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AESTHETIC OUTCOMES OF IMMEDIATE VERSUS DELAYED IMPLANT PLACEMENT OF MAXILLARY ANTERIOR TEETH: A SYSTEMATIC REVIEW

[Resultados estéticos da colocação imediata versus retardada de implantes na região anterior maxilar: uma revisão sistemática]

Dissertação de Mestrado

[Mestrado Integrado de Medicina Dentária]

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DEDICATION

Here we are at the end of this dental school journey, and five years later, I wish to dedicate this dissertation, all my studies, and my victories to my parents: François and Nicaise Caulier. Thanks to them, I have not only had the opportunity but also the ability to accomplish this goal: to become a dentist one day.

These five years have been filled with many emotions: fear, joy, stress, sadness, and the pride of passing exams and having my first patient. Thanks to my parents, I had the courage to persevere, to be far from my family and loved ones: I fought. I drew this strength from them.

From my mother, this loving and accomplished woman who always thinks of others and has comforting words. She has always fought for her family, for my brother, and to achieve the life she dreamed of (even if it meant leaving her island and living far from all her landmarks). I also drew this strength from my father, who has always been a role model for better or worse (some jokes could have been avoided). His quick wit, protection, and love have been a guiding light since my childhood. It has now been more than a year that I have seen him fight against illness, for life, and for our family with a determination and courage that I can only hope to have one day.

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Nous voici arrivés à la fin de ce cursus de médecine dentaire, et cinq ans plus tard je souhaite dédier cette dissertation, l'ensemble de mes études et de mes victoires à mes parents : François et Nicaise Caulier. Grace à eux j'ai pu avoir non seulement l'opportunité mais aussi les capacités d'accomplir cet objectif : devenir un jour dentiste. Ces cinq ans ont été remplis de nombreux sentiments, la peur, la joie, le stress, la tristesse ou encore la fierté de réussir des examens et d'avoir mon premier patient. Grace à mes parents j'ai eu le courage de tenir, d'être loin de ma famille de mes proches : je me suis battue. Cette force je l'ai tirée d'eux.

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servi de modèle pour le meilleur comme pour le pire (certaines blagues auraient pu être évitées).Sa vivacité d'esprit, sa protection et son amour ont été un repère depuis mon enfance. Cela fait maintenant plus d'un an que je le vois se battre contre la maladie, pour la vie et pour notre famille avec une détermination et un courage que je peux seulement espérer avoir un jour.

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proud of the people we are becoming. A thought for Jo, with her infectious smile, thanks to whom, despite the years and difficulties, I have experienced incredible moments. Even though it hasn't always been easy, we started this health studies course together, and we will end up where we wish to be. Charlotte and Jo have become more than friends; they are now part of my family.

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RESUMO

Objetivo: O objetivo deste estudo foi responder à seguinte questão PICO: A colocação imediata de implantes demonstra uma taxa de sucesso semelhante em termos de desempenho clínico, resultados estéticos e PES, comparada à colocação de implantes diferida em pacientes adultos saudáveis que necessitam de substituição de um único dente na zona estética da maxila? **Metodologia**: Para a realização desta revisão sistemática, utilizámos os critérios PICO com o objetivo de formular a questão que este trabalho pretende responder (Tabela 1). Para realizar esta revisão sistemática, foram efetuadas pesquisas eletrónicas comtemplando publicações de 2014 a 2023. Foram utilizadas as seguintes bases de dados eletrónicas: PubMed, Wiley Online Library e Cochrane Library. **Resultados**: Onze estudos (11 ensaios clínicos randomizados) foram incluídos com um seguimento de 3 meses a 5 anos. Oitocentos e vinte implantes foram colocados com taxas de sucesso comparáveis para ambos os protocolos "Delayed Implant" (DI) e "Immediate Implant" (II), geralmente acima de 90% (com uma média geral de 98,53%). Nos estudos, as taxas de complicações para ambos os implantes imediatos e diferidos são geralmente baixos. A peri-implantite é o problema mais comum relatado nos estudos. A peri-implantite refere-se à formação de uma infeção em torno do implante dentário. Esta análise mostra que os II geralmente têm melhores pontuações PES a longo prazo. No entanto, deve-se notar que a diferença com os DI é mínima e, portanto, não significativa. Em termos de recessão gengival, é sempre ligeiramente maior nos DI, mas não há diferença significativa entre os dois protocolos. O mesmo se aplica ao índice de papila, sem diferença significativa entre os dois protocolos. É apenas ligeiramente maior nos II. **Conclusão**: Tanto os II quanto os DI de implantes são estratégias eficazes para a substituição de um único dente na zona estética maxilar, ambos com altas taxas de sucesso e resultados estéticos satisfatórios. A escolha entre II e DI deve ser personalizada de acordo com o cenário clínico individual do paciente, necessidades estéticas e preferências pessoais. É essencial envolver os pacientes no processo de tomada de decisão e fornecer uma educação abrangente sobre os procedimentos para melhorar a sua compreensão e envolvimento. Os ligeiramente melhores resultados estéticos do II tornam-no a escolha preferida quando a estética é crucial. No entanto, as mínimas diferenças nas taxas de sucesso e os resultados comparáveis dos tecidos moles sugerem que o DI continua a ser uma opção confiável e eficaz, particularmente em casos complexos onde a colocação imediata pode apresentar maiores riscos.

Palavras-chave: Implantes Dentários, imediato, adiado, região estética, maxilar, anterior, maxila anterior, Pink Esthetic Score, pontuação estética.

ABSTRACT

Objective: The aim of this study was to answer the following PICO question: Does immediate implant (II) placement show a similar success rate in terms of clinical performances, aesthetic outcomes, PES as the delayed implant (DI) placement in healthy adult patients requiring single-tooth replacement in the maxilla aesthetic zone? **Methodology:** For the elaboration of this systematic review, we used the PICO criteria with the aim of formulating the question this work intends to answer (Table 1). To carry out this systematic review, an electronic searche of publications from 2014 to 2023 was performed. The following electronic databases were utilized: PubMed, Wiley Online Library, and the Cochrane Library databases. **Results:** Eleven studies (11 randomized controlled trials) were included with a follow-up from 3 months to 5 years. Eight hundred twenty implants were placed with comparable success rates for both DI and II protocols and generally above 90% (with an overall average of 98.53%). In the studies, the complication rates for both immediate and delayed implant placements are generally low. Peri-implantitis is the most common issue reported across studies. Peri-implantitis refers to the formation of an infection around the dental implant. This analysis shows that II generally have better PES scores in the long term. However, it should be noted that the difference with DI is minimal and therefore not significant. In terms of gingival recession, it is always slightly higher in DI, but there is no significant difference between the two protocols. The same applies to the papilla index, with no significant difference between the two protocols. It is just slightly higher in II. **Conclusion:** In conclusion, both II and DI placements are effective strategies for single-tooth replacement in the maxillary aesthetic zone, each with high success rates and satisfactory aesthetic outcomes. The choice between II and DI should be personalized to the individual patient's clinical scenario, aesthetic needs, and personal preferences. It is essential to involve patients in the decision-making process and provide comprehensive education about the procedures to enhance their understanding and engagement. The slightly better aesthetic outcomes of II make it the preferred choice when aesthetic is crucial. However, the minimal differences in success rates and the comparable soft tissue outcomes suggest that DI remains a reliable and effective option, particularly in complex cases where immediate placement may pose higher risks.

Keyword: Dental Implants, immediate, delayed, aesthetic region, maxillary, anterior, anterior maxilla, Pink Esthetic Score, aesthetic score.

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INDEX OF ACRONYMS AND ABBREVIATIONS

CBCT	Radiographic Evaluation
DI/DIP	Delayed Implant Placement
EAO	European Association for Osseointegration
EP	Early Implant Placement
FDA	Food and Drug Administration
ICAI	The Implant Crown Aesthetic Index
II	Immediate Implant Placement
IIP	Immediate Implant Placement
IMARC	International Market Analysis Research and Consulting Group
ISQ	Implant Stability Quotient
JBI	Joanna Briggs Institute
MeSH	Medical Subject Headings
mm	Millimeter
mod-ICAI	Modified Implant Crown Aesthetic Index
NA	Not Applicable
OHIP	Oral Health Impact Profile
PES	Pink Esthetic Score
PES/WES	Pink Esthetic Score / White Esthetic Score
PICI	The Peri-Implant and Crown Index
PICO	Patient Intervention Control Outcome
PPI	The Papilla Presence Index
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
PROMs	Patient-Related Outcome Measures
RCT	Randomized Controlled Clinical Trial

SST	Socket Shield Technique
USA	United States of America
UTHSCSA	University of Texas Health Science Center at San Antonio
VA	Visual Analogue Scale
WES	White Esthetic Score

1. INTRODUCTION

It often happens that due to trauma or illness, tooth extraction is necessary, and implant placement may be a treatment option. The issue of being toothless has been a concern for humans for decades, this is why over the past 50 years, their use has multiplied and evolved on various levels (FDA, 2021).

Currently, the demand for implants is experiencing steady growth, while research and articles on the subject are also following this trend by increasing and multiplying. As demonstrated on the PubMed medical research site, the number of new results between 2013 and 2023 for research on "(implant) AND (dentistry)" amounts to 35,919, with a peak of 4,422 new articles in 2021. This significant increase in publications represents double the number recorded between 2003 and 2013, which was 19,567 (Elani et al., 2018).

It is reported by the European Association for Osseointegration (EAO) reports that between 5.5 and 6 million dental implants are placed every year in Europe, a high number indicating a robust and growing market. A recent study from the IMARC Group indicates that the European market for dental implants was worth $2.4 billion in 2022. It is projected to increase to $2.9 billion by 2028, demonstrating a consistent annual growth rate of 3.1% over the coming years (Kumar, 2024).

1.1. What is an Implant? Exploring the Evolution of History and Osteointegration

A dental implant serves as a non-natural root placed into the jawbone as treatment of both complete and partial edentulism. It provides an effective solution for tooth loss by replacing missing teeth with prosthetic ones, comprising an implant, an abutment, and an implant-supported prosthesis (FDA, 2021).

In the last fifty years, implant dentistry has evolved significantly, moving from an experimental technique to a widely trusted method for replacing missing teeth with implant-supported prostheses.

Implant placement is now a common treatment option in routine clinical practice for patients who are fully or partially missing teeth. Modern implant therapy provides substantial functional and biological benefits compared to traditional fixed or removable

prostheses, but it also shows impressive long-term results. Numerous studies over a decade have shown success and survival rates of over 95%, showing its effectiveness (FDA, 2021).

One of the major advancements in dental rehabilitation occurred fifty years ago when it became apparent that implants made from commercially pure titanium could form a stable attachment to bone through direct contact between the bone and the implant. Professor P. I. Brånemark pioneered clinical and preclinical studies in the 1960s at the University of Gothenburg in Sweden. He originated the term "osseointegration" to describe this phenomenon, a concept now widely embraced within the field (Buser et al., 2016).

As described in the article "Contemporary Concepts in Osseointegration of Dental Implants: A Review," osseointegration is a fundamental biological process necessary for the success of dental implants. This process achieves structural stability by the formation of a solid, lasting bond between the bone and the implant, effectively acting as a new root for the replaced tooth. This connection provides a solid foundation that mimics the natural stability of a tooth. (Pandey et al., 2022).

Additionally, osseointegration helps prevent bone resorption. It aids in maintaining the density and structure of the alveolar bone, thus preventing its degradation that could occur following tooth loss (Pandey et al., 2022).

Osseointegration also contributes to functional restoration. Osseo integrated implants restore the functionality of lost teeth, enhancing chewing ability, speech, stability, and comfort. These improvements significantly enhance the overall quality of life, offering a durable solution as implants are designed for long-term use (Pandey et al., 2022).

Thanks to osseointegration and to the evolution of implants technics the implant has become implants have become an essential treatment approach in dentistry, surpassing conventional fixed partial dentures in several aspects (Pandey et al., 2022).

There are numerous indications for the placement of implants: Total or partial edentulous patients to replace one or more missing teeth. Implants can also have esthetic indications to improve smile and face proportions by restoring the natural appearance of the smile.

Implants can stabilize existing complete dental prostheses that have a lack of stability and retention, improving it. Additionally, dental implants help prevent bone loss by stimulating the jawbone following tooth extraction (Gupta et al., 2023).

The success of implant placement is influenced by several factors, including the biocompatibility and both the macroscopic and microscopic characteristics of the implant material. The surgical technic chosen, and the skills of the operator also have a huge impact on protocols. Factors such as the uninterrupted healing period, the design of the prosthetic, and the long-term loading phase can also play a role. Success will consider factors such as the design and materials of the implants, their placement, the anatomy, expected load, and hygiene practices (Albrektsson et al., 1986).

Advantages of dental implants include: a remarkable success rate, achieving over 97% success over a decade. They effectively reduce the risk of cavities and root canal issues in teeth next to them and play a crucial role in maintaining the bone structure in areas without teeth. Additionally, they help lessen sensitivity in adjacent teeth (Gupta et al., 2023).

Implants serve not only a mechanical or physiological function; they play a very important role in aesthetic rehabilitation (Hirsch & Brisman.,1994).

1.2. Implant, Maxillary, and Esthetic Considerations

From an aesthetic standpoint, implants offer a more natural and appealing solution than traditional prosthetics, as they can be designed to closely mimic the appearance of natural teeth. The aesthetic aspect of dental implants has a very significant role in the overall experience of patients, directly impacting their satisfaction and psychological well-being. Indeed, a "pleasing" smile plays a major role in self-confidence, professional success, and human relationships (Forna & Agop-Forna, 2019).

Implants that combine functionality and a pleasant appearance enhance patient self-confidence and improve their social interactions. Indeed, the ability of implants to not only restore function but also the natural appearance of the smile has an important impact on patient quality of life. To ensure the success of dental rehabilitation, great care must be taken with the visual aspect of the implants, while considering patients' aesthetic expectations when planning treatments. It is very important to consider patients' perceptions of the aesthetic outcomes of implants. Moreover, if the anticipated aesthetics are suitable for the patient, this allows for better overall and personal acceptance of the treatment plan. This can also be a source of motivation to follow the dentist's recommendations and guidelines. Today, the perception of aesthetic outcomes is

considered a primary indicator of the success of a dental treatment (Duong et al., 2022).

As we have seen in dentistry, visual appearance has become very important for patients. This trend is particularly evident in the care of the upper front teeth, commonly referred to as the "esthetic zone" (Forna & Agop-Forna, 2019).

The esthetic zone in dentistry refers to the area of the mouth that shows when someone smiles, typically expanding from one canine to another in either the upper or lower jaw. Depending on how wide a person smiles, this zone might also include the first or second premolars (Ghahroudi et al., 2015).

Placing implants in the maxilla presents challenges compared to those in the mandible for various reasons. First, the anterior region of the maxilla, which is highly visible during smiling, speaking, and daily activities, requires extreme precision due to high aesthetic expectations. Treatments performed in this area thus necessitate great precision and meticulous planning. Imperfections are less tolerated (Ghahroudi et al., 2015).

1.3. Definition of Key Concepts: Timings of Implant Placements

After exploring the crucial importance of dental aesthetics and the significant role of dental implants in the functional and aesthetic restoration of teeth, it becomes essential to delve deeper into the complexities inherent in their placement. While the selection of dental implants might seem optimal on paper, the clinical reality raises complex issues, particularly regarding the ideal timing for implantation. The debate between immediate and delayed implant placement poses specific challenges, directly impacting the aesthetic and functional outcomes. This transition naturally leads us to address the central issue of this study, which seeks to evaluate and compare these two approaches considering their aesthetic and clinical implications.

In dental implantology, the timing of implant placement is crucial and can be categorized into three main approaches based on the post-extraction delay. Immediate Implant Placement (II) involves installing implants directly into the socket just after tooth extraction. This method is favoured for its ability to preserve bone and gingival structures while reducing the overall duration of treatment (Donos et al., 2021).

Early Implant Placement (EP) is another method where the implant is placed after the initial phase of soft tissue healing, typically between 10 days and 8 weeks after extraction,

or after some degree of bone healing, between 12 and 16 weeks. This delay allows the soft tissues to stabilize while providing a more predictable environment for implant integration compared to immediate placement (Donos et al., 2021).

Finally, Delayed Implant Placement (DI) occurs after the site has fully healed, typically between 3 and 6 months after tooth extraction. This delayed approach is often considered when extensive bone grafting is needed or if the clinician prefers to work with fully healed bone, thus ensuring the most stable and predictable result for the implant (Donos et al., 2021).

Each of these strategies has its indications and advantages, depending on the clinical scenario and specific patient factors, including the need for aesthetic optimization, the condition of the extraction site, and patient preferences (Donos et al., 2021).

According to Donos et al. (2021), the survival rate for immediate implant placement is 96.2% and 98.3% for delayed implant placement. Therefore, there is a slight but not significant difference between the two types of placements. Therefore, we will consider the difference in aesthetics between the two methods (Donos et al., 2021).

1.4. Definition of Key Concepts: Aesthetics Scores

There are various ways to compare aesthetic outcomes in implant placement: through metric parameters, aesthetic indices, or patient satisfaction.

Patient satisfaction, although crucial, is not a completely objective method for evaluating outcomes in dental implantology. A systematic study published in "Health and Quality of Life Outcomes" highlights that patient expectations and satisfaction are influenced by subjective factors, making these measures less reliable for objective clinical evaluation (Yao et al., 2014).

Additionally, another study published in "BMC Oral Health" examined patient satisfaction and quality of life related to oral health, concluding that methods based on patient satisfaction should not be the only indicators used to assess the success of implant treatments (Wang et al., 2021).

These studies indicate that it is essential to use additional objective measures, such as metric parameters or aesthetic indices, to ensure that clinical decisions are based on reliable data and not solely on the subjective perceptions of patients (Wang et al., 2021).

They are five main metric parameters: papilla height, linear changes in soft tissue level, color assessment, soft tissue thickness, and profilometric changes in soft tissues. These are recorded by several methods including intra-oral registrations, radiographic assessments, digital analyses, and ultrasonic assessments (Cosyn et al., 2021).

The main aesthetic indices include the Pink Esthetic Score (PES), the Papilla Presence Index (PPI), the Peri-Implant and Crown Index (PICI), the PES/White Esthetic Score (PES/WES), the Implant Crown Aesthetic Index (ICAI), and a modified version of the ICAI (mod-ICAI) index.

The PES/WES (Pink Esthetic Score/White Esthetic Score) remains the most widely accepted tool (Afrashtehfar et al., 2021).

In the PES Score they are seven features including the mesial and distal papillae, soft-tissue level and contour, alveolar process deficiency, and the color and texture of the soft tissue. These features were rated using a scale from 0 to 2, where 0 is the lowest score and 2 the highest, making the highest possible total PES 14. The mesial and distal papillae are directly evaluated (considered if they are fully, partially formed or completely missing) For all the other parameters, the assessment involved comparing them to a reference tooth, which could be the corresponding tooth in the anterior section or an adjacent tooth in the premolar area (Fürhauser et al., 2005).

The maximum possible score for the PES is 14 points, which indicates perfect aesthetic integration. A lower score indicates aesthetic deficits in the soft tissues around the implant (Genetti et al., 2022).

The PES Score offers a standardized and objective method for assessing the aesthetics of dental implants, which enhances communication among healthcare professionals and allows for consistent tracking of aesthetic improvements. This tool is essential for identifying areas that could benefit from improvements and for refining treatment protocols to maximize aesthetic outcomes.

In conclusion, the PES Score is an indispensable clinical tool for assessing and enhancing the aesthetics around dental implants, thereby ensuring results that meet patient expectations both aesthetically and functionally (Fürhauser et al., 2005).

1.5. Literature review

The objective of this systematic review is to analyse and compare the aesthetic outcomes of implants placed immediately versus those placed in a delayed manner in the anterior region of the maxilla, a highly visible area crucial for smile aesthetics. While numerous studies address the aesthetic performance of implants in general, specific literature on outcomes in the anterior maxillary sector (for immediate vs delayed) remains insufficient.

There are systematic reviews comparing early implant placement with delayed implant placement in the aesthetic zone (Asghar et al., 2023) and others comparing delayed implant placement with early implant placement but not exclusively in the aesthetic sector (Carosi et al., 2023). This lack of data limits clinicians' ability to make informed decisions, so it can help optimizing aesthetic outcomes for the patients concerned. Therefore, there is a need for research focused specifically on the maxillary aesthetic zone. The lack of data is notable because the aesthetic challenges and requirements of this area are particularly complex.

This study aims to collect and synthesize all available data on the topic to identify trends, similarities, and differences in aesthetic outcomes between two implant placement approaches. It will systematically measure and quantify the aesthetics of soft tissues around dental implants using the PES. In doing so, it will address a critical question: What are the aesthetic outcomes of immediate dental implants compared to delayed implants in the anterior maxillary region? Which technique achieves the best results? What are the short-term and long-term impacts?

Additionally, the analysis of this systematic review will include a methodical evaluation of the included studies, examining the quality of the research and identifying potential biases. This will help to distinguish consistent clinical recommendations from less authenticated conjectures. The findings will be used to develop clear clinical guidelines, thereby increasing the likelihood of aesthetic success for implantation procedures in the anterior region of the maxilla. This work could also assist patients seeking information or making decisions regarding their implant placement treatment plan.

Additionally, this research may suggest future research axes, leading to new advancements in the field of aesthetic implantology.

In conclusion, this systematic review will provide a significant contribution to the dental literature by validating or challenging current practices, facilitating a better understanding

of aesthetic dynamics related to different implant placement techniques, and ultimately improving outcomes for patients in a critical area for dental aesthetics.

1.6. Methodology

1.6.1. Eligibility Criteria

According to the PICO strategy, the following criteria were considered with the specific objective to compare clinical outcomes between delayed and immediate implant placement in the esthetic zone.

Population: All included patients were healthy adult men and women needing at least one post-extraction implant in the maxilla aesthetic zone and had good motivation for oral hygiene.

Intervention: Immediate or delayed implant placement in the maxilla aesthetic zone.

Comparison: Delayed implant placement versus Immediate implant placement in the maxilla aesthetic zone.

Results: The results will include Clinical performances (implant survival rate) a comparison of the PES, aesthetic outcomes between the two types of implant placement, complications, and recommendations for the patient and the dentist.

The types of studies in this review are randomized clinical trials, trials only addressing anterior maxillary regions and trials with PES evaluation.

Thanks to the PICO system, the problem was formulated as follows: Has immediate implant placement (Intervention) shown a similar success rate in terms of clinical performances, aesthetic outcomes, PES (Results) as delayed implant placement (Comparison) in healthy adult patients requiring single-tooth replacement in the maxilla aesthetic zone (Population)?

Table 1

PICO strategy used to assess the scientific evidence on the comparison between immediate and delayed implant placement in the maxilla aesthetic zone.

PICO Criteria	Evaluation
Population	Healthy adult male and female patients requiring at least one post-extraction implant in the aesthetic area.
Intervention	Immediate implant placement in the maxilla aesthetic zone.
Comparison	Delayed implant placement in the maxilla aesthetic zone.
Outcome	The results will include implant survival rate, a comparison of the PES, aesthetic outcomes between the two types of implant placement, complications, and recommendations for the patient and the dentist.

1.6.2. Inclusion and exclusion criteria

Were included in this study: Randomized controlled trials (RCTs) of implants using an immediate or a delayed loading in the anterior maxilla, including objective aesthetic outcomes, protocols information, surgical procedures, PES evaluation, trials published between 2014 and 2023.

Excluded studies included non-English publications, non-randomized clinical trials, systematic reviews, in-vitro or animal studies, non-comparative trials, trials addressing areas other than the anterior maxillary region, and trials without PES evaluation. Trials without follow-up.

1.6.3. Search Strategy

For the elaboration of this systematic review, we used the PICO criteria (Population, Intervention, Comparison, Outcome), with the aim of formulating the question this work intends to answer (cf. Table 1).

To carry out this systematic review, electronic searches from 2014 to 2023 were performed. The following electronic databases were utilised: PubMed, Wiley Online Library, and the Cochrane Library databases.

The digital search methodology employed a mix of the following keywords and mesh (Medical Subject Headings) terms to conduct a precise and concise search: The term “Immediate” for Immediate implant loading and the term “delayed” for delayed implant loading. Terms: “esthetic region”, “maxillary”, anterior”, “esthetic”, “anterior maxilla” for the localization. And finally, the term “implant”.

The bibliographic references of all eligible articles were checked for other relevant studies and articles that were not fully available for reading were excluded.

Table 2

The digital search methodology

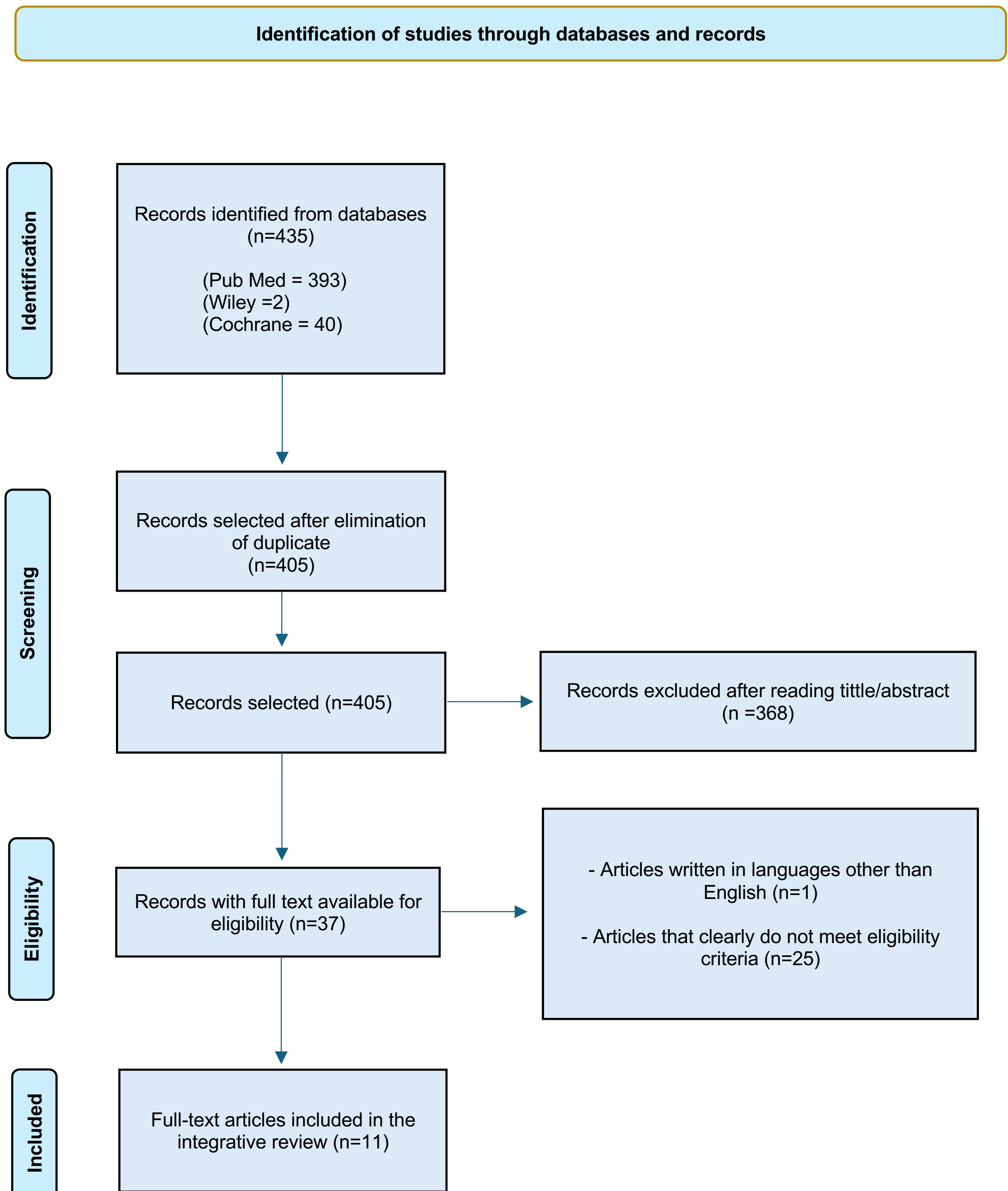
Data Base	Search Terms	Number of Results
PubMed	((immediate) OR (delayed)) AND ((esthetic region) OR (maxillary) OR (anterior) OR (esthetic) OR (anterior maxilla)) AND (implant)	393
Wiley Online Library	“implant" in Title "anterior maxilla" in Title and "immediate" in Title and "delayed" in Title	2
Cochrane	“Implant” “maxilla” “immediate” “delayed” “randomized” all searched in Title	40
Total		435

1.6.4. Selection of Articles

The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) guidelines were followed throughout the article selection process. In the preliminary literature search conducted in the electronic databases PubMed, Wiley Online Library and Cochrane Library, 395 articles were identified (cf. Table 2).

Figure 1

The PRISMA guidelines article selection process



The initial electronic search across three databases gave a total of 435 references. After removing 30 duplicates, 405 potential references remained.

368 records have been excluded after reading the tittle or the abstract. resulting in 37 references being included for full-text evaluation. Subsequently, 14 articles were included, and 23 were excluded based on the selection criteria.

1.6.5. Risk of Bias (Methodological Critical Appraisal)

Scientific studies can sometimes be biased, which can modify results and affect the accuracy of conclusions. This bias can appear at any stage, from the study's design to the publication of results. It can happen because of mistakes in choosing participants, inaccurate measurements, or uncontrolled outside influences. To get trustworthy results, it's important to use strict methods, be transparent at every step, and take steps to reduce possible biases. Paying attention to these details helps ensure that scientific findings are reliable and credible.

This is why here we have used tools from the Joanna Briggs Institute (JBI) to evaluate our systematic review and examine each of the selected studies (bias during its design, execution, and analysis).

The JBI, located at the University of Adelaide in Australia, is an international organization focused on research and development in healthcare. Their main goal is to promote and support evidence-based healthcare. To help make informed clinical decisions, the JBI has created theories, methods, and processes for carefully evaluating and summarizing evidence.

JBI's risk analysis covers many areas, such as how effective a treatment is, qualitative studies, how common or frequent conditions are, causes and risks, economic evaluations, and the accuracy of diagnostic tests. (« JBI Manual For Evidence Synthesis », 2020)

However, there are some limitations. The evaluation can be subjective, leading to varying scores. The tool focuses on methodological quality. Some risk categories might not be relevant to all reviews, which can waste time and resources.

Overall, JBI’s risk analysis is valuable for assessing studies in systematic reviews, but it's important to understand its strengths and limitations to interpret results accurately. A good systematic review should critically evaluate evidence and integrate results to make

solid conclusions.

Each selected article for inclusion undergoes an evaluation, and their conclusions guide the synthesis and interpretation of the results. The JBI is composed of a checklist of 11 questions with 4 types of answer: “yes”, “no”, “unclear” and “not applicable (NA)” in some circumstances. Answering these questions will help us to ensure the quality and reliability of the studies, supporting evidence-based clinical practices.

1. Is the review question clearly and explicitly stated?
2. Were the inclusion criteria appropriate for the review question?
3. Was the search strategy appropriate?
4. Were the sources and resources used to search for studies adequate?
5. Were the criteria for appraising studies appropriate?
6. Was critical appraisal conducted by two or more reviewers independently?
7. Were there methods to minimize errors in data extraction?
8. Were the methods used to combine studies appropriate?
9. Was the likelihood of publication bias assessed?
10. Were recommendations for policy and/or practice supported by the reported data?
11. Were the specific directives for new research appropriate?

Here is the summary table of the risk of bias analysis for our selected articles (cf. Table 3).

Table 3

The risk of bias analysis for our selected articles

Authors	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Results
Tonetti et al. (2017)	Yes	Yes	Yes	Yes	Yes	Unclear	Yes	NA	NA	Yes	Yes	Low Risk of Bias
Chen et al. (2022)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Hof et al. (2014)	Yes	Yes	Yes	Yes	Yes	Unclear	NA	NA	NA	Yes	Yes	Low Risk of Bias
Santhanakrishnan et al. (2021)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Santhanakrishnan, Subramanian et al. (2021)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Esposito et al. (2015)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Felice et al. (2015)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Huynh-Ba et al. (2019)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Gjelvold et al. (2017)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Slagter et al. (2021)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias
Cardaropoli et al. (2022)	Yes	Yes	Yes	Yes	Yes	NA	NA	NA	NA	Yes	Yes	Low Risk of Bias

As we can see into the table the answer is often NA because our chosen studies are single studies, RCT. They are not systematic reviews or meta-analysis that would require critical appraisal by multiple reviewers and does not involve searching for other studies.

But overall, the risk of bias is low.

2. RESULTS

3.1. Tonetti et al. (2017)

In the study " Immediate versus delayed implant placement after anterior single tooth extraction: the timing randomized controlled clinical trial" by Tonetti et al. (2017), a randomized controlled trial (RCT) of 124 patients was conducted at ERGO Perio Clinical Research support infrastructure in Genova, Italy. Patients were recruited from 7 private practices. The average age of the treated patients was 52.5 ± 13.5 years, with 84 females and 40 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

The aim of this study was to determine the efficacy of immediate implantation (II) and delayed implantation (DI) for single-tooth restoration of maxillary anterior teeth.

In the study, 124 patients received implants in the maxillary anterior teeth. Out of these, 62 underwent immediate implantation, and 62 underwent delayed implantation. The implants used were SPI Contact (Thommen Medical AG, Waldenburg, Suisse). The success rate of implant placement was 99%, and the failure rate was 1% (1 lost in the II group).

They were 26.1% of complications in the II group and 5.3% in the DI group. They were due to wound failure. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used aesthetic indices (PES) and WES, clinical outcomes, clinical performance assessed through probing depth and radiographic evaluation. The follow-up was at 1 week, 2 weeks, 6 weeks, 12 weeks, then periodic follow-up at 12, 24, and 36 months. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Tonetti et al. (2017) observed PES scores: 7 for II group and 8 for DI group at 12 months. Inadequate PES was obtained in 19% of delayed implant cases and in 42% of immediate implant cases.

No changes in recession of the gingival margin were observed, or the width of the facial

band of keratinized tissue that remained stable.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.2. Chen et al. (2022)

In the study "Immediate versus Delayed Implantation for Single-Tooth Restoration of Maxillary Anterior Teeth: A Comparative Analysis on Efficacy" by Chen et al. (2022), a randomized controlled trial (RCT) of 80 patients was conducted at Suzhou Kowloon Hospital in China. The average age of the treated patients was 33.60 ± 9.70 years, with 28 females and 52 males participating. The aim of this study was to determine the efficacy of immediate implantation (II) and delayed implantation (DI) for single-tooth restoration of maxillary anterior teeth. The demographics of the study and the clinical settings are detailed in Annex A.

In the study, 80 patients received implants in the maxillary anterior teeth. Out of these, 42 underwent II, and 38 underwent DI. The implants used were Certain Implant from Biomet 3i. The success rate of implant placement was 96.18%, and the failure rate was 3.82%. The study noted high success rates for both implant timings, with only a marginal difference between the two groups. There was no bone augmentation in this study.

There were 10 complications reported in total (5 in the II group, 5 in the DI group), with complications being similar between the two groups and showing no significant difference ($P > 0.05$). For the II group, complications included 2 cases of gingival margin recession, 1 case of peri-implant inflammation, 2 cases of metal exposure, and no infections. For the DI group, there were 2 cases of gingival margin recession, 1 case of peri-implant inflammation, 1 case of metal exposure, and 1 infection. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used subjective satisfaction (Visual Analogue Scale (VAS)), aesthetic effect after anterior teeth trauma restoration (PES), aesthetics of dental hard tissue (WES), pocket depth assessed by pure titanium periodontal probe, implant stability (Implant Stability Quotient (ISQ)), and oral health-related quality of life (Oral Health Impact Profile- (OHIP-14) were evaluated. The follow-up was Every 6 months up to 2 years. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Chen et al. (2022) noted for the PES scores progressing from 7,3 DI and 8,125 II at 3 months, to 8,5 DI and 10,5 II at 6 months, reaching 10 for DI and 11.4 for II at 12 months.

For gingival recession and the papilla index, there are no numerical results in the study. The authors have noted peri-implant inflammation, metal exposure, and infection in both groups, with no significant differences (P > 0.05).

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.3. Hof et al. (2014)

In the study "Does Timing of Implant Placement Affect Implant Therapy Outcome in the Aesthetic Zone? A Clinical, Radiological, Aesthetic, and Patient-Based Evaluation" by Hof et al. (2014) a randomized controlled trial (RCT) of 153 patients was conducted in universities and clinics Austria. The average age of the treated patients was 37 ± 17 years, with 80 females and 73 males participating. The study evaluates five distinct protocols for implant treatment in the anterior maxilla, covering various timing strategies such as immediate, early, and delayed implantation. Additionally, it assesses implant placement alongside simultaneous guided bone regeneration and implant placement three months after horizontal autologous bone block grafting. The part of the study that interests us is to determine the efficacy of immediate implantation (II) and delayed implantation (DI) for single-tooth restoration of maxillary anterior teeth.

In the study, 153 patients received implants in the maxillary anterior teeth. Out of these, 26 underwent immediate implantation, and 13 underwent delayed implantation. The implants used were Brånemark® MK-III and Nobel Replace TM Tapered, Nobel Biocare®, Gotebörg, Sweden. The demographics of the study and the clinical settings are detailed in Annex A.

The article does not provide explicit percentages for implant failure and success.

Gingival margin recession, peri-implant inflammation, metal exposure, and infection were observed in both groups with no significant difference (P > 0.05). The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used subjective satisfaction (Visual Analogue Scale (VAS)), aesthetic index (PES, aesthetics of dental hard tissue (WES) Papilla Index (PI) and Subjective Esthetic Score (SES). The follow-up was Every 6 months up to 2 years. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Hof et al. (2014) measured PES at 56 months for immediate implants and at 58 months for delayed, each scoring 11.

The authors have found no significant differences in midfacial recession between the two implant protocols (p = 0.266). The papilla index measurements were 2 for the II group at 56 months and 2,5 for the DI group at 58 months.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.4. Santhanakrishnan et al. (2021)

In the study " Variations in Soft and Hard Tissues following Immediate Implant Placement versus Delayed Implant Placement following Socket Preservation in the Maxillary Esthetic Region: A Randomized Controlled Clinical Trial" by Santhanakrishnan et al. (2021) a randomized controlled trial (RCT) of 50 patients was conducted at Outpatient Department of Periodontology and Implantology, Sri Ramachandra Dental College and Hospital, Chennai in India. The average age of the treated patients was 30.3 ± 8.1 years, with 26 females and 24 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

The aim of this study was to determine the efficacy of immediate implantation (II) and delayed implantation (DI) for single-tooth restoration of maxillary anterior teeth.

In the study, 50 patients received implants in the maxillary anterior teeth. Out of these, 25 underwent immediate implantation, and 25 underwent delayed implantation. The implants used were Nobel Biocare®. The success rate of implant placement was 100%, and the failure rate was 0%.

No major mechanical or biological complication was reported during the study period. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used patient-related outcome measures (PROMs)

using visual analogue scale (VAS), radiographic evaluation (CBCT), and aesthetic index (PES). The follow-up was at 3 months and 6 months post-surgery. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Santhanakrishnan et al. (2021) observed PES scores improving over time from: 11.4 ± 1.2 for II group and 10.8 ± 1.4 for DI group at 3 months, to 12.1 ± 1.3 for II group and 11.0 ± 1.5 for DI group at 6 months.

They have reported gingival recession of 0.4 ± 0.2 mm at 3 months and 0.3 ± 0.2 mm at 6 months for the II group: 0.5 ± 0.3 mm at 3 months and 0.4 ± 0.3 mm at 6 months for the DI group. The papilla index was 2.5 ± 0.6 at 3 months, rising to 2.7 ± 0.5 at 6 months for the II group, and 2.3 ± 0.7 rising to 2.4 ± 0.6 for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.5. Santhanakrishnan, Subramanian et al. (2021)

In the study " Radiographic and Esthetic Evaluation Following Immediate Implant Placement with or without Socket Shield and Delayed Implant Placement Following Socket Preservation in the Maxillary Esthetic Region – A Randomized Controlled Clinical Trial" by Santhanakrishnan, Subramanian et al. (2021) a randomized controlled trial (RCT) of 75 patients was conducted at Outpatient Department of Faculty of Dental Sciences, Sri Ramachandra Institute of Higher Education and Research, Chenna in India.The average age of the treated patients was 30.4 ± 7.5 years, with 41 females and 34 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to evaluate alterations in soft and hard tissues within the maxillary aesthetic zone following different implant placement strategies. These included immediate implant placement (IIP) both with and without the socket shield technique (SST), as well as delayed implant placement (DIP) four months after socket preservation. The part of the study that interests us is to determine the efficacy of immediate implantation (II) and delayed implantation (DI) for single-tooth restoration of maxillary

anterior teeth.

In the study, 75 patients received implants in the maxillary anterior teeth. Out of these, 25 underwent immediate implantation, and 25 underwent delayed implantation. The implants used were Osstem® GS III. The success rate of implant placement was 100%, and the failure rate was 0%.

No major mechanical or biological complication was reported during the study period. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used patient-related outcome measures (PROMs) using visual analogue scale (VAS), radiographic evaluation (CBCT), and aesthetic indices (PES).

In our case, we are interested in the results of the PES, gingival recession, and the papilla index. The follow-up was at 3 months and 6 months post-surgery. The implant interventions and follow-up period are available in Annex B.

Santhanakrishnan, Subramanian et al. (2021) observed PES scores improving over time from: 10.5 ± 1.3 for II group and 9.8 ± 1.4 for DI group at 3 months, to 11.2±2.1for II group and 10.2±1.4 for DI group at 6 months.

They have reported gingival recession of 0.3 ± 0.2 mm at 3 months, 0.2 ± 0.2 mm at 6 months at 6 months for the II group: 0.4 ± 0.3 mm at 3 months, 0.3 ± 0.2 mm at 6 months for the DI group. The papilla index was 2.6 ± 0.5 at 3 months, rising to 2.8 ± 0.4 at 6 months for the II group, and 2.3 ± 0.6 rising to 2.5 ± 0.5 for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.6. Esposito et al. (2015)

In the study " Immediate loading of post-extractive versus delayed placed single implants in the anterior maxilla: outcome of a pragmatic multicenter randomized controlled trial 1-year after loading” by Esposito et al. (2015) a randomized controlled trial (RCT) of 106 patients was conducted in different private practices in Italy.The average age of the treated patients was 49 ± 11 years, with 54 females and 46 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of immediate implant placement (II) and delayed implant placement (DI) for single-tooth restoration of maxillary anterior teeth.

In the study, 106 patients received implants in the maxillary anterior teeth. Out of these, 54 underwent immediate implantation, and 52 underwent delayed implantation. The implants used were NobelActive, Nobel Biocare.

The success rate of implant placement was 98% for II group and 96% for DI group. The failure rate was 2% for II group and 4% for DI group.

There were 5 complications reported in total (2 in II group, 3 in DI group): for the II group: 2 patients with peri-implantitis and for the DI group: 3 patients with peri-implantitis. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used PES, changes in peri-implant marginal bone levels, and patient satisfaction, all of which were recorded by independent evaluators.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index. The follow-up was at 6 months and 12 months post-surgery. The implant interventions and follow-up period are available in Annex B.

Esposito et al. (2015) observed PES scores improving over time from: 11.4 ± 1.2 for II group and 10.8 ± 1.4 for DI group at 6 months, to 12.1 ± 1.3 for II group and 11.0 ± 1.5for DI group at 12 months.

They have reported gingival recession of 0.3 ± 0.2 mm at 6 months, 0.2 ± 0.2 mm at 12 months for the II group; 0.4 ± 0.3 mm at 6 months, 0.3 ± 0.2 mm at 12 months for the DI group. The papilla index was 2.6 ± 0.5 at 6 months, 2.8 ± 0.4 at 12 months for the II group, and 2.3 ± 0.6 at 6 months, 2.5 ± 0.5 at 12 months for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.7. Felice et al. (2015)

In the study “Immediate non-occlusal loading of immediate post-extractive versus delayed placement of single implants in preserved sockets of the anterior maxilla: 1-year post-loading outcome of a randomized controlled trial” by Felice et al. (2015) a randomized controlled trial (RCT) of 50 patients was conducted in different private

practices in Italy.The average age of the treated patients was 52.2 ± 13.5 years, with 25 females and 25 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of II and DI for single-tooth restoration of maxillary anterior teeth.

In the study, 50 patients received implants in the maxillary anterior teeth. Out of these, 25 underwent immediate implantation, and 25 underwent delayed implantation. The implants used were NobelActive, Nobel Biocare.

The success rate of implant placement was 96% for II group and 92% for DI group. The failure rate was 4% for II group and 8% for DI group.

There were 7 complications reported in total (3 in II group, 4 in DI group); for the II group: 3 patients with peri-implantitis and for the DI group: 4 patients with peri-implantitis. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used PES, changes in peri-implant marginal bone levels, and patient satisfaction, all of which were recorded by independent evaluators. The follow-up was at 6 months and 12 months post-surgery. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Felice et al. (2015) observed PES for II group: 11.5 ± 1.3 at baseline and for DI group: 10.9 ± 1.4 at baseline.

They have also measured PES scores improving over time from: 11.8 ± 1.4 for II group and 11.0 ± 1.3 for DI group at 6 months, to 12.1 ± 1.5 for II group and 11.2 ± 1.4 for DI group at 12 months.

They have reported gingival recession of 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months for the II group; 0.3 ± 0.3 mm at baseline, 0.3 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months for the DI group.

The papilla index was 2.7 ± 0.5 at baseline, 2.8 ± 0.4 at 6 months, 2.9 ± 0.4 at 12 months for the II group, and 2.5 ± 0.6 at baseline, 2.6 ± 0.5 at 6 months, 2.7 ± 0.5 at 12 months for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.8. Huynh-Ba et al. (2019)

In the study "Esthetic, clinical, and radiographic outcomes of two surgical approaches for single implant in the esthetic area: 1-year results of a randomized controlled trial with parallel design" by Huynh-Ba et al. (2019) a randomized controlled trial (RCT) of 50 patients was conducted in The University of Texas Health Science Center at San Antonio (UTHSCSA) Graduate Periodontics Clinic in the USA. 35 patients completed the one-year examination. The average age of the treated patients was 52.5 ± 13.5 years, with 17 females and 18 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of II and DI for single-tooth restoration of maxillary anterior teeth.

In the study, 44 patients received implants in the maxillary anterior teeth. Out of these, 22 underwent immediate implantation, and 22 underwent delayed implantation. The implants used were NobelActive, Nobel Biocare.

The success rate of implant placement was 96% and the failure rate was 4%.

There were 7 complications reported in total (3 in II group, 4 in DI group); for the II group: 3 patients with peri-implantitis and for the DI group: 4 patients with peri-implantitis. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used PES and WES, clinical performance assessed through probing depth, modified plaque index, and sulcus bleeding index, radiographic bone level measurements, and patient satisfaction determined using visual analogue scales (VAS). The follow-up was at 6 months and 12 months post-surgery. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Huynh-Ba et al. (2019) observed PES for II group: 11.6 ± 1.3 at baseline and for DI group: 10.8 ± 1.5 at baseline.

They have also measured PES scores improving over time from: 11.9 ± 1.4 for II group and 11.1 ± 1.4 for DI group at 6 months, to 12.2 ± 1.5 for II group and 11.3 ± 1.5 for DI group at 12 months.

They have reported gingival recession of 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months for the II group; 0.3 ± 0.3 mm at baseline, 0.3 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months for the DI group.

The papilla index was 2.6 ± 0.5 at baseline, 2.8 ± 0.4 at 6 months, 2.9 ± 0.4 at 12 months for the II group, and 2.4 ± 0.6 at baseline, 2.6 ± 0.5 at 6 months, 2.7 ± 0.5 at 12 months for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.9. Gjelvold et al. (2017)

In the study “Clinical and radiographic outcome following immediate loading and delayed loading of single-tooth implants: Randomized clinical trial” by Gjelvold et al. (2017) a randomized controlled trial (RCT) of 50 patients was conducted in the Centre of Dental Spe- cialist Care, Malmö in the USA.The average age of the treated patients was 40.9 ± 14.4 years, with 30 females and 20 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of II and DI for single-tooth restoration of maxillary anterior teeth.

In the study, 50 patients received implants in the maxillary anterior teeth. Out of these, 25 underwent immediate implantation, and 25 underwent delayed implantation. The implants used were NobelActive, Nobel Biocare.

The success rate of implant placement was 96% for II group and 92% for DI group. The failure rate was 4% for II group and 8% for DI group.

There were 7 complications reported in total (3 in II group, 4 in DI group); for the II group: 3 patients with peri-implantitis and for the DI group: 4 patients with peri-implantitis. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used aesthetic indices (PES) and WES, implant

survival, marginal bone level, soft tissues changes, papillae index and oral health impact profile (OHiP-14). The follow-up was at 3, 6, and 12 months post-definitive crown placement. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Gjelvold et al. (2017) measured PES scores improving over time from: 9.32 ± 2.14 for II group and 10.08 ± 2.52 for DI group at 3 months, to 9.75 ± 2.36 for II group and 10.33 ± 2.68 for DI group at 6 months, and PES finally reaching 10.36 ± 2.46 for II group and 10.67 ± 2.32 for DI group at 12 months.

They have reported gingival recession of 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months for the II group: 0.3 ± 0.3 mm at baseline, 0.4 ± 0.3 mm at 6 months, 0.5 ± 0.3 mm at 12 months for the DI group.

The papilla index was: 0.77 ± 0.71 mm at 12 months for the II group, and 0.60 ± 0.74 mm at 12 months for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.10. Slagter et al. (2021)

In the study "Immediate single-tooth implant placement with simultaneous bone augmentation versus delayed implant placement after alveolar ridge preservation in bony defect sites in the esthetic region: A 5-year randomized controlled trial" by Slagter et al. (2021) a randomized controlled trial (RCT) of 40 patients that was conducted at: Department of Oral and Maxillofacial Surgery, Department of Implant Dentistry who are both at the University Medical Center Groningen in The Netherlands.The average age of the treated patients was 46.5 ± 15 years.The number of males and females is not specified. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of II and DI for single-tooth restoration of maxillary anterior teeth.

In the study, 40 patients received implants in the maxillary anterior teeth. Out of these, 20 underwent immediate implantation, and 20 underwent delayed implantation. The implants used were NobelActive, Nobel Biocare.

The success rate of implant placement was 95% for II group and 90% for DI group. The failure rate was 5% for II group and 10% for DI group.

There were 5 complications reported in total (2 in II group, 3 in DI group); for the II group: 2 patients with peri-implantitis and for the DI group: 3 patients with peri-implantitis. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used aesthetic indices ((PES) and (WES)), papilla index, clinical outcomes, marginal bone level, clinical performance assessed through probing depth, patient's satisfaction. The follow-up was at 6 months, 12 months, and annually up to 5 years post-surgery. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Slagter et al. (2021) observed PES for II group: 7.00(2.05) at baseline and for DI group: 6.90(1.32) at baseline.

They have also measured PES scores improving over time from: 12.0 ± 1.3for II group and 11.0 ± 1.5 for DI group at 6 months, to 12.2 ± 1.4 for II group and 11.2 ± 1.6for DI group at 12 months. Scores finally have reached 12.5 ± 1.5 for the II group and 11.5 ± 1.7 for the DI group after 5 years.

They have reported gingival recession of 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months, 0.4 ± 0.3 mm at 5 years for the II group: 0.3 ± 0.3 mm at baseline, 0.4 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months, 0.5 ± 0.4 mm at 5 years for the DI group.

The papilla index was: 2.6 ± 0.5 at baseline, 2.7 ± 0.4 at 6 months, 2.8 ± 0.4 at 12 months, 2.9 ± 0.3 at 5 years for the II group, and: 2.4 ± 0.6 at baseline, 2.5 ± 0.5 at 6 months, 2.6 ± 0.5 at 12 months, 2.7 ± 0.4 at 5 years for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3.11. Cardaropoli et al. (2022)

In the study "Bone and Soft Tissue Modifications in Immediate Implants Versus Delayed

Implants Inserted Following Alveolar Ridge Preservation: A Randomized Controlled Clinical Trial. Part I: Esthetic Outcomes” by Cardaropoli et al. (2022) a randomized controlled trial (RCT) of 48 patients that was conducted in a private periodontal practice in Torino, Italy. The average age of the treated patients was 55.15 ± 13.98 years, with 26 females and 22 males participating. The demographics of the study and the clinical settings are detailed in Annex A.

This research goal is to determine the efficacy of II and DI for single-tooth restoration of maxillary anterior teeth.

In the study, 48 patients received implants in the maxillary anterior teeth. Out of these, 24 underwent immediate implantation, and 24 underwent delayed implantation. The implants used were Bone Level Tapered SLAactive, Straumann.

The success rate of implant placement was 100% and the failure rate was 0%.

No major mechanical or biological complication was registered during the study period. The details and causes of the complications are summarized in Annex C.

To evaluate the results, the authors used aesthetic indices (PES), papilla index, clinical outcomes soft tissue horizontal width, mesial and distal papillary levels and midfacial gingival level. The follow-up was at baseline and 1-year post-extraction. The implant interventions and follow-up period are available in Annex B.

In our case, we are interested in the results of the PES, gingival recession, and the papilla index.

Cardaropoli et al. (2022) observed PES for II group: 11.00 at baseline and for DI group: 10.63 at baseline.

They have also measured PES scores reaching 10.92 for the II group and 10.79 for DI group at 12 months.

They have reported gingival recession of 7.70 ± 0.60 mm at baseline, 7.81 ± 0.51 mm at 1 year for the II group: 8,1 ± 0.62 mm at baseline (T0), 7.83 ± 0.65 mm at 1 year for the DI group.

A summary table of PES scores is available in Annex D, along with a summary of gingival recession and papilla index in Annex E.

3. DISCUSSION

4.1. Success and complication rates

We can note from the studies reviewed that the success rates for both DI and II protocols are comparable and generally above 90% (with an overall average of 98.53%). These high success rates indicate that both immediate and delayed placements are viable options for implant therapy in the maxillary aesthetic zone. Immediate placements generally showed slightly higher success rates, although the differences were not always statistically significant.

In the studies, the complication rates for both immediate and delayed implant placements are generally low. Tonetti et al. (2017) is the only study with more II complications than DI. Delayed implant placements tend to show a slightly higher incidence of complications in some cases, but these differences are not consistent across all studies. Peri-implantitis is the most common issue reported across studies. Peri-implantitis refers to the formation of an infection around the dental implant. It is an infection caused by bacteria that develops around dental implants and, if left untreated, can become a serious condition leading to the loss of the implant. This infection can be caused by various factors, such as lack of post-operative care, inadequate periodontal therapy, improper implant placement, or inconsistent follow-up. However, we have a deficiency of sufficient data in our studies to precisely determine the causes of infection (Roccuzzo et al., 2023).

The total number of implants reported in these studies reaches 820, with a varied incidence of complications and success rates. Immediate placements generally showed a slightly higher success rate, but this comes with the caveat of increased aesthetic risk in some cases. The findings suggest that both techniques can be successfully implemented with careful case selection and meticulous surgical technique.

The similar complication rates underscore the importance of personalized treatment planning to optimize outcomes and minimize risks for each patient.

4.2. Clinical and aesthetic outcomes

From the review, it is evident that both immediate and delayed implant placements have their respective merits and limitations regarding clinical and aesthetic outcomes.

For instance, Tonetti et al. (2017) report that immediate implants often require more frequent bone augmentation (72% vs. 43.9%) and show higher instances of inadequate PES, suggesting that immediate placement may compromise aesthetic outcomes under certain conditions. Conversely, Chen et al. (2022) found that immediate placement yielded higher PES, indicating better aesthetic outcomes over delayed placements.

Different conclusions can be drawn depending on the articles, but overall, this analysis shows that II generally have better PES scores in the long term (except for Tonetti et al. (2017), Gjelvold et al. (2017) and Hof et al. (2014), where the PES of DI slightly surpasses that of II). However, it should be noted that the difference with DI is minimal and therefore not significant.

In terms of gingival recession, it is always slightly higher in DI, but there is no significant difference between the two protocols.

The same applies to the papilla index, with no significant difference between the two protocols. It is just slightly higher in II.

Therefore, PES scores, gingival recessions and papillae indexes do not seem to be affected by the type of placement.

The differences in findings could be attributed to different patient demographics, implant types, and procedural nuances across the studies. For example, the study populations varied widely, from Tonetti et al. (2017) Italian cohort to Chen et al. (2022) study in China, potentially influencing the clinical and aesthetic results due to differing standards of care and patient expectations.

4.3. Authors' conclusions and recommendations

The recommendations and conclusions from the studies (as described in the Annex F) align generally with their findings. Tonetti et al. (2017) unlike the other studies conclude that II placement should not be recommended when aesthetics is important; it should be limited to selected cases with bone augmentation.

Studies like Hof et al. (2014) and Slagter et al. (2021), which reported favorable outcomes with immediate placements, support this approach, especially to enhance patient satisfaction and aesthetic outcomes. However, they also emphasize the importance of case selection and meticulous surgical techniques to minimize complications such as soft

tissue recession and peri-implantitis, which were noted concerns in both immediate and delayed groups in several studies including Esposito et al. (2015) and Gjelvold et al. (2017).

In our comparison of studies, it is evident that authors generally recommend II placement for achieving aesthetic results. However, it is important to consider proper case selection and surgical technique before application. Soft tissue management has also its importance to enhance aesthetic outcomes.

The detailed follow-up periods, ranging from 6 months to 5 years, provide a longitudinal view, indicating that the long-term success of an implant might depend more on ongoing care and maintenance rather than the timing of the placement alone.

Given the previous conclusions, it appears that the choice of the implant placement protocol belongs to the practitioner. However, considering the importance of follow-up and periodontal maintenance, the patient's participation remains essential for the proper procedure and success of the implant placement protocol.

When discussing implant placement with patients, various barriers may arise, such as lack of knowledge, costs, factors that motivate patients, the relationship between dentists and their patients, dental anxiety, potential future complications, and necessary maintenance (Kashbour et al., 2015).

For this reason, it seems important to properly inform the patient about what an implant is, the different available options, and the long-term process of placement. That's why I have imagined a brochure that could serve as a model to be placed in dental offices. Better understanding of the treatment could foster patient engagement, involvement, and a higher success rate in care. This brochure, available in the appendix (Annex G), answers the main questions a patient might have when discussing dental implant placement: "What is an implant? What is it for?"

"Why choose an implant over traditional fixed or removable prostheses?"

"What are the different solutions?"

"How does the implant placement process work? Does it hurt?"

"Will I need to replace my implants? How long will they last?"

"How do I maintain my implant? How can I ensure its longevity?"

4. CONCLUSION

The objective of this systematic review was to assess whether immediate implant placement (II) demonstrates similar success rates in terms of clinical performance, aesthetic outcomes, and PES compared to delayed implant placement (DI) in healthy adult patients requiring single-tooth replacement in the maxillary aesthetic zone. The findings from various studies provide a comprehensive understanding of the effectiveness and potential complications associated with both approaches.

5.1. Implant Success Rates

The success rates for both II and DI protocols are consistently high, typically exceeding 90%, with an overall average success rate of approximately 98.53%. Studies such as those by Esposito et al. (2015) and Felice et al. (2015) report success rates of 98% for II and 96% for DI, and 96% for IMI and 92% for DI, respectively. This demonstrates that while II tends to have slightly higher success rates, the difference is not always statistically significant. The high success rates observed in both protocols underline their viability for clinical application in the maxillary aesthetic zone.

5.2. Aesthetic Outcomes

Aesthetic outcomes, particularly measured by the PES, generally favor IMI, which tends to achieve better long-term PES scores compared to DI. For instance, Chen et al. (2022) and Hof et al. (2014) found that II had slightly higher PES scores. However, studies like Tonetti et al. (2017) reported better PES scores for DI, indicating variability in results depending on the specific conditions and methodologies of the studies. Despite these differences, the overall minimal difference between II and DI suggests that both approaches can achieve satisfactory aesthetic results.

5.3. Gingival Recession and Papilla Index

The studies indicate no significant differences between II and DI in terms of gingival

recession and the papilla index. While gingival recession is slightly higher in DI, the difference is not statistically significant. Similarly, the papilla index is marginally higher in II, but this difference is also not substantial. These findings suggest that both protocols maintain comparable soft tissue outcomes, crucial for achieving optimal aesthetic results in the maxillary aesthetic zone.

5.4. Complications

Both II and DI show low complication rates, with peri-implantitis being the most reported issue. For example, Felice et al. (2015) and Huynh-Ba et al. (2019) observed similar rates of peri-implantitis in both II and DI groups. Other complications, such as wound failure, gingival margin recession, and peri-implant inflammation, were reported more frequently in the immediate implant group in some studies, such as Tonetti et al. (2017). However, the overall incidence of complications remains low, underscoring the safety of both approaches when performed correctly.

5.5. Clinical Recommendations

Based on the reviewed studies, there is a general preference among authors for II due to its slightly superior aesthetic outcomes and high success rates. Studies such as Hof et al. (2014) and Slagter et al. (2021) advocate for immediate placement to enhance patient satisfaction and achieve better aesthetic results. However, it is crucial to emphasize the importance of proper case selection, meticulous surgical techniques, and effective management of soft tissues. These factors are vital for optimizing outcomes and minimizing complications, regardless of the chosen protocol.

5.6. Limitations and Challenges of This Dissertation

This systematic review faced several challenges and limitations. Firstly, the variability in study designs, sample sizes, and methodologies across the included studies made it difficult to directly compare results and draw definitive conclusions. The lack of standardized outcome measures, particularly in assessing aesthetic outcomes such as the PES, could have introduced potential biases and inconsistencies. Indeed, many different measurement tools were used in the selected studies. Additionally, the heterogeneity in

patient populations and clinical settings could have influenced the reported success rates and complication incidences, limiting the generalizability of the findings. Another significant limitation was the lack of long-term follow-up data, which is crucial for evaluating the enduring success and stability of both immediate and delayed implant placements. In this field, there is indeed a lack of studies with clear pre-operative results, followed by assessments at 3 months, 6 months, 12 months, and then annual check-ups.

Finally, the review was constrained by the quality of the available studies, with some lacking rigorous methodological approaches, further complicating the synthesis of evidence. Despite these challenges, this thesis provides valuable insights into the comparative efficacy of immediate and delayed implant placements, highlighting areas for future research and clinical improvement.

5.7. Conclusion

In conclusion, both immediate and delayed implant placements are effective strategies for single-tooth replacement in the maxillary aesthetic zone, each with high success rates and satisfactory aesthetic outcomes. The choice between II and DI should be personalized to the individual patient's clinical scenario, aesthetic needs, and personal preferences. It is essential to involve patients in the decision-making process and provide comprehensive education about the procedures to enhance their understanding and engagement.

The slightly better aesthetic outcomes of II make it the preferred choice when aesthetic is crucial. However, the minimal differences in success rates and the comparable soft tissue outcomes suggest that DI remains a reliable and effective option, particularly in complex cases where immediate placement may pose higher risks.

Future research should continue to refine these protocols, addressing any remaining gaps in the literature and providing more definitive guidelines to further enhance clinical practice in dental implantology. By building on the existing evidence, dental practitioners can make more informed decisions and achieve better outcomes for their patients.

Given the high success rates and aesthetic outcomes associated with both immediate and delayed implant placements, future research could explore the integration of advanced technologies such as digital dentistry and computer-guided implant placement. Investigating the impact of these innovations on improving precision, reducing complications, and enhancing patient satisfaction could provide valuable insights.

Additionally, long-term studies focusing on the psychological and quality-of-life benefits of immediate versus delayed implants could offer a more holistic understanding of their impact on patient well-being. Exploring these avenues will not only advance clinical practice but also ensure that dental implantology continues to evolve in alignment with patient needs and technological advancements.

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ANNEXES

Annex A. Study Demographics and Clinical Settings

Authors	Study Design	Clinical settinngs	Number of patients	Patient age	Gender	Country
Tonetti et al. (2017)	RCT	7 Private practice	124	52.5 ± 13.5 years	84 female 40 male	Italy
Chen et al. (2022)	RCT	Hospital	80	33.60 ± 9.70 years	28 female 52 male	China
Hof et al. (2014)	RCT	Universities and clinics	153	37 ± 17 years	80 female 73 male	Austria
Santhanakrishnan et al. (2021)	RCT	Faculty and Hospital	50	30.3 ± 8.1 years	26 female 24 male	India
Santhanakrishnan, Subramanian et al. (2021)	RCT	Faculty and Hospital	75	30.4 ± 7.5 years	41 female 34 male	India
Esposito et al. (2015)	RCT	Private practice	106	49 ± 11 years	54 female 46 male	Italy
Felice et al. (2015)	RCT	Private practice	50	52.2 ± 13.5 years	25 female 25 male	Italy
Huynh-Ba et al. (2019)	RCT	University Clinic	50	52.5 ± 13.5	17 female 18 male	USA
Gjelvold et al. (2017)	RCT	Private Clinic	50	40.9 ± 14.4 years	30 female 20 male	USA
Slagter et al. (2021)	RCT	University medical center	40	46.5 ± 15 years		The Netherlands
Cardaropoli et al. (2022)	RCT	Private practice	48	55.15 ± 13.98 years	26 female 22 male	Italy
TOTAL	RCT		826	43.64	53.7%of women	

Annex B. Implant Interventions and Follow-up Periods

Authors	Article Number	Intervention Number of Immediate placements	Comparison Number of Delayed placements	Total number of implants	Type and brand of implants	Type of teeth	Implant failure	Implant Sucess	Follow-up
Tonetti et al. (2017)	1	62	62	124	SPI Contact (Thommen Medical AG, Waldenburg, Suisse)	Maxillary anterior teeth	1 lost in the II group 1%	99%	1 week, 2 weeks, 6 weeks, 12 weeks, then periodic follow-up at 12, 24, and 36 months.
Chen et al. (2022)	2	42	38	80	Certain Implant ; Biomet 3i	Maxillary anterior teeth	3,82%	96.18%	Every 6 months up to 2 years.
Hof et al. (2014)	3	26	Early 35 DI 13	153 (5 different protocols) 39 for DI and II	Brånemark® MK-III Nobel Replace™ Tapered, Nobel Biocare®	Maxillary anterior teeth	does not provide explicit percentages for implant failure and success	does not provide explicit percentages for implant failure and success	Every 6 months up to 2 years.
Santhanakrishnan et al. (2021)	4	25	25	50	Nobel Biocare®	Maxillary anterior teeth	0%	100%	At 3 months and 6 months post-surgery
Santhanakrishnan, Subramanian et al. (2021)	5	25	25	75 total 50 for DI and II	Osstem® GS III	Maxillary anterior teeth	0%	100%	At 3 months and 6 months post-surgery
Esposito et al. (2015)	6	54	52	106	NobelActive, Nobel Biocare	Maxillary anterior teeth	II 2% failure DI 4% failure	II 98% sucess DI success 96%	At 6 months and 12 months post-surgery

Annex B Continues

Authors	Article Number	Intervention Number of Immediate placements	Comparison Number of Delayed placements	Total number of implants	Type and brand of implants	Type of teeth	Implant failure	Implant Sucess	Follow-up
Felice et al. (2015)	7	25	25	50	NobelActive, Nobel Biocare	Maxillary anterior teeth	II 4 % failure DI 8% failure	II 96% sucess DI success 92%	At 6 months and 12 months post-surgery
Huynh-Ba et al. (2019)	10	22	22	44	NobelActive, Nobel Biocare	Maxillary anterior teeth	4%,	96%	At 6 months and 12 months post-surgery
Gjelvold et al. (2017)	11	25	25	50	NobelActive, Nobel Biocare	Maxillary anterior teeth	II 4% DI 8%	II 96% DI 92%	At 3, 6, and 12 months post-definitive crown placement
Slagter et al. (2021)	12	20	20	40	NobelActive, Nobel Biocare	Maxillary anterior teeth	II 5% DI 10%	II 95% DI 90%	At 6 months, 12 months, and annually up to 5 years post-surgery
Cardaropoli et al. (2022)	13	24	24	48	Bone Level Tapered SLAactive, Straumann	Maxillary anterior teeth	0%	100%	At baseline and 1-year post-extraction
Total		350	331	TOTAL 820		Maxillary anterior teeth		General : 98.53%	

Annex C. Complications and Causes

Authors	Article Number	Number or percentage of Complications	Cause
Tonetti et al. (2017)	1	26.1% II group and 5.3% DI group	Wound failure
Chen et al. (2022)	2	10 (5 in II group, 5 in DI group)	Complications were similar between the two groups with no significant difference (P > 0:05) IMI: 2 gingival margin recession, 1 peri-implant inflammation, 2 metal exposure, and 0 infection DI: 2 gingival margin recession, 1 peri-implant inflammation, 1 metal exposure, and 1 infection
Hof et al. (2014)	3	Non specified	Gingival margin recession, peri-implant inflammation, metal exposure, and infection were observed in both groups with no significant difference (P > 0.05)
Santhanakrishnan et al. (2021)	4	0	No major mechanical or biological complication during the study period
Santhanakrishnan, Subramanian et al. (2021)	5	0	No major mechanical or biological complication during the study period
Esposito et al. (2015)	6	5 (2 in II group, 3 in DI group):	IMI : 2 patients with peri-implantitis DI: 3 patients with peri-implantitis
Felice et al. (2015)	7	7 (3 in II group, 4 in DI group)	IMI : 3 patients with peri-implantitis DI: 4 patients with peri-implantitis
Huynh-Ba et al. (2019)	10	7 (3 in II group, 4 in DI group)	IMI : 3 patients with peri-implantitis DI: 4 patients with peri-implantitis
Gjelvold et al. (2017)	11	7 (3 in II group, 4 in DI group)	IMI : 3 patients with peri-implantitis DI: 4 patients with peri-implantitis
Slagter et al. (2021)	12	5 (2 in II group, 3 in DI group)	IMI : 2 patients with peri-implantitis DI: 3 patients with peri-implantitis
Cardaropoli et al. (2022)	13	0	No major mechanical or biological complication during the study period

Annex D. Pink Esthetic Score (PES) at Different Intervals

Authors	PES	PES 3 months	PES 6 months	PES 12 months	More
Tonetti et al. (2017)	- PES for II group: 42% inadequate - PES for DI group: 19% inadequate			II : 7 DI: 8	
Chen et al. (2022)	The results indicated that the immediate group had higher PES and WES scores compared to the delayed at 3-, 6-, and 12-months post-surgery (P < 0.05).	II: 8,125 DI: 7,3	II: 10,5 DI:8,5	II: 11,4 DI: 10	
Hof et al. (2014)					PES at 56 months: II: 10.7 ±2.4 PES at 58 months: DI: 11.2 ± 2.0
Santhanakrishnan et al. (2021)		II :11.4 ± 1.2 DI: 10.8 ± 1.4	II: 12.1 ± 1.3 DI: 11.0 ± 1.5		
Santhanakrishnan, Subramanian et al. (2021)	Baseline : II : 12.2±1.9 DI : 10.9±1.5	II: 10.5 ± 1.3 DI: 9.8 ± 1.4	II : 11.2±2.1 DI :10.2±1.4		
Esposito et al. (2015)			II 11.4 ± 1.2 DI 10.8 ± 1.4	II 12.1 ± 1.3 DI 11.0 ± 1.5	
Felice et al. (2015)	PES II: 11.5 ± 1.3 at baseline DI: 10.9 ± 1.4 at baseline		II 11.8 ± 1.4 DI 11.0 ± 1.3	II 12.1 ± 1.5 DI 11.2 ± 1.4	
Huynh-Ba et al. (2019)	II: 11.6 ± 1.3 at baseline DI: 10.8 ± 1.5 at baseline		II 11.9 ± 1.4 DI 11.1 ± 1.4	II 12.2 ± 1.5 DI 11.3 ± 1.5	
Gjelvold et al. (2017)		II 9.32 ± 2.14 DI 10.08 ± 2.52	II 9.75 ± 2.36 DI 10.33 ± 2.68	II 10.36 ± 2.46 DI 10.67 ± 2.32	
Slagter et al. (2021)	II: 7.00(2.05) at baseline DI :6.90(1.32) at baseline		II 12.0 ± 1.3 DI 11.0 ± 1.5	II 12.2 ± 1.4 DI 11.2 ± 1.6	PES at 5 years: II 12.5 ± 1.5 Di 11.5 ± 1.7
Cardaropoli et al. (2022)	II: 11.00 at baseline DI: 10.63 at baseline			II 10.92 DI 10.79	

Annex E. Gingival Recession and Papilla Index

Authors	Article Number	Gingival Recession	Papilla Index
Tonetti et al. (2017)	1	No changes in recession of the gingival margin were observed, or the width of the facial band of keratinized tissue that remained stable	
Chen et al. (2022)	2	Recession of the gingival margin, peri-implant inflammation, metal exposure, and infection were noted in both groups, with no significant differences between them (P > 0.05).	
Hof et al. (2014)	3	No significant differences between implant protocols were found in terms of... midfacial recession (p = .266)	II group : 2 at 56 months DI group: 2,5 at 58 months
Santhanakrishnan et al. (2021)	4	II group: 0.4 ± 0.2 mm at 3 months, 0.3 ± 0.2 mm at 6 months DI group: 0.5 ± 0.3 mm at 3 months, 0.4 ± 0.3 mm at 6 months	II group: 2.5 ± 0.6 at 3 months, 2.7 ± 0.5 at 6 months DI group: 2.3 ± 0.7 at 3 months, 2.4 ± 0.6 at 6 months
Santhanakrishnan, Subramanian et al. (2021)	5	II group: 0.3 ± 0.2 mm at 3 months, 0.2 ± 0.2 mm at 6 months DI group: 0.4 ± 0.3 mm at 3 months, 0.3 ± 0.2 mm at 6 months	II group: 2.6 ± 0.5 at 3 months and 2.8 ± 0.4 at 6 months DI group: 2.3 ± 0.6 at 3 months, 2.5 ± 0.5 at 6 months
Esposito et al. (2015)	6	II group: 0.3 ± 0.2 mm at 6 months, 0.2 ± 0.2 mm at 12 months DI group: 0.4 ± 0.3 mm at 6 months, 0.3 ± 0.2 mm at 12 months	II group: 2.6 ± 0.5 at 6 months, 2.8 ± 0.4 at 12 months DI group: 2.3 ± 0.6 at 6 months, 2.5 ± 0.5 at 12 months
Felice et al. (2015)	7	II group: 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months DI group: 0.3 ± 0.3 mm at baseline, 0.3 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months	II group: 2.7 ± 0.5 at baseline, 2.8 ± 0.4 at 6 months, 2.9 ± 0.4 at 12 months DI group: 2.5 ± 0.6 at baseline, 2.6 ± 0.5 at 6 months, 2.7 ± 0.5 at 12 months
Huynh-Ba et al. (2019)	10	II group: 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months DI group: 0.3 ± 0.3 mm at baseline, 0.3 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months	II group: 2.6 ± 0.5 at baseline, 2.8 ± 0.4 at 6 months, 2.9 ± 0.4 at 12 months DI group: 2.4 ± 0.6 at baseline, 2.6 ± 0.5 at 6 months, 2.7 ± 0.5 at 12 months
Gjelvold et al. (2017)	11	II group: 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months DI group: 0.3 ± 0.3 mm at baseline, 0.4 ± 0.3 mm at 6 months, 0.5 ± 0.3 mm at 12 months	II group: 0.77 ± 0.71 mm at 12 months Di group: 0.60 ± 0.74 mm at 12 months

Annex E Continues

Authors	Article Number	Gingival Recession	Papilla Index
Slagter et al. (2021)	12	II group: 0.2 ± 0.2 mm at baseline, 0.3 ± 0.2 mm at 6 months, 0.3 ± 0.2 mm at 12 months, 0.4 ± 0.3 mm at 5 years DI group: 0.3 ± 0.3 mm at baseline, 0.4 ± 0.3 mm at 6 months, 0.4 ± 0.3 mm at 12 months, 0.5 ± 0.4 mm at 5 years	II group: 2.6 ± 0.5 at baseline, 2.7 ± 0.4 at 6 months, 2.8 ± 0.4 at 12 months, 2.9 ± 0.3 at 5 years DI group: 2.4 ± 0.6 at baseline, 2.5 ± 0.5 at 6 months, 2.6 ± 0.5 at 12 months, 2.7 ± 0.4 at 5 years
Cardaropoli et al. (2022)	13	II group: 7.70 ± 0.60 mm at baseline (T0), 7.81 ± 0.51 mm at 1 year (T1). DI group: 81 ± 0.62 mm at baseline (T0), 7.83 ± 0.65 mm at 1 year (T1).	

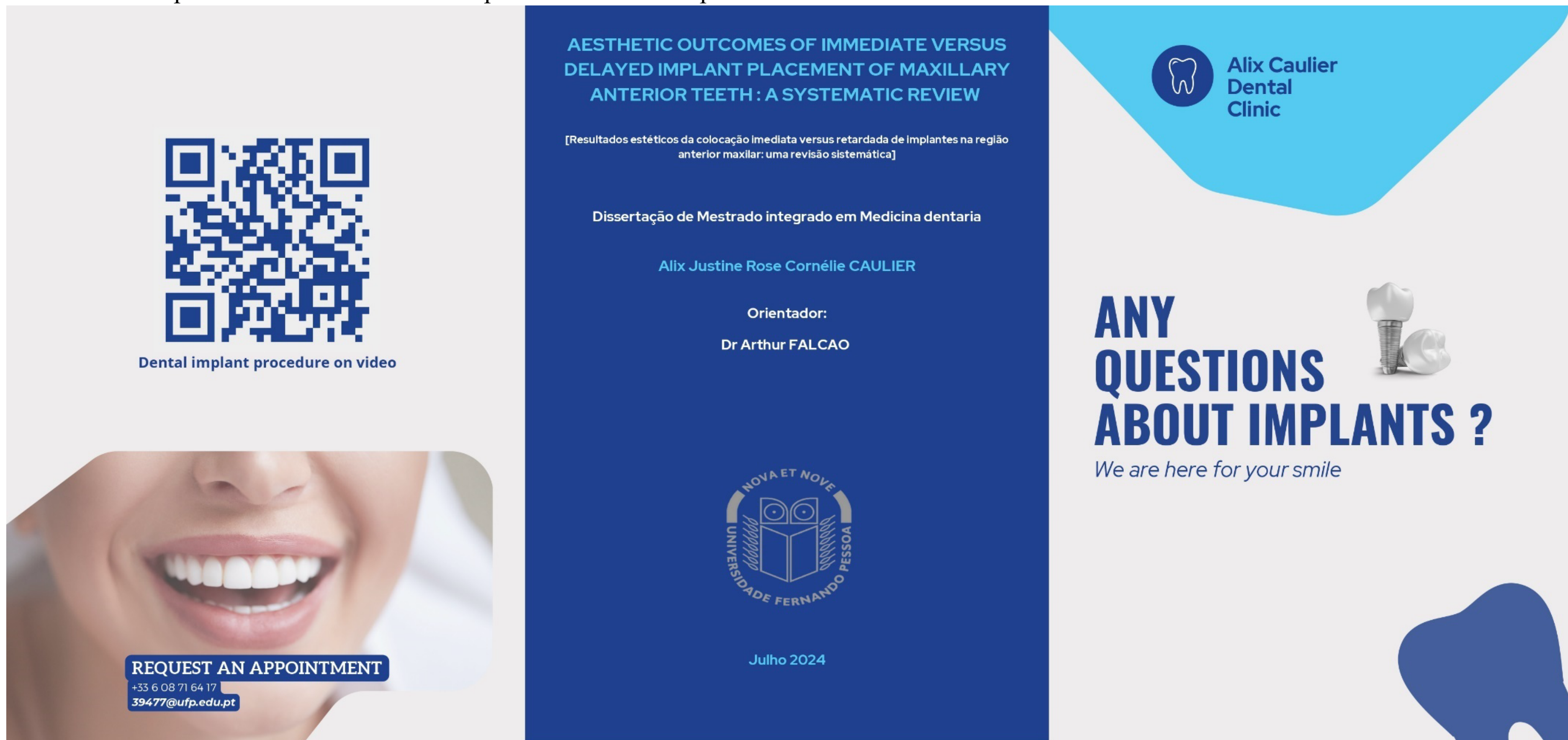
Annex F. Conclusions and Aesthetic Recommendations

Authors	Article Number	Conclusion
Tonetti et al. (2017)	1	**Conclusion**: Immediate implants often require bone augmentation more frequently (72% versus 43.9%, p = 0.01). Immediate implants also demonstrated inadequate PES more frequently (42% versus 19%, p = 0.03). **Preferred Technique for Aesthetics:** Immediate implant placement should not be recommended when aesthetics are important; it should be limited to selected cases. The issues related to timing of implant placement are complicated by the lack of consensus on effective and established procedures.
Chen et al. (2022)	2	**Conclusion:** Immediate has higher prognostic value and is more conducive to improving implant stability, treatment satisfaction, and QOL with more significant aesthetic effects, which is worth promoting clinically." Immediate implant placement (II) presents better aesthetic characteristics compared to delayed placement (DI). The PES and WES were higher in the II group at 3, 6, and 12 months after surgery. **Preferred Technic for Aesthetic:**Immediate implant placement show better aesthetic outcomes
Hof et al. (2014)	3	**Conclusion:** The conclusion of the article is that comparable clinical, radiological, and aesthetic outcomes can be achieved with all implant treatment protocols. However, longer follow-up tends to favor the apical displacement of soft tissues on the medial face, regardless of the treatment protocol. **Preferred Technique for Aesthetics:** Immediate implant placement offers better aesthetic characteristics in terms of patient satisfaction and papilla formation compared to other placement methods. "Papilla formation was more pronounced following delayed and immediate implant placement." **Recommendations:** The authors recommend using immediate implant placement to enhance patient satisfaction and the aesthetics of the papillae. They also emphasize the importance of considering crown length and keratinized soft tissues to minimize soft tissue recession.
Santhanakrishnan et al. (2021)	4	**Conclusion:** The conclusion of the article is that both immediate and delayed placement techniques, following socket preservation, have shown favorable outcomes in terms of stability of hard and soft tissues. **Preferred Technique for Aesthetics:** However, immediate placement offers slightly superior aesthetic benefits. Immediate implant placement (IIP) exhibits the best aesthetic characteristics compared to delayed placement (DIP), with slightly better results in terms of soft tissue stability and aesthetic satisfaction. **Recommendations:** The authors recommend the use of the immediate placement technique for patients seeking optimal aesthetic outcomes. They also emphasize the importance of case selection and soft tissue management to enhance aesthetic results.
Santhanakrishnan, Subramanian et al. (2021)	5	**Conclusion:** Both IIP and DIP following socket preservation can achieve favorable outcomes, but SST with IIP showed superior soft tissue preservation and esthetic outcomes. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations:** Consider SST with immediate implant placement for optimal esthetic outcomes. Proper case selection and careful execution are crucial.

Annex F Continues

Authors	Article Number	Conclusion
Esposito et al. (2015)	6	**Conclusion:** Both immediate and delayed implant placements in the anterior maxilla achieve high success rates. Immediate loading provides a shorter treatment time and may enhance patient satisfaction. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations:** Consider immediate implant placement and loading for improved patient satisfaction and reduced treatment duration. Proper case selection and surgical technique are essential.
Felice et al. (2015)	7	**Conclusion:** Both immediate and delayed implant placements in the anterior maxilla achieve high success rates. Immediate non-occlusal loading provides a shorter treatment time and may enhance patient satisfaction. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations:** Consider immediate implant placement and loading for improved patient satisfaction and reduced treatment duration. Proper case selection and surgical technique are essential.
Huynh-Ba et al. (2019)	10	**Conclusion:** Both immediate and delayed implant placements in the anterior maxilla yield favorable esthetic, clinical, and radiographic outcomes after one year. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations:** Consider immediate implant placement and loading for improved patient satisfaction and reduced treatment duration. Proper case selection and surgical technique are essential.
Gjelvold et al. (2017)	11	**Conclusion:** Both immediate and delayed loading of single-tooth implants in the anterior maxilla achieve high success rates. Immediate loading provides a shorter treatment time and may enhance patient satisfaction. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations :** Consider immediate loading for improved patient satisfaction and reduced treatment duration. Proper case selection and surgical technique are essential.
Slagter et al. (2021)	12	**Conclusion :** Both immediate and delayed implant placements in the esthetic zone achieve high success rates. Immediate implant placement with simultaneous bone augmentation showed better preservation of the peri-implant tissues. **Preferred Technic for Aesthetic:** Immediate implant placement show better aesthetic outcomes. **Recommendations:** Consider immediate implant placement with simultaneous bone augmentation for optimal esthetic outcomes. Proper case selection and meticulous surgical technique are essential.
Cardaropoli et al. (2022)	13	**Conclusion:** No significant differences were observed between the immediate and delayed groups in any of the considered parameters. Both procedures yielded similar and comparable clinical results over time. **Preferred Technic for Aesthetic:** Both immediate implant placement and alveolar ridge preservation with staged placement presented similar and comparable esthetic outcomes. **Recommendations:** It is possible to choose either immediate implant placement or alveolar ridge preservation with staged placement, considering the specific indications of the two techniques.

Annex G. Comprehensive Guide: Dental Implant Brochure Template

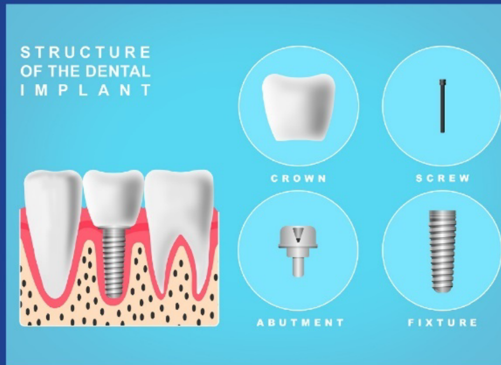


What is an implant? What is it for?

A dental implant serves as an **artificial root** placed into the jawbone to treat tooth loss. It provides an effective solution by **replacing missing teeth** with artificial ones, including an implant, an abutment, a screw, a fixture and a crown.

Why choose an implant over traditional fixed or removable prostheses?

- Remarkable success rate, achieving over **97% success** over a decade
- Offering impressive **long-term results**.
- **Improve the smile** and facial proportions by restoring the natural appearance of the smile, boosting **self-confidence**.
- Compared to traditional options, implants offer better dental **stability**, improved appearance, and less social limitations, such as during social eating.



What are the different solutions?

There are three different protocols:

- **Immediate implantation**: Placing the dental implant immediately after tooth extraction.
- **Early implantation**: Placing the dental implant a few weeks to a few months after tooth extraction, once initial healing has occurred.
- **Delayed implantation**: Placing the dental implant several months after tooth extraction, after complete healing of the extraction site.

How does the implantation process works? Does it hurt ?

- The implantation process takes about **1-2 hours** in the dental office.
- It involves **local anesthesia**, ensuring **no pain** during the procedure.
- Depending on the chosen protocol, it may require **between 3 and 6 consultations** (initial assessment and planning, extraction, implant placement, follow-up, and final crown placement).

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Will I need to replace my implants? How long will they last?

No, dental implants can last from **10 to 40 years**, depending on maintenance.

How do I maintain my implant? How can I ensure its longevity?

Maintain regular dental check-ups

Good oral hygiene

- **Regular brushing**: Brush your teeth 2 to 3 times a day for at least 2 minutes. Avoid hard-bristled toothbrushes and use a suitable toothpaste.
- **Use of dental floss**: Floss helps remove residues between the teeth and around the implant, reducing infection risks and aiding in healing.
- **Regular mouthwash**: Helps eliminate bacteria.