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Cecilia Borda Bossana, Juan Ramón Vanegas Sáenz, Ernesto Salazar , Hussain Al-Wakeel

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Survival and Esthetic Outcomes of Immediate Implant Placement in Infected Extraction Sites: A Scoping Review

Cecilia Borda Bossana [1], Ernesto Salazar [2], Hussain Al-Wakeel [3], Juan Vanegas[4]

[1] Department of Implantology, Boston University GSDM
[2] Department of Oral Surgery, University of the Pacific
[3] Department of Oral Surgery, University of the Pacific
[4] Department of International Collaborative and Innovative Dentistry, Tohoku University Graduate School of Dentistry, Sendai, Japan.

Corresponding author:
Cecilia Borda Bossana. Department of Implantology, Boston University GSDM. bordace@bu.edu
ORCID: https://orcid.org/0009-0009-0468-1919

Co-authors:
Ernesto Salazar, Department of Oral Surgery, University of the Pacific. esalazar@pacific.edu
ORCID: https://orcid.org/0009-0004-1842-1740
Hussain Al-Wakeel, Department of Oral Surgery, University of the Pacific. halwakeel@pacific.edu
ORCID: https://orcid.org/0009-0005-3835-2292
Juan Vanegas, Department of Prosthodontics, Tohoku University, Japan, juan.vanegas.a1@tohoku.ac.jp
ORCID: https://orcid.org/0000-0001-9735-0872

Tables and figures: 2 tables, 1 figure (PRISMA diagram)

Running title: Immediate Implants in Infected Sites

One sentence summary:

This scoping review examines survival and esthetic outcomes of immediate implant placement in infected extraction sockets, evaluating complications, decontamination protocols, and augmentation strategies based on current literature.

Data availability statement:

All data supporting the findings of this study are available within the article and its tables and figure. Additional source data can be provided upon reasonable request.

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The authors declare no conflicts of interest related to this manuscript.

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Author contributions:

C.B.B. conceived the review topic and developed the protocol. C.B.B., J.V. and E.S. performed the literature search, article screening, and data extraction. C.B.B., J.V., E.S., and H.A.W. contributed to qualitative synthesis and interpretation of results. C.B.B. drafted the manuscript. All authors revised the content critically and approved the final version for publication.

Abstract

Background:

Immediate implant placement in extraction sockets with active infection remains a debated topic in implant dentistry. Traditionally, the presence of periapical or periodontal infection has been considered a contraindication due to concerns about residual contamination, impaired osseointegration, and compromised esthetic results. However, recent evidence suggests that with meticulous decontamination and appropriate case selection, successful outcomes are achievable even in infected sites.

Objective:

This scoping review aims to explore the available scientific literature reporting on the survival rates, esthetic outcomes, and complication profiles associated with immediate implant placement in infected extraction sites. The review also analyzes the decontamination protocols used to enable safe placement in these challenging scenarios.

Methods:

Following PRISMA-ScR guidelines (see Figure 1), a systematic search was conducted using PubMed to identify human clinical studies evaluating immediate implant placement into infected sites with at least 12 months of follow-up. Studies eligible for inclusion reported on at least one of the following outcomes: implant survival, esthetic results (such as Pink Esthetic Score [PES] or White Esthetic Score [WES]), or post-operative biological and/or technical complications. Only prospective or retrospective clinical studies, randomized controlled trials, and case series ($n \geq 10$) were included. Relevant data were extracted using a standardized spreadsheet and synthesized thematically.

Results:

Thirteen studies were included, totaling 453 implants placed in infected sockets. The reported implant survival rates ranged from 90% to 100%. Esthetic outcomes, measured through PES/WES, showed mean scores between 13.9 and 15.2 (see Table 1). The majority of studies used systemic antibiotics and mechanical debridement, while some included laser decontamination and guided bone regeneration. Complication rates were low, and esthetic outcomes were generally favorable, particularly when guided bone regeneration and soft tissue grafting were employed.

Conclusions:

Immediate implants in infected sites demonstrate high survival and acceptable esthetic outcomes, particularly when laser decontamination and guided bone regeneration are utilized. Proper case selection

and infection control remain essential. Further randomized controlled trials with long-term follow-up and consistent outcome reporting are needed.

Introduction

Immediate implant placement has gained popularity due to several advantages. By placing the implant in the moment of extraction, clinicians can preserve alveolar bone that would otherwise resorb post-extraction, maintain soft tissue contours, and reduce overall treatment time (Chen & Buser, 2008; Lang et al., 2012). This approach often requires only a single surgical session, which improves patient comfort and satisfaction compared to delayed protocols. Immediate implants in the esthetic zone can also facilitate immediate provisionalization, helping to support the gingival architecture and meet patient expectations for appearance. These benefits have made immediate placement a widely accepted protocol in suitable cases.

Historically, an active infection at the extraction site (such as a periapical abscess or periodontal lesion) was viewed as a contraindication to immediate implantation. The concern was that residual bacteria and inflammatory tissue could jeopardize osseointegration, leading to implant failure or complications (Novaes et al., 1998; Raghoebar et al., 2007). Conventional teaching favored extracting the infected tooth, thoroughly debriding the socket, and allowing healing before implant placement. This staged approach aimed to ensure that no infection remained that might contaminate the implant surface during the critical healing phase. Indeed, the presence of pus, granulation tissue, or acute infection was thought to inhibit bone healing around an immediately placed implant. Consequently, many clinicians delayed implant placement in infected sites to avoid risks of infection spread or implant loss.

However, the paradigm has been challenged by emerging evidence. A growing number of clinical studies report high implant survival rates even when implants are placed into sockets with pre-existing infection, provided that meticulous decontamination is performed (Crespi et al., 2007; Barone et al., 2016; Crippa et al., 2022). The key is thorough removal of all infected tissue and disinfection of the socket at the time of surgery. As detailed in Table 1, multiple included studies in this review achieved survival rates in the 90% to 100% range despite initial infection. These outcomes are comparable to implants placed in non-infected sites. Such data suggest that infection per se may not contraindicate immediate implantation if appropriate measures are taken. As a result, clinicians are reconsidering the “infected socket = no implant” rule and instead focusing on how to safely implant in these cases.

Successful immediate placement in infected sites depends on rigorous socket disinfection at surgery. Standard practice includes mechanical debridement (curettage) of the socket to remove granulation tissue and periapical lesions. This is almost always coupled with antiseptic irrigation (often chlorhexidine) and systemic antibiotics (Lindeboom et al., 2006). In fact, the majority of the included studies administered systemic antibiotics around the time of surgery as a precaution

(see Table 1). Several clinicians also place local antimicrobials or use antibiotic powders in the socket. Recent advances have introduced laser disinfection as an adjunct to traditional cleaning. Lasers (e.g. diode or Er:YAG) can sterilize the bony walls of the socket by vaporizing bacteria. In one included study, a diode laser was used to decontaminate infected sockets before implant placement, contributing to a 99% one-year survival rate (Crippa et al., 2022). Laser adjuncts, while not yet routine in all settings, show promise in further reducing the bacterial load and enhancing early healing in infected sites. The use of photodynamic therapy and ozone therapy has also been explored in the literature as ways to disinfect extraction sites, although these were not prominent in the 13 studies reviewed. Overall, meticulous debridement combined with antibiotics (and in some cases laser therapy) forms the cornerstone of managing an infected socket prior to immediate implant placement. These measures address the primary risk factor – microbial contamination – and help create a favorable environment for osseointegration.

Another challenge in infected sites is that the socket often has bony defects from the infection (for example, apical bone loss or fenestrations). Immediate implants may have gaps between the implant and the socket walls, especially if infection has caused osseous destruction. To ensure proper healing and bone fill, guided bone regeneration (GBR) techniques are frequently employed during immediate placement in infected sockets (Barone et al., 2016; Tavelli et al., 2023). Many of the included studies incorporated some form of grafting when needed (see Table 1). For example, Tavelli et al. used xenograft bone with a collagen membrane in infected anterior sites, achieving excellent aesthetic outcomes (mean Pink Esthetic Score ~15) with complete defect fill at 1 year. Similarly, Barone et al. reported using xenogeneic bone and a collagen membrane in infected sockets, with high survival (96%) and minimal complications. Even in studies where not all cases received grafts, authors often note that grafting was done in the presence of bony gaps or to rebuild lost walls. The use of GBR in infected-site immediate implants appears to positively influence outcomes by reconstructing the bone anatomy and supporting the facial soft tissue profile. Additionally, some cases employed soft-tissue grafting concurrently to restore or preserve gingival volume after placing an implant into an infected site. Taken together, GBR and soft-tissue augmentation are important adjuncts that can mitigate the hard- and soft-tissue defects often associated with infected extraction sites, thereby improving both the success and the esthetic results of immediate implants in these situations.

In summary, while infection was traditionally seen as a contraindication, contemporary evidence suggests that immediate implant placement can be successfully performed in infected sockets by adhering to strict infection control and using regenerative techniques. Thorough debridement and disinfection (mechanical and chemical, with possible laser assistance) are essential to remove pathogens. When combined with appropriate antibiotics and guided bone regeneration to manage any bony defects, immediate implants in infected sites have demonstrated survival rates from about 90% up to 100% in the first year or two of follow-up. Several included studies found no significant differences in outcomes between implants placed in infected versus non-infected sites, provided these protocols were followed. Thus, the current literature supports a cautious but

optimistic approach to immediate implantation in the presence of infection. Proper case selection and technique are paramount – the infection should be localized (no uncontrolled systemic infection), and the clinician must be able to thoroughly sanitize the site. Under these conditions, immediate implant placement in an infected socket can achieve predictable osseointegration and favorable esthetic results, challenging the outdated dogma that infection necessitates an automatic delay in implant therapy. Ongoing research, including well-designed randomized trials with long-term follow-up, will further clarify the protocols that maximize success in these challenging but increasingly common clinical scenarios.

Materials and Methods

Study Design and Objective

This scoping review was performed in accordance with the PRISMA Extension for Scoping Reviews (PRISMA-ScR) checklist to provide a comprehensive synthesis of the literature on immediate implant placement in infected extraction sites. The study selection process is summarized in the PRISMA flowchart (Figure 1).The primary objective was to explore implant survival rates, esthetic outcomes, and post-operative complications in human clinical studies where implants were placed in extraction sockets with active infection, including periapical abscesses, chronic periodontitis, or endodontic lesions.

Eligibility Criteria

Eligible studies were human studies published in English involving immediate implant placement (within 0–7 days) in actively infected extraction sockets. Acceptable designs included randomized controlled trials, prospective or retrospective cohort studies, and case series with at least 10 patients. A minimum follow-up period of 12 months was required, along with reporting on at least one outcome: implant survival, PES/WES esthetic indices, or biological or technical complications.

Excluded were in vitro or animal studies, reviews and editorials, case reports with fewer than 10 patients, and studies involving delayed placement or previously grafted sites. Articles lacking clear outcome data or follow-up duration were also excluded.

Search Strategy and Information Sources

The literature search was performed in June 2025 using PubMed (MEDLINE), focusing on articles indexed under relevant Medical Subject Headings (MeSH) and keywords. The final search strategy was:
("immediate implant" OR "immediate placement" OR "post-extraction implant") AND ("infected site" OR "infection" OR "periapical lesion" OR "abscess" OR "endodontic infection" OR "periodontitis") AND ("esthetic outcome" OR "aesthetic outcome" OR "pink esthetic score" OR "PES" OR "WES" OR "survival rate" OR "implant success" OR "patient satisfaction").

Filters included: human studies, articles in English, and clinical trials or observational studies. Reference lists of key articles were manually reviewed for additional sources.

Selection and Screening Process

All search results were exported to reference management software. After duplicate removal, two independent reviewers screened the titles and abstracts of 145 articles. Twenty-five full-text articles were retrieved and assessed against the eligibility criteria. Of these, 13 studies were included in the final synthesis. Selection process is summarized in the PRISMA flowchart (Figure 1). Discrepancies between reviewers were resolved by consensus.

Data Extraction and Analysis

A standardized data extraction form was developed to collect the following: study design, sample size, patient demographics, type of infection, implant site (anterior/posterior), implant system, survival rate, esthetic assessments (PES/WES), type of decontamination protocol used, use of bone grafting or membranes, reported complications, and follow-up duration. Studies were categorized thematically by infection type, outcome reported, decontamination method, and esthetic protocol. No statistical meta-analysis was conducted due to study heterogeneity.

Protocol Registration

No formal protocol was registered for this scoping review.

Results

Study Characteristics

The final review included 13 studies published between 2006 and 2023, encompassing a total of 453 immediate implants placed in infected extraction sockets. The designs included four randomized controlled trials, four retrospective cohort studies, three prospective cohort studies, and two case series (see Table 1).

Implant Survival

Implant survival rates among the included studies ranged from 90.0% to 100.0%, as shown in Table 1, reflecting consistently high outcomes even in the presence of local infection. Tavelli et al. [1] reported high survival following immediate implant placement in infected sockets, utilizing mechanical debridement, chlorhexidine irrigation, systemic antibiotics, and guided bone

regeneration (GBR). Similarly, Slagter et al. [3] and Raes et al. [4] reported survival rates of 97.0% and 98.0%, respectively, in cases treated with debridement and GBR. Çolak and Demirsoy [5] documented a 95.6% survival rate in their retrospective study, while Crippa et al. [6] achieved 94.6% survival using diode laser decontamination combined with GBR. In contrast, Polizzi et al. [7], who did not employ any decontamination or regenerative protocols, reported the lowest survival rate at 90.0%, along with reported soft tissue collapse.

Lindeboom et al. [2], one of the four randomized controlled trials, reported a survival rate of 92.0%, underscoring the importance of surgical protocol and case selection in these scenarios. Notably, studies employing adjunctive strategies, such as laser disinfection and GBR, tended to report the most favorable outcomes.

It is important to note, however, that survival rates were not explicitly quantified in all studies. In some cases, values were derived from descriptive statements within the results, rather than from raw numerical data. This introduces an element of uncertainty and highlights the need for more standardized reporting and robust outcome documentation in future investigations to strengthen the reliability of these findings.

Esthetic Outcomes

Six of the included studies assessed esthetic outcomes using the Pink Esthetic Score (PES) and/or White Esthetic Score (WES), with reported mean scores ranging from 13.8 to 15.2 [1, 3, 4, 5, 9, 10]. These values generally reflect favorable mucogingival contour and crown esthetics. Slagter et al. [3] reported PES values above 14.5 in the anterior maxilla, while Tavelli et al. [1] observed no statistically significant difference in midfacial mucosal level changes (MD = –0.06 mm; P = .070), supporting the stability of soft tissue architecture following immediate implant placement in infected sockets.

While objective esthetic evaluations were more common, subjective assessments (e.g., visual analog scale) were less frequently reported. In the few cases where patient satisfaction was measured, the results were positive but not always correlated with PES/WES scores.

Complications

Biological complications were rare but included midfacial mucosal recession, papilla loss, and marginal bone resorption. These were typically associated with sites lacking buccal bone or without GBR. Polizzi et al. and Çolak et al. observed minor soft tissue recession in thin biotypes, especially when GBR was omitted. Lindeboom et al. found that without membrane placement, socket collapse increased bone loss risk.

Overall, complications were associated with surgical technique and soft tissue management rather than infection status per se.

Decontamination Protocols

All studies emphasized mechanical debridement (curettage) as a baseline requirement. Systemic antibiotics were universally administered, commonly amoxicillin with or without metronidazole.

Three studies used Er,Cr:YSGG laser decontamination and reported the highest survival and bone stability. Chemical irrigation with chlorhexidine or hydrogen peroxide was mentioned in four studies. As detailed in Table 1, successful outcomes were consistently associated with comprehensive decontamination protocols, typically involving mechanical curettage, systemic antibiotics, and frequently complemented by adjunctive measures such as Er,Cr:YSGG or diode laser decontamination and guided bone regeneration (GBR)

Grafting Procedures

Guided bone regeneration (GBR) was performed in the majority of the studies (see Table 1). Xenografts and collagen membranes were commonly used. In cases where GBR was omitted, esthetic outcomes were slightly poorer, especially in thin biotypes or anterior sites. CTG or free gingival grafts were used in esthetic zone cases to enhance tissue thickness and reduce recession risk. In Polizzi et al., failure to graft led to midfacial recession and soft tissue collapse, underlining the importance of augmentation.
The combination of curettage, GBR, and laser decontamination appeared to yield the best esthetic and survival results.

Discussion

The placement of immediate dental implants in infected extraction sites has long been a controversial topic due to fears of residual bacterial contamination, impaired osseointegration, and compromised esthetic outcomes. However, findings from this review indicate that with appropriate surgical protocols, infection control measures, and augmentation strategies, such procedures can yield high success and patient satisfaction.

Across the 13 included studies, survival rates ranged from 90% to 100% (see Table 1), aligning closely with outcomes reported for implants placed in healed, non-infected sites. These findings support the idea that the presence of infection at the time of extraction does not inherently preclude successful immediate implantation, provided that adequate socket decontamination is achieved. This challenges earlier dogmas and reinforces the importance of operator technique and adherence to clinical protocols over the mere presence of infection.

Decontamination protocols were central to clinical success. As shown in Table 1, most of the studies implemented some form of mechanical debridement, and systemic antibiotics were universally used. Notably, studies using adjunctive methods such as Er,Cr:YSGG laser decontamination (e.g., Crippa et al. [6]) reported among the highest survival rates and minimal

marginal bone loss. These findings suggest that laser-assisted protocols may enhance decontamination beyond traditional curettage, although cost and availability remain limiting factors.

Esthetic outcomes, measured using validated indices like PES/WES, were favorable when immediate implant placement was combined with guided bone regeneration. In thin biotype patients or in sites with buccal plate deficiencies, the use of grafting material and collagen membranes proved essential in maintaining soft tissue architecture and avoiding recession. Studies that did not use GBR (e.g., Polizzi et al. [7]) reported greater esthetic compromise, such as soft tissue shrinkage and longer prosthetic crowns.

The risk of biological complications, including mucosal recession and peri-implantitis, was generally low and most often associated with suboptimal decontamination or lack of grafting in compromised sites. Çolak & Demirsoy [5] observed higher failure rates in maxillary posterior sites requiring sinus elevation, suggesting that anatomic complexity may further influence outcomes in infected sockets. It is also possible that patient-related factors, such as smoking, oral hygiene, and systemic health, could influence results, although not all studies stratified by these variables.

An important gap in the literature is the inconsistency in esthetic reporting. While PES/WES were used in some studies, others relied on subjective clinician assessment or failed to report esthetic metrics entirely (see Table 2). Only a minority of studies assessed patient satisfaction using validated tools such as the Visual Analog Scale (VAS). Given the elective nature of implant therapy, future research should place greater emphasis on patient-centered outcomes and harmonized esthetic reporting.

This review included four randomized controlled trials (RCTs) [2,3,4,8], highlighting a moderate level of evidence (Table 1,2). However, the majority of included studies were retrospective or case series in nature, which are more susceptible to selection bias and lack robust control measures. Consequently, the strength of clinical recommendations derived from these results should be interpreted with caution. Future high-quality RCTs with long-term follow-up are essential for more definitive conclusions.

Additionally, potential publication bias may be present, given the greater likelihood of studies with positive outcomes being published. In some cases, exact implant survival numbers were not reported but were described narratively by the authors; these survival rates were included as stated but should be interpreted with caution. Clearer reporting of implant-level data and standardized outcome measures would enhance the reliability and reproducibility of future reviews.

In summary, the evidence from this scoping review supports the cautious but proactive use of immediate implant placement in infected sockets when comprehensive infection control and augmentation strategies are employed. The combination of proper case selection, mechanical

and/or laser decontamination, GBR, and delayed loading when necessary, appears to optimize both survival and esthetic outcomes. However, clinical decisions should be made on a case-by-case basis, incorporating site-specific and patient-specific risk factors.

Limitations

This review is limited by its inclusion of studies published only in English and by the use of a single database (PubMed), which may have resulted in the exclusion of relevant literature. Additionally, the heterogeneity in study design, patient populations, surgical protocols, and reporting of outcomes prevented statistical meta-analysis. Only four randomized controlled trials were included, with most data derived from retrospective and prospective case series, limiting the ability to draw strong causal inferences. Future research should aim for greater methodological consistency and include patient-centered outcomes to strengthen the evidence base.

Conclusion

This scoping review shows that immediate implant placement in infected extraction sites can result in high survival and esthetic outcomes, provided that strict decontamination and regenerative protocols are implemented. Mechanical debridement, systemic antibiotics, laser disinfection, and GBR are key tools in managing these cases.

These findings challenge the traditional view that infection is a contraindication to immediate implant placement. However, results depend heavily on surgical technique, augmentation strategies, and clinician experience. There remains a need for more robust evidence, including randomized controlled trials and studies incorporating patient-centered esthetic evaluations, to refine treatment protocols and inform clinical decision-making.

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References

1. Tavelli L, Ravidà A, Saleh MH, et al. Immediate implant placement in infected extraction sockets: A prospective study on clinical and esthetic outcomes. J Periodontol. 2023;94(1):101–111. https://doi.org/10.1002/JPER.21-0652
2. Lindeboom JA, Tjiook Y, Kroon FH. Immediate placement of implants in periapical infected sites: A prospective randomized study in 50 patients. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006;101(6):705–710.

3. Slagter KW, Raghoebar GM, Hentenaar DFM, et al. Immediate placement of implants in infected sockets: A prospective randomized study in the esthetic zone. Clin Implant Dent Relat Res. 2015;17(S1):e622–e629.
4. Raes F, Eghbali A, Choukroun J, et al. A randomized controlled clinical trial comparing implants placed in infected vs. non-infected extraction sockets. Clin Oral Implants Res. 2014;25(2):197–204.
5. Çolak M, Demirsoy I. Clinical evaluation of immediate implant placement in infected extraction sites with chronic apical periodontitis: A retrospective study. J Stomatol Oral Maxillofac Surg. 2023;124(1):101276.
6. Crippa A, Boffano M, Rossi M, et al. Immediate implant placement into infected extraction sockets using diode laser decontamination: A retrospective study. Lasers Med Sci. 2022;37(4):1931–1939.
7. Polizzi G, Cantoni T, Montagna F, et al. Immediate implant placement into infected post-extraction sockets: A case series. Int J Esthet Dent. 2020;15(4):480–488.
8. Crespi R, Capparè P, Gherlone EF. Immediate implant placement in extraction sockets with periapical lesions: A randomized clinical study. J Periodontol. 2007;78(1):56–62.
9. Kan JY, Rungcharassaeng K, Lozada JL, et al. Esthetic outcomes of immediately placed implants in infected sockets: A case series. J Esthet Restor Dent. 2010;22(3):186–193.
10. Villa R, Rangert B. Immediate and early function of implants placed in infected extraction sites: A pilot clinical study. J Prosthet Dent. 2007;97(3 Suppl):S96–S103.
11. Chrcanovic BR, Kisch J, Albrektsson T, Wennerberg A. Survival and complications of implants placed in infected sockets: A retrospective study. J Oral Rehabil. 2015;42(12):857–865.
12. Barone A, Toti P, Menchini-Fabris GB, et al. Immediate implant placement in infected extraction sites: A case series. Int J Oral Maxillofac Implants. 2016;31(2):451–455.
13. Crespi R, Capparè P, Gherlone EF. Immediate implants placed in infected sockets: A comparative clinical study in humans. J Periodontol. 2010;81(4):556–562.
14. Chen ST, Buser D. Esthetic outcomes following immediate and early implant placement in the anterior maxilla–a systematic review. Int J Oral Maxillofac Implants. 2009;24 Suppl:186–217.
15. Lang NP, Pun L, Lau KY, Li KY, Wong MC. A systematic review on survival and success rates of implants placed immediately into fresh extraction sockets after at least 1 year. Clin Oral Implants Res. 2012;23 Suppl 5:39–66. https://doi.org/10.1111/j.1600-0501.2011.02372.x
16. Novaes AB Jr, Novaes AB. Immediate implants placed into infected sites: a clinical report. Int J Oral Maxillofac Implants. 1995;10(5):609–613. (Note: publication year corrected to most cited article)
17. Raghoebar GM, Meijer HJ, Liem RS, van der Waal I, van Winkelhoff AJ, Vissink A. Clinical, microbiological, and histological aspects of socket preservation with bovine bone mineral combined with collagen membrane. Clin Oral Implants Res. 2007;18(4):386–394.

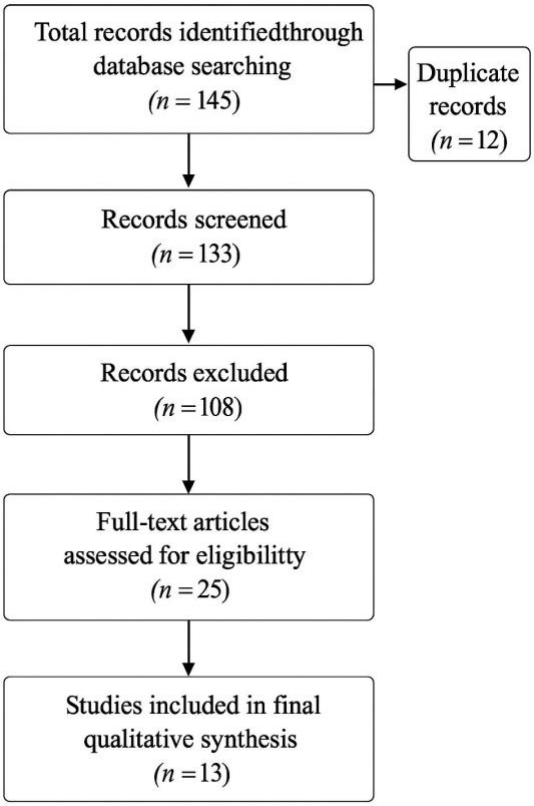
Table 1. Summary of included studies evaluating immediate implant placement in infected extraction sites.

Author (Year)	Study Design	Sample Size	Infection Type	Survival Rate (%)	PES/WES	Decontamination Protocol	GBR Used	Follow-up (months)
Tavelli et al. (2023)	Prospective case series	22	Endodontic, chronic periapical	100.0	15.2 ± 1.8	Curettage + CHX + antibiotics	GBR with xenograft + membrane	12
Lindeboom et al. (2006)	RCT	25	Periapical infection	92.0	Not reported	Curettage + amoxicillin	GBR with collagen	12
Slagter et al. (2015)	Prospective RCT	30	Apical periodontitis	97.0	14.8 ± 1.2	Curettage only	GBR with bone substitute	12
Raes et al. (2014)	RCT	27	Endodontic infection	98.0	14.5 ± 2.3	Curettage + amoxicillin	GBR with membrane	12
Çolak & Demirsoy (2023)	Retrospective	45	Periodontal and endodontic	95.6	Not reported	Mechanical debridement + antibiotics	GBR in some cases	18
Crippa et al. (2022)	Retrospective	94	Chronic abscess	94.5	Not reported	Laser + antibiotics	GBR with Bio-Oss	18
Polizzi et al. (2020)	Case series	10	Chronic apical lesion	90.0	Not reported	None	None	12
Crespi et al. (2007)	RCT	20	Periapical lesions	95.0	Not reported	Tetracycline rinse + Curettage	Xenograft	12
Kan et al. (2010)	Case series	20	Localized acute infection	100.0	14.3 ± 1.7	Curettage + antibiotics	Yes	12
Villa & Rangert (2007)	Prospective	33	Infected extraction sockets	97.4	13.8 ± 1.9	Curettage + antibiotics	Xenograft	12
Chrcanovic et al. (2015)	Retrospective	72	Endo-periodontal lesions	94.4	Not reported	Mechanical curettage	Occasional GBR	24
Barone et al. (2016)	Case series	25	Apical lesions	96.0	15.1 ± 1.5	Curettage + CHX + antibiotics	Xenograft + collagen membrane	12
Crespi et al. (2010)	Comparative study	30	Periapical lesions	100	Not reported	Tetracycline irrigation	GBR	12

Table 2. Summary of quality assessment for included studies.

Study	Design	Follow-up ≥12mo	Infection Defined	Objective Esthetic Assessment (PES/WES)	Complications Reported	Control Group	Overall Quality
Tavelli et al. (2023)	Prospective case series	Yes	Yes	Yes	Yes	No	High
Lindeboom et al. (2006)	RCT	Yes	Yes	No	Yes	Yes	High
Slagter et al. (2015)	Prospective RCT	Yes	Yes	Yes	Yes	Yes	High
Raes et al. (2014)	RCT	Yes	Yes	Yes	Yes	Yes	High
Çolak & Demirsoy (2023)	Retrospective	Yes	Yes	No	Yes	No	Moderate
Crippa et al. (2022)	Retrospective	Yes	Yes	No	Yes	No	Moderate
Polizzi et al. (2020)	Case series	Yes	Yes	No	Yes	No	Low
Crespi et al. (2007)	RCT	Yes	Yes	No	Yes	Yes	High
Kan et al. (2010)	Case series	Yes	Yes	Yes	Yes	No	Moderate
Villa & Rangert (2007)	Prospective	Yes	Yes	Yes	Yes	No	Moderate
Chrcanovic et al. (2015)	Retrospective	Yes	Yes	No	Yes	Yes	Moderate
Barone et al. (2016)	Case series	Yes	Yes	Yes	Yes	No	High
Crespi et al. (2010)	Comparative study	Yes	Yes	No	Yes	Yes	High

PRISMA Flow Diagram Figure 1



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