completo y se extrajeron los

datos utilizando un formulario de recolección previamente establecido para confirmar la elegibilidad de los estudios.

- **Extracción de datos:**

Se extrajo la siguiente información de los estudios según los criterios: autores, año de publicación, tipo de estudio, país, número de pacientes, edad, período de seguimiento, número de implantes, con o sin injerto de tejido blando, tipo de injerto de tejido blando, presencia o no de injerto óseo, evaluación del Pink Esthetic Score (PES) y el White Esthetic Score (WES).

- **Valoración de la calidad:**

La evaluación del riesgo de sesgo fue realizada por dos revisores (DP, ELWS) con el fin de analizar la calidad metodológica de los artículos incluidos. Para la evaluación de la calidad de los estudios experimentales (ensayos clínicos aleatorizados), se utilizó la guía Cochrane 5 (<https://www.cochranelibrary.com/es/>) (13), evaluando el riesgo de sesgo como bajo, alto o incierto. La escala Newcastle-Ottawa (14) se utilizó para evaluar la calidad de los estudios observacionales. Los estudios fueron clasificados como de "bajo riesgo de sesgo" si obtuvieron más de 6 estrellas y de "alto riesgo de sesgo" si obtuvieron ≤ 6 estrellas.

- **Síntesis de datos:**

Para resumir y comparar las variables de los resultados entre los diferentes estudios, los valores promedio de las principales variables se agruparon según el grupo de estudio. Dado que el promedio encontrado en los estudios analizados provenía de muestras con diferentes números de áreas anteriores injertadas y no injertadas con tejido blando, número de implantes, y las puntuaciones PES (Pink Esthetic Score) y WES (White Esthetic Score), fue necesario calcular el promedio ponderado.

Resultados:

- **Selección de estudios:**

Se obtuvieron un total de 187 artículos del proceso de búsqueda inicial: Medline – PubMed (n=83), Web of Science (n=92) y SCOPUS (n=11). Además, se obtuvo

1 artículo adicional a través de búsqueda manual. De estas publicaciones, 37 fueron identificadas como artículos potencialmente elegibles mediante el filtrado por título y resumen. Posteriormente, se recuperaron los artículos completos y se evaluaron detenidamente. Como resultado, 9 artículos cumplieron con los criterios de inclusión y fueron incluidos en esta revisión sistemática (Fig. 1).

- Análisis de las características de los estudios revisados:

Un total de 9 artículos fueron seleccionados para su inclusión en esta revisión sistemática. Estos estudios evaluaron los resultados estéticos de la colocación de implantes inmediatos con y sin el uso de injertos de tejido conectivo. De estos 9 estudios, 6 son ensayos controlados aleatorizados (15-20), 2 son estudios de cohorte (21,22) y 1 es un estudio prospectivo (23). Todos los artículos incluidos se centraron en comparar el uso de injertos de tejido conectivo junto con implantes inmediatos frente a implantes inmediatos solos, evaluando los resultados estéticos mediante el uso del Pink Esthetic Score (PES) (15-23). Además, 6 de estos estudios también evaluaron la apariencia estética de la corona protésica de estos implantes inmediatos utilizando el White Esthetic Score (WES) (15,17,18,19,22,23). En total, se evaluaron 352 pacientes utilizando el PES y 250 pacientes fueron evaluados utilizando el WES. En cuanto a la fuente del injerto de tejido conectivo, 5 estudios extrajeron el injerto de la zona palatina de los pacientes (15,19,20,21,22), mientras que los otros 4 estudios lo obtuvieron de la tuberosidad maxilar de los pacientes (16,17,18,23). (Tabla 1).

- Evaluación de la calidad metodológica:

Para los 9 artículos seleccionados para esta revisión sistemática, el riesgo de sesgo fue evaluado utilizando la herramienta de riesgo de sesgo de Cochrane (13) y la escala de Newcastle-Ottawa (14).

De los ensayos controlados aleatorizados, 4 artículos presentaron un riesgo de sesgo poco claro (15,17,18,19), 1 artículo mostró un alto riesgo de sesgo (16) y 1 artículo fue evaluado como de bajo riesgo de sesgo (20) (Fig. 2). Para el estudio observacional con grupos de control no aleatorizados (23), presentó una puntuación de 4 estrellas, lo que indica un alto riesgo de sesgo (≤ 6 estrellas), y para los estudios de cohorte no aleatorizados, 1 artículo (21) obtuvo 7 estrellas,

indicando un bajo riesgo de sesgo, mientras que el otro artículo (22) obtuvo 6 estrellas, lo que indica un alto riesgo de sesgo (Fig. 3 y 4).

- **Síntesis de resultados:**

Evaluación de los resultados estéticos en implantes inmediatos con y sin injertos de tejido blando utilizando el PES

La Tabla 2 presenta los resultados del Pink Esthetic Score (PES) de los 9 estudios seleccionados. Algunos estudios individuales, como el de van Nimwegen y cols. 2018 (16) y Abd El-Aziz y cols. 2022 (20), informaron puntajes altos de PES independientemente de la utilización de injertos, mientras que otros como Levine y cols. 2022 (22) y Zuiderveld y cols. 2024 (17) observaron puntajes más bajos, especialmente en la ausencia de injertos. Los resultados muestran que los implantes inmediatos sin injerto de tejido blando tienen un promedio ponderado total de PES de 8,11, mientras que los implantes con injerto de tejido blando tuvieron un promedio ponderado ligeramente superior de PES de 8,35. Esto sugiere un beneficio estético marginal cuando se emplea injerto de tejido conectivo junto con implantes inmediatos. La media aritmética total de PES es de 8,34 para el grupo sin injerto y 8,87 para el grupo injertado, lo que indica resultados estéticos ligeramente mejores con injerto. Sin embargo, la desviación estándar total (DE) también es ligeramente mayor en el grupo injertado con 2,79 en comparación con el grupo sin injerto con 2,54, lo que sugiere una mayor variabilidad en los resultados cuando se utilizaron injertos. Los valores medianos de PES mostraron una tendencia similar, con una mediana de 6,73 para el grupo sin injerto y 7,30 para el grupo injertado.

Evaluación de los resultados estéticos en implantes inmediatos con y sin injertos de tejido blando utilizando el WES

La Tabla 3 presenta los resultados descriptivos del White Esthetic Score (WES). Zuiderveld y cols. 2024 (17) y Zuiderveld y cols. 2018 (19) reportaron puntajes altos de WES para ambos grupos, con un beneficio modesto observado en el grupo sin injerto. Levine y cols. 2022 (22) mostró un promedio relativamente bajo de WES en ausencia de injerto, mejorando notablemente con injertos. Curiosamente, Nazarian y cols. 2023 (23) solo reportaron datos para el grupo injertado, con un puntaje promedio fuerte de 9.5, el más alto entre todos los

estudios. El promedio ponderado total de WES es 7,76 para los implantes inmediatos sin injertos de tejido blando y 8,02 para aquellos con injertos de tejido blando, lo que indica una pequeña mejora en los resultados estéticos cuando se utiliza injerto de tejido conectivo. En términos del promedio aritmético total, el grupo injertado también muestra un puntaje más alto de 8,10 en comparación con 7,60 para el grupo sin injerto. Esto refleja una tendencia consistente hacia resultados estéticos blancos ligeramente mejores cuando se realiza injerto de tejido conectivo. La desviación estándar (DE) es algo más baja en el grupo injertado, lo que indica una menor variabilidad en los resultados estéticos cuando se utilizan injertos. La mediana de WES es 7,98 para el grupo sin injerto y 7,84 para el grupo injertado, mostrando que están muy cerca en el rango. Estos resultados sugieren que el injerto de tejido conectivo puede contribuir a una ligera mejora en los resultados estéticos blancos en implantes inmediatos, aunque las diferencias entre los dos grupos no son significativas.

Discusión:

Esta revisión sistemática evalúa los resultados estéticos de la colocación de implantes dentales inmediatos en la región maxilar anterior con y sin el uso de técnicas de injerto de tejido blando empleadas para favorecer el volumen, la estabilidad y la integración del tejido blando alrededor del sitio del implante. El objetivo principal es evaluar el Pink Esthetic Score (PES). Al comparar los valores de PES entre la colocación de implantes inmediatos con injertos de tejido blando y aquellos sin injertos, la revisión tiene como objetivo determinar si la augmentación del tejido blando proporciona mejoras medibles en la apariencia estética del tejido blando alrededor de los implantes. El objetivo secundario es evaluar el White Esthetic Score (WES), que permite una comprensión más completa de los resultados estéticos, ya que cubre no solo los aspectos biológicos y de injertos, sino también los componentes restaurativos protésicos de los implantes.

Evaluación de los resultados estéticos en implantes inmediatos con y sin injertos de tejido blando utilizando el PES

Los resultados de esta revisión son consistentes con investigaciones previas que han enfatizado la influencia positiva del injerto de tejido blando en la estética peri-

implantar. Por ejemplo, De Angelis y cols. 2021 (24) observaron que el uso de injertos de tejido conectivo en la zona estética resultó en perfiles de tejido blando estables y niveles marginales de hueso favorables, respaldando los beneficios a largo plazo del injerto para mejorar los resultados estéticos. De manera similar, Seyssens y cols. 2021 (25) concluyeron que diversos tipos de materiales de injerto de tejido blando, como los injertos autógenos de tejido conectivo o las matrices xenogénicas, podrían producir resultados similares y que el injerto de tejido blando era especialmente ventajoso para los pacientes con biotipos gingivales finos. Estos estudios destacan el valor del injerto de tejido blando para lograr resultados más estables y estéticamente agradables en la colocación de implantes inmediatos. Sin embargo, Galve-Huertas y cols. 2024 (26), al comparar la efectividad de la matriz dérmica acelular derivada de cerdo (pADM) y los injertos de tejido conectivo (CTG), no encontraron diferencias significativas después de 12 meses de seguimiento. Entre los estudios incluidos en la revisión, van Nimwegen y cols. 2018 (16) reportaron los puntajes más altos de PES, independientemente de si se utilizó injerto de tejido blando, lo que sugiere que factores distintos al tipo de injerto, como la experiencia quirúrgica, la selección de pacientes y el manejo del colgajo, podrían jugar un papel significativo en los resultados estéticos de los implantes inmediatos. Esto resalta la importancia de considerar un enfoque integral para la planificación y ejecución del tratamiento. En contraste, Levine y cols. 2022 (22) reportaron uno de los resultados más bajos de PES en el grupo sin injerto, reforzando el valor potencial de la augmentación del tejido blando, especialmente en casos con mayores demandas estéticas o en pacientes con biotipos gingivales más finos. Los puntajes más altos de PES en el grupo injertado están relacionados con los beneficios biológicos de los injertos de tejido conectivo (CTG) que mejoran el grosor de la mucosa, la estabilidad del tejido blando y el contorno alrededor de los implantes. Estos factores mejoran la integración estética y reducen la recesión medio-facial, lo que conduce a márgenes gingivales más estables y mejores resultados a largo plazo del PES. Esto explica la ventaja constante del PES observada en los casos con injerto, destacando el valor estético de la augmentación de tejido blando en los procedimientos de implantes inmediatos.

Evaluación de los resultados estéticos en implantes inmediatos con y sin injertos de tejido blando utilizando el WES

Estos resultados se alinean con los de estudios previos que han mostrado el impacto positivo del injerto de tejido blando en los resultados de WES. Por ejemplo, Seyssens y cols. 2021 (25) concluyeron en su estudio clínico que el injerto de tejido blando ayudó a mejorar la coincidencia de color y el contorno de la mucosa peri-implantar, lo que condujo a puntajes más altos de WES en la zona estética. De manera similar, una revisión sistemática de Torra-Money y cols. 2024 (27) enfatizó que la augmentación del tejido blando, particularmente con el uso de injertos de tejido conectivo, no solo mejora los Pink Esthetic Scores (PES) sino que también mejora los resultados de WES al optimizar el perfil de emergencia del implante y mejorar la adaptación del tejido blando alrededor de la corona. En contraste, otros autores han reportado diferencias mínimas o no significativas en WES entre los casos con injerto y sin injerto. Por ejemplo, Seyssens y cols. 2021 (25) no encontraron un consenso claro sobre si el injerto de tejido blando mejora definitivamente los resultados estéticos blancos, notando la alta variabilidad entre los estudios, con algunos mostrando mejora en WES mientras que otros no. Además, los autores observaron que, aunque el injerto de tejido blando a menudo mejoraba los puntajes de PES, las mejoras en WES eran menos consistentes porque está influenciado por las características de la corona protésica. Entre los estudios incluidos en esta revisión sistemática, Zuiderveld y cols. 2018 (19) reportaron el promedio más alto de WES en el grupo sin injerto, mientras que Nazarian y cols. 2023 (23) reportaron el puntaje más alto de WES en el grupo injertado, lo que sugiere que se pueden lograr excelentes resultados estéticos con o sin injerto cuando otras variables clínicas, como la técnica quirúrgica y la selección de pacientes, están bien controladas. En contraste, Levine y cols. 2022 (22) reportaron los valores más bajos de WES en el grupo sin injerto, destacando las posibles desventajas estéticas en los casos en los que el volumen o el contorno del tejido blando está comprometido. La mejora modesta en los White Esthetic Scores (WES) en el grupo injertado se debe probablemente a la mejora de la estabilidad mucosa peri-implantar, lo que apoya mejores perfiles de emergencia de la corona y contornos de tejido blando de aspecto natural (28). Los tejidos más gruesos mejoran el soporte de la corona, ayudando a características estéticas como la simetría, la textura y el color. Sin

embargo, el WES también está fuertemente influenciado por factores protésicos como la elección de material y la técnica de diseño, lo que puede disminuir el impacto relativo del injerto de tejido blando (29). Esto sugiere que, si bien el injerto mejora la estética, los resultados óptimos de WES requieren tanto planificación biológica como protésica.

Esta revisión presenta varias limitaciones, como riesgos de sesgo, tamaños de muestra pequeños y metodologías inconsistentes. A pesar de estos problemas, sugiere que los injertos de tejido blando pueden mejorar los resultados estéticos, especialmente en pacientes con tejido periimplantario delgado. La revisión hace un llamado a futuras investigaciones con ensayos más grandes y de mayor calidad, seguimientos más largos, comparaciones de sustitutos de tejido blando y la consideración de flujos de trabajo digitales y la satisfacción del paciente para mejorar las guías clínicas y la evidencia.

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Tabla 1: Características de los estudios revisados.

Autor y año	Tipo de estudio	País	N° de pacientes (mujer/ hombre)	Edad (años)	Follow-up (años)	N° de implantes	CON injerto de tejido blando	SIN injerto de tejido blando	Tipo de injerto de tejido blando	Injerto hueso	PES	WES	Aleatorización
Migliorati y cols. 2015 (15)	Ensayo de control aleatorizado	Italia	48 (25/23)	22-70	2	48	4	24	Tejido conectivo (paladar)	Yes	Yes	Yes	Yes
van Nimwegen y cols. 2018 (16)	Ensayo de control aleatorizado	Países Bajos	60 (32/28)	19-82	1	60	0	30	Tejido conectivo (tuberosidad maxilar)	Yes	Yes	No	Yes
Zuiderveld y cols. 2024 (17)	Ensayo de control aleatorizado	Países Bajos	60 (32/28)	29-64	5	60	7	27	Tejido conectivo (tuberosidad maxilar)	Yes	Yes	Yes	Yes

Zuiderveld y cols. 2018 (18)	Ensayo de control aleatorizado	Países Bajos	60 (32/28)	30-64	1	60	9	29	Tejido conectivo (tuberosidad maxilar)	Yes	Yes	Yes	Yes
Noelken y cols. 2018 (21)	Estudio de cohorte	Alemania	26 (12/14)	20-77	3	26	3	13	Tejido conectivo (paladar)	Yes	Yes	No	No
Levine y cols. 2022 (22)	Estudio de cohorte	Brasil	28 (20/8)	39-75	6	28	7	11	Tejido conectivo (paladar)	Yes	Yes	Yes	No
Zuiderveld y cols. 2018 (19)	Ensayo de control aleatorizado	Países Bajos	60 (35/25)	18-73	1	60	0	20	Tejido conectivo (paladar)	Yes	Yes	Yes	Yes
Abd El-Aziz y cols. 2022 (20)	Ensayo de control aleatorizado	Egipto	16 (15/1)	21-46	0,8	16	8	8	Tejido conectivo (paladar)	No	Yes	No	Yes
Nazarian y cols. 2023 (23)	Estudio prospectivo	Rusia	22 (10/12)	20-70	1	35	22	0	Tejido conectivo (tuberosidad maxilar)	No	Yes	Yes	No

Tabla 2. Resultados descriptivos del Pink Esthetic Score (PES) en implantes inmediatos con y sin injerto de tejido blando recolectados por los estudios.

	Implantes inmediatos SIN injerto de tejido blando					Implantes inmediatos CON injerto de tejido blando				
	N° implantes	PES				N° implantes	PES			
		Media	SD	p value	Media ponderada		Media	SD	p value	Media ponderada
Migliorati y cols. 2015 (15)	24	6,65	1,80	<0.001	0,99	24	7,15	1,75	<0.001	0,90
van Nimwegen y cols. 2018 (16)	30	11,36	1,65	0.866	2,10	30	11,28	1,67	0.866	1,78
Zuiderveld y cols. 2024 (17)	27	6,40	0,70	0.350	1,07	27	6,20	0,70	0.350	0,88
Zuiderveld y cols. 2018 (18)	29	6,80	1,50	0.210	1,22	29	6,40	1,50	0.210	0,98
Noelken y cols. 2018 (21)	13	12,20	0,60	<0.001	0,98	13	13,00	1,20	<0.001	0,89
Levine y cols. 2022 (22)	11	6,20	1,70	0.083	0,42	17	7,30	1,60	0.083	0,65
Zuiderveld y cols. 2018 (19)	20	6,60	1,50	0.710	0,81	20	7,00	2,40	0.710	0,74

Abd El-Aziz y cols. 2022 (20)	8	10,50	1,00	0.004	0,52	8	13,00	0,00	0.004	0,55
Nazarian y cols. 2023 (23)	0	-	-	-	-	22	8,50	1,66	-	0,98
Media ponderada total		8,11					8,35			
Media aritmética total		8,34					8,87			
Total SD		2,54					2,79			
Mediana total		6,73					7,30			
Máximo		12,20					13,00			
Mínimo		6,20					6,20			

Tabla 3. Resultados descriptivos del White Esthetic Score (WES) en implantes inmediatos con y sin injerto de tejido blando recolectados por los estudios.

	Implantes inmediatos SIN injerto de tejido blando					Implantes inmediatos CON injerto de tejido blando				
	N° implantes	WES				N° implantes	WES			
		Media	SD	p value	Media ponderada		Media	SD	p value	Media ponderada
Migliorati y cols. 2015 (15)	24	7,98	0,99	0.880	1,73	24	7,98	0,99	0.880	1,38
Zuiderveld y cols. 2024 (17)	27	8,00	0,50	0.560	1,95	27	7,60	0,70	0.560	1,48
Zuiderveld y cols. 2018 (18)	29	7,40	1,30	0.300	1,93	29	6,90	1,90	0.300	1,44
Levine y cols. 2022 (22)	11	5,90	2,40	0.025	0,58	17	7,70	1,70	0.025	0,94
Zuiderveld y cols. 2018 (19)	20	8,70	0,90	0.390	1,57	20	8,90	1,20	0.390	1,28
Nazarian y cols. 2023 (23)	0	-	-	-	-	22	9,50	0,57	-	1,50
Media ponderada total		7,76					8,02			
Media aritmética total		7,60					8,10			

Total SD		1,05					0,94			
Mediana total		7,98					7,84			
Máximo		8,70					9,50			
Mínimo		5,90					6,90			

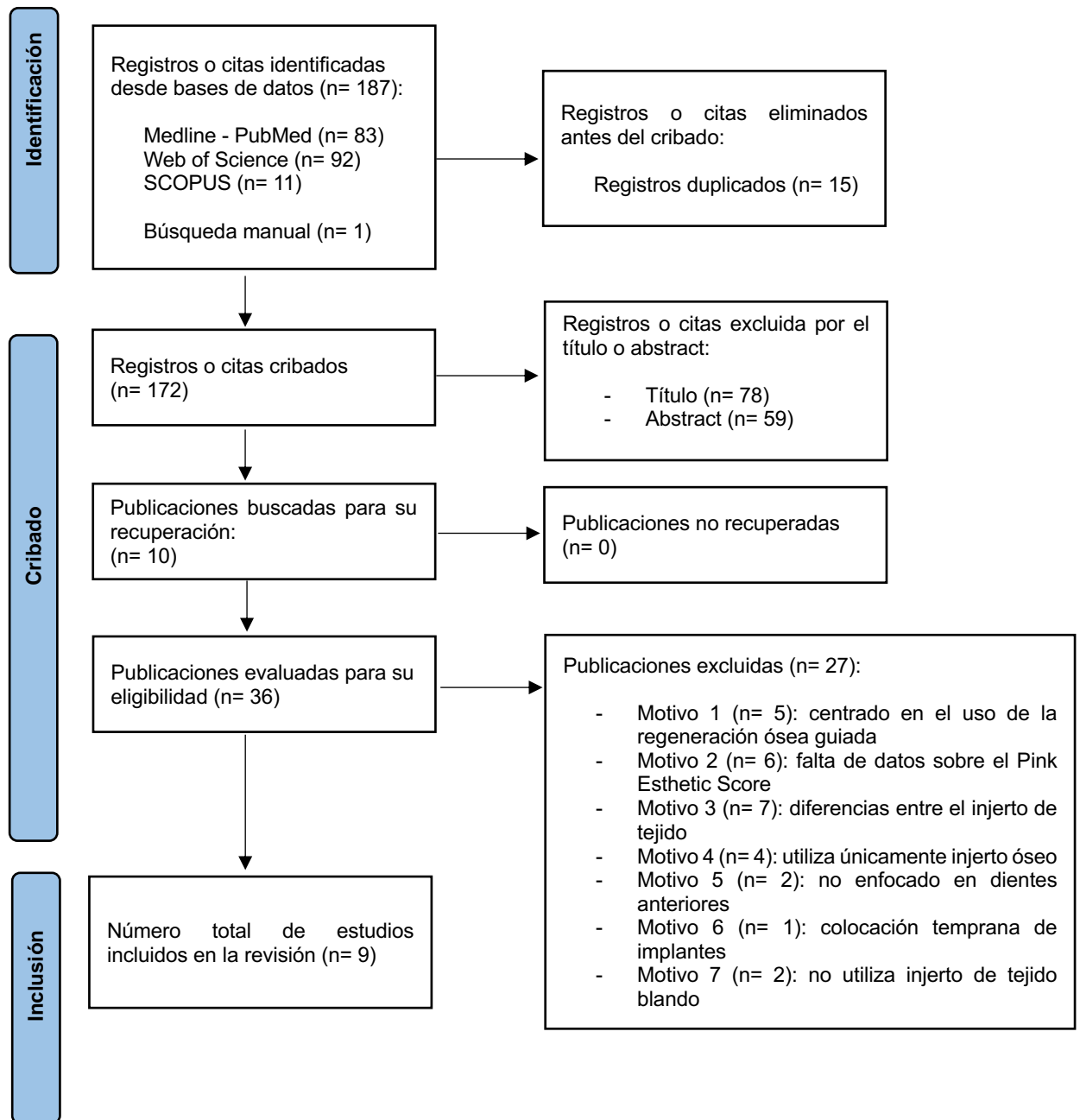


Fig. 1: Diagrama de flujo de búsqueda y proceso de selección de títulos durante la revisión sistemática.

	Generar secuencia aleatorizada (sesgo selección)	Ocultación de la asignación (sesgo selección)	Cegamiento evaluados de resultados (sesgo detección)	Seguimiento y exclusiones (sesgo deserción)	Descripción selectiva (sesgo informe)	Otros sesgos
Migliorati y cols. 2015 (15)	?	+	+	+	+	+
van Nimwegen y cols. 2018 (16)	+	+	?	-	+	+
Zuiderveld y cols. 2024 (17)	+	?	?	+	+	+
Zuiderveld y cols. 2018 (18)	?	?	+	+	+	+
Zuiderveld y cols. 2018 (19)	?	?	+	+	+	+
Abd El-Aziz y cols. 2022 (20)	+	+	+	+	+	+

Fig. 2: Medición del riesgo de sesgo de los estudios randomizado según la guía Cochrane.

	Definición de los casos	Representatividad	Selección de los controles	Definición de los controles	Comparabilidad (factor más importante)	Comparabilidad (cualquier otra variable)	Comprobación de la exposición	Mismo método para ambos grupos	Tasa de abandonos	Total
Nazarian y cols. 2023 (23)	☆	☆	-	-	-	-	☆	-	☆	4

Fig. 3: Medición del riesgo de sesgo de estudios observacionales no randomizados con la escala de Newcastle-Ottawa – estudios observacionales con un grupo de control no randomizado.

	Representatividad cohorte	Selección cohorte no expuesta	Comprobación exposición	Demostración no presencia variable interés al inicio	Comparabilidad (factor más importante)	Comparabilidad (otros factores)	Medición resultados	Suficiente seguimiento	Tasa de abandonos	Total
Noelken y cols. 2018 (21)	★	★	★	★	-	-	★	★	★	7
Levine y cols. 2022 (22)	★	★	★	★	-	-	★	★	-	6

Fig. 4: Medición del riesgo de sesgo de los estudios observacionales no randomizados con la escala de Newcastle-Ottawa – estudios observacionales de cohortes sin grupo de control.