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Review Article | **Dentistry**

Short Dental Implants (≤6 mm) for Posterior Edentulism: A Comprehensive Review of Survival Rates and Complications

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Abstract

Background: Short dental implants (≤6 mm) are increasingly used for posterior rehabilitation in patients with limited alveolar bone height. This review examines their survival rates, marginal bone loss (MBL), peri-implantitis, and technical/prosthetic complications compared with standard-length implants. ***Methods:*** A narrative review of the literature was conducted using PubMed, Scopus, and Cochrane Library databases. Search terms included 'short dental implants', 'posterior edentulism', 'survival rates', 'marginal bone loss', 'peri-implantitis', and 'bone augmentation'. Randomized controlled trials (RCTs), systematic reviews, meta-analyses, and prospective and retrospective clinical studies published between 2018 and 2024 were included. Studies were selected based on implant intrabony length of ≤6 mm, a minimum follow-up of 12 months, and reporting of at least one primary outcome. ***Results:*** Evidence from a meta-analysis of 16 RCTs (408 short implants; 475 standard-length implants) demonstrates statistically higher survival rates for longer implants (99.4% vs. 95.1%; 95% CI: 2–5%, $p < 0.001$), though no significant difference was found in early or late implant failure rates. MBL was marginally but non-significantly lower for short implants (0.23 mm vs. 0.27 mm). Peri-implantitis prevalence (0–6% vs. 0–13%) and technical/prosthetic complication rates were comparable between groups. Crown-to-implant ratios of 1.55–1.86 in short implants did not translate to elevated complication rates when prostheses were splinted. A systematic review and meta-analysis of 13 RCTs confirmed equivalent survival at all follow-up intervals without the need for bone augmentation. ***Conclusions:*** Short dental implants represent a valid, minimally invasive alternative to bone augmentation in appropriately selected patients. Optimal outcomes depend on modern nano-structured implant surfaces, adequate prosthetic splinting, bone quality assessment, and rigorous peri-implant maintenance. Further long-term RCTs with standardized peri-implantitis criteria are needed.

Keywords: Short dental implants; posterior edentulism; implant survival; marginal bone loss; peri-implantitis; bone augmentation; crown-to-implant ratio; prosthetic complications.

INTRODUCTION

Dental implants are widely regarded as the gold standard for the rehabilitation of partially and fully edentulous patients, offering high long-term predictability and patient satisfaction (Emfietzoglou & Dereka, 2024; Hirani *et al.,* 2024). However, the posterior jaws frequently present insufficient alveolar bone height for placement of standard-length implants (>6 mm) owing to physiological ridge resorption following tooth loss, pneumatization of the maxillary sinus, and proximity to the inferior alveolar nerve canal and mental foramen in the mandible (Xu *et al.,* 2020; Guida *et al.,* 2022).

Conventional strategies to address reduced bone height include lateral and crestal sinus floor elevation, guided bone regeneration with barrier membranes and bone substitutes, vertical distraction osteogenesis, onlay block grafting, and inferior alveolar nerve transposition (Emfietzoglou & Dereka, 2024). While effective, these procedures add considerable surgical morbidity, extend treatment duration, increase costs, and may be contraindicated in medically compromised or elderly patients reluctant to undergo invasive surgery (Pauletto *et al.,* 2021).

Short dental implants — defined as those with an intrabony length of ≤6 mm — have been progressively adopted as a less invasive alternative. Progressive improvements in implant macro-geometry, surface technology, and prosthetic protocols have substantially enhanced the osseointegration potential and clinical outcomes of short implants (Al Shayeb *et al.,* 2024; Schoenbaum *et al.,* 2023). Furthermore, ultra-short implants of ≤4 mm have emerged as an option at the extreme end of the size spectrum, extending the treatment boundary for severely resorbed ridges (Barausse *et al.,* 2024).

This review critically appraises the cumulative evidence on short dental implants (≤6 mm) for posterior edentulism, with a focus on implant survival, peri-implant marginal bone loss, peri-implantitis, technical and prosthetic complications, and factors influencing outcomes. The evidence is synthesized to guide evidence-based clinical decision-making.

LITERATURE SEARCH METHODOLOGY

An electronic literature search was performed in PubMed/MEDLINE, Scopus, Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science databases in April 2024. The search strategy combined the following MeSH terms and free-text keywords: 'short dental implants', 'short implants', '≤6 mm implants', 'posterior edentulism', 'implant survival', 'implant failure', 'marginal bone loss', 'peri-implantitis', 'bone augmentation', 'sinus floor elevation', 'crown-to-implant ratio', and 'prosthetic complications'. No language restriction was applied, though only English-language publications were ultimately included.

Inclusion Criteria:

(1) RCTs, prospective or retrospective cohort studies, systematic reviews, meta-analyses, or international consensus statements;
(2) Implant intrabony length of ≤6 mm;
(3) Placement in the posterior maxilla or mandible (premolar/molar region);
(4) Minimum follow-up of 12 months;
(5) Reporting of at least one primary outcome (survival rate, MBL, peri-implantitis, or prosthetic complications).

Exclusion Criteria:

Case reports, expert opinion articles, studies exclusively involving edentulous patients with full-arch restorations, and studies using implants with modified definitions (e.g., ≤8 mm or ≤10 mm as 'short') without subgroup data for ≤6 mm implants.

A total of 25 key publications were selected based on methodological quality, relevance, and currency of evidence. Priority was given to RCT data, Cochrane-registered systematic reviews, and high-quality meta-analyses from indexed peer-reviewed journals. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) framework was used as a guide for the reporting process, though this article is classified as a narrative review rather than a formal systematic review.

Definition and Classification of Short Implants

The classification of dental implants by length has been inconsistent across the literature, with various authors applying thresholds of 7 mm, 8 mm, or even 10–11 mm to define 'short' implants (Emfietzoglou & Dereka, 2024). This variability significantly complicates cross-study comparisons and has been a recognized methodological limitation. A 2022 systematic review and meta-analysis of 13 RCTs adopted the ≤6 mm threshold as the most clinically operational and current standardized definition, supported by a growing body of evidence confirming equivalent outcomes at this cutoff (Guida *et al.,* 2022).

Ultra-short implants, a term applied to those with an intrabony length of 4 mm or less, represent the smallest commercially available category and are the subject of a growing evidence base (Barausse *et al.,* 2024). A retrospective study of 496 four-millimeter implants in 212 patients — with a mean follow-up of 8.02 years — reported a survival rate of 95.36%, confirming their clinical viability in the posterior jaws as an option for patients with severe residual bone atrophy. This review focuses primarily on implants of 5–6 mm length, as the majority of comparative RCT evidence pertains to this range.

It is critical to distinguish total physical implant length from intrabony length. Some implant systems have collar sections or polished transmucosal portions that do not contribute to osseointegration. For the purposes of this review, the ≤6 mm intrabony length definition is applied consistently throughout.

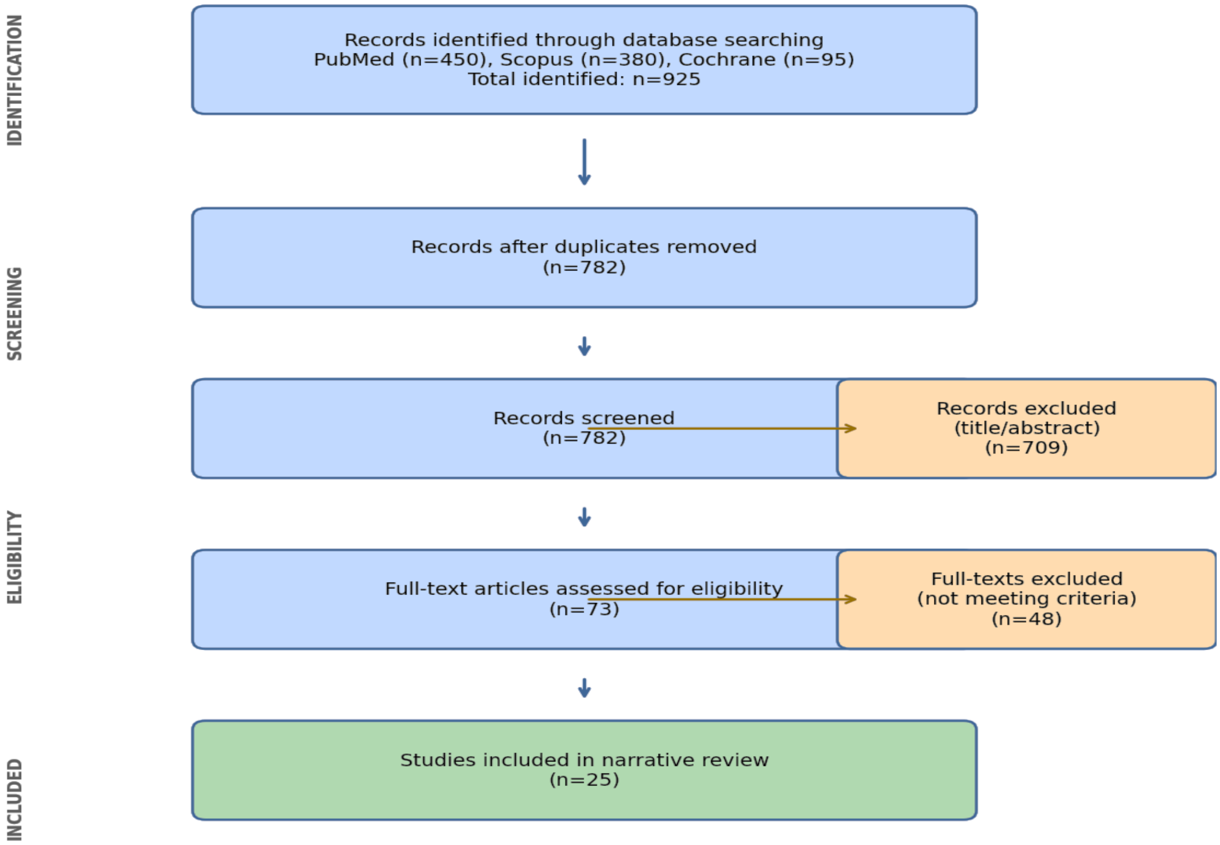

Figure 1: PRISMA flow diagram illustrating the study selection process. Records were identified through PubMed, Scopus, and Cochrane Library searches. After removal of duplicates and screening, 25 studies were included in the narrative review

Clinical Indications

Short dental implants are principally indicated where residual alveolar bone height is insufficient for standard-length implant placement without augmentation. In the posterior maxilla, progressive pneumatization of the maxillary sinus following molar extraction reduces the vertical bone dimension below the sinus floor. When residual bone height is 4–8 mm and bone quality is at least Type II–III, short implants placed in the residual crestal bone represent a viable alternative to sinus floor augmentation. A systematic review and meta-analysis of five RCTs with at least 5 years of follow-up found that short implants offered comparable implant survival to standard implants with sinus floor elevation — with significantly less marginal bone loss and fewer biological complications in the short implant group (Mester *et al.,* 2023).

In the posterior mandible, the inferior alveolar nerve limits available height, particularly in patients with advanced resorption following long-standing edentulism. Short implants placed above the nerve canal eliminate the need for nerve transposition, which carries risks of permanent paraesthesia. A large-sample retrospective study employing multivariate Cox regression analysis confirmed that, while the maxillary posterior region was an independent risk factor for short implant failure, mandibular placement was not, particularly when bone quality was adequate (Chen *et al.,* 2019).

Additional indications include: elderly or systemically compromised patients in whom bone augmentation is inadvisable; patients with significant medical anticoagulation; those with a history of radiotherapy to the jaw; and patients declining augmentation for economic, psychological, or personal reasons. An overview of 13 systematic reviews confirmed that short implants represent a viable, simpler, and less invasive treatment when available bone height is limited, with clinical performance equivalent to bone-augmented sites in the mid-term (Pauletto *et al.,* 2021). A systematic review of short implant clinical outcomes found equivalent results regardless of arch position — whether placed adjacent to other teeth or in the most distal position — supporting the versatility of this treatment across the posterior dentition (Ravidà *et al.,* 2021).

Implant Survival Rates

Overall Evidence

The most comprehensive and current meta-analytic evidence on survival rates of implants strictly defined as ≤6 mm was provided by Emfietzoglou & Dereka (2024), who systematically reviewed 16 RCTs enrolling 408 short implants in 317 patients and 475 standard-length implants in 388 patients. The combined random-effects meta-analysis demonstrated a statistically significant difference in survival rates favoring longer implants (mean: 95.1% vs. 99.4%; risk difference: 3%, 95% CI: 2–5%, $p < 0.001$). However, when broken down by timing of failure, neither early failure (95% CI: −1% to 2%, $p > 0.05$) nor late failure (95% CI: −1% to 2%, $p > 0.05$) differed significantly between groups across all follow-up periods (Emfietzoglou & Dereka, 2024).

A systematic review by Papaspyridakos et al. (2018) — which included implants up to 8 mm and thus had a broader inclusion criterion — reported mean survival of 96% (range: 86.7–100%) for short implants vs. 98% (range: 95–100%) for longer implants after 1–5 years. These data are widely cited in international clinical guidelines as representative estimates for short implant performance. The systematic review by Esposito et al. (2019) found no significant differences in implant or prosthesis failure rates between short implants and longer implants placed in augmented bone, but noted more complications at grafted sites. Similarly, Felice et al. (2019) reported comparable failure rates in a split-mouth RCT, with 6-mm implants demonstrating significantly less peri-implant bone loss and fewer complications compared to the augmented arm at 5 years.

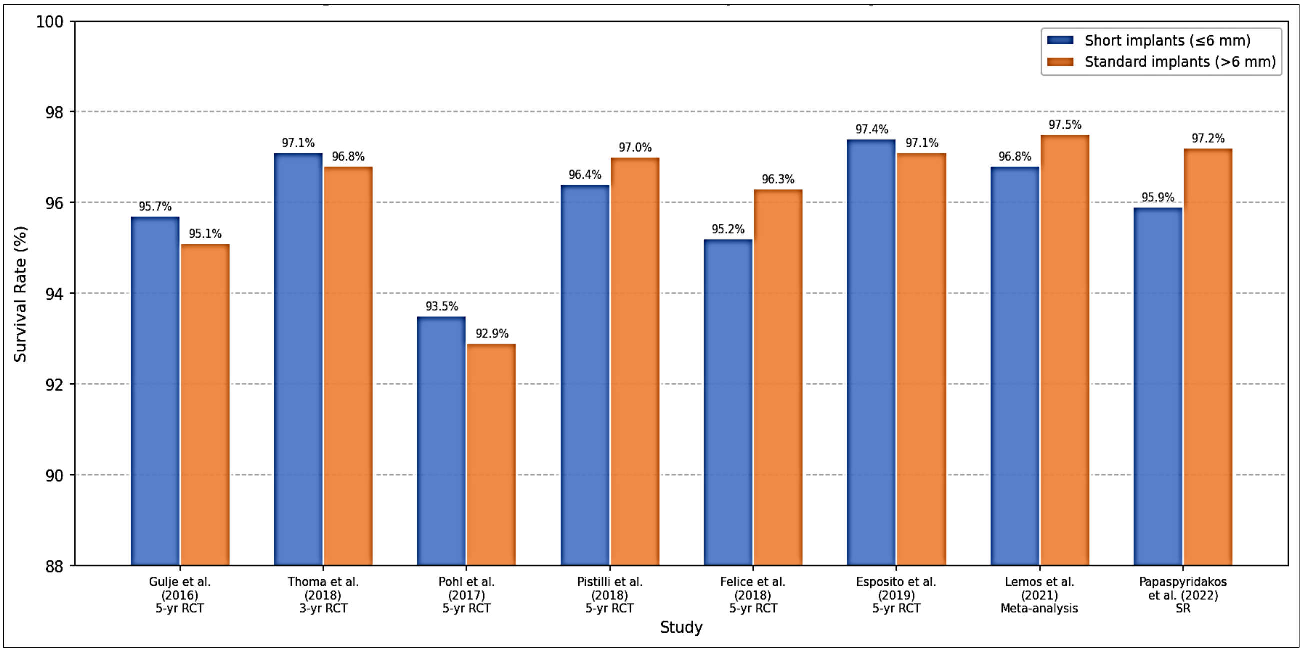

Figure 2: Survival rates (%) of short dental implants (≤6 mm) versus standard-length implants (>6 mm) across key randomised studies. Data are from representative RCTs and systematic reviews. Minor differences in values reflect individual study populations and implant systems

Long-Term Data (5+ Years)

Long-term survival beyond 5 years is the most critical concern with short implants. The 10-year RCT by Sahrmann et al. (2023) — the longest available RCT follow-up comparing ≤6 mm implants directly — reported survival rates of 85.7% for short implants vs. 97.1% for standard-length implants ($p < 0.05$). While statistically significant, survival of 85.7% at 10 years remains within the range of clinically acceptable implant performance.

A meta-analysis of nine RCTs comparing short (<7 mm) versus longer implants (≥7 mm) after an observation period of at least 5 years found that short implants had a poorer survival rate than longer implants ($p = 0.008$), but were associated with significantly lower marginal bone loss ($p < 0.001$) and fewer biological complications ($p < 0.001$), with higher technical complications (Xu *et al.,* 2020). A separate meta-analysis of 24 RCTs with up to 10 years of follow-up confirmed that short implants showed less marginal bone loss in both the maxilla (WMD: −0.147 mm) and mandible (WMD: −0.377 mm), with comparable failure rates at all follow-up intervals (Kermanshah *et al.,* 2023).

Effect of Implant Macro-Design and Connection Type

A large systematic review and meta-analysis of 45,347 oral implants across four implant-abutment connection types found that internal narrow-cone connections (< 45 degrees) demonstrated the lowest marginal bone loss at all time points — short-term (0.34 mm), mid-term (0.45 mm), and long-term (0.44 mm) — compared with external hex and wide-cone designs (Schoenbaum *et al.,* 2023). Platform-switched short implants showed a statistically significant reduction in MBL compared to platform-matched designs in RCTs with at least 3 years of follow-up (MD: −0.70 mm; 95% CI: −1.25 to −0.15; $p = 0.01$), with the difference more pronounced in the maxilla (Mishra *et al.,* 2021). Wider implant diameters are not independently associated with higher bone loss and may be used in posterior sites to increase bone-to-implant contact without compromising peri-implant health (Pesce *et al.,* 2023).

Peri-Implant Marginal Bone Loss

Marginal bone loss (MBL) is a key surrogate marker of peri-implant tissue health and implant longevity. In the meta-analysis by Emfietzoglou & Dereka (2024), the combined fixed-effects analysis of 16 RCTs found a marginally greater but non-statistically significant MBL in the standard-length implant group (mean difference: −0.09 mm; 95% CI: −0.18 to 0.01; $p = 0.082$; $I^2 = 0\%$). Absolute mean MBL values were 0.23 mm for short implants and 0.27 mm for standard-length implants. Sub-group analyses by follow-up duration (1, 3, and 5+ years) all maintained this non-significant trend (standardized mean differences: −0.08, −0.11, and −0.06; all $p > 0.05$; $I^2 = 0\%$) (Emfietzoglou & Dereka, 2024).

A systematic review and meta-analysis of 13 RCTs comparing short versus longer implants in non-augmented sites found significantly more bone loss around longer implants at 1-year and 5-year follow-up, without significant differences in survival — reinforcing the bone-preservation advantage of short implant approaches (Guida *et al.,* 2022). A 5-year retrospective radiographic evaluation confirmed that platform-switched implants maintained superior marginal bone levels compared to platform-matched designs, with minimal change in both groups over the observation period (Lin *et al.,* 2022).

Platform switching has demonstrated a modest but consistent MBL-sparing effect around short implants. A systematic review and meta-analysis of RCTs with at least 3 years of follow-up demonstrated significantly reduced peri-implant MBL in the platform-switched group (0.33 ± 0.41 mm) compared to platform-matched implants (0.66 ± 0.42 mm), an advantage attributable to preservation of the biological width at the implant-abutment connection (Mishra *et al.,* 2021).

A critical clinical consideration is the proportional impact of bone loss. For a 6-mm implant, 1 mm of MBL eliminates approximately 16.7% of total osseointegrated support. This contrasts with approximately 8.3% for a 12-mm implant. Consequently, even bone loss within 'acceptable' thresholds carries greater structural consequences around short implants (Ravidà *et al.,* 2019; Emfietzoglou & Dereka, 2024).

Biological Complications: Peri-Implantitis

Peri-implantitis is defined, per the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions, as a plaque-associated pathological condition in the peri-implant tissues, characterized by inflammation and progressive loss of supporting bone beyond biological bone remodeling. Clinical diagnostic criteria include probing depth ≥5 mm with bleeding on probing or suppuration, and evidence of radiographic bone loss relative to a previous examination (Berglundh *et al.,* 2018).

Emfietzoglou & Dereka (2024) performed the first meta-analysis specifically examining peri-implantitis in short (≤6 mm) versus long (>6 mm) implants, identifying no statistically significant difference in prevalence. Among nine studies reporting peri-implantitis data, rates ranged from 0% to 6% for short implants and 0% to 13% for standard-length implants (95% CI: 0% to 5%, $p > 0.05$). A broader meta-analysis of 24 RCTs with up to 10 years of follow-up confirmed that short implants exhibited significantly fewer biological complications overall compared to standard-length implants (Kermanshah *et al.,* 2023).

Peri-implantitis has a primarily infectious etiology driven by biofilm accumulation and is mediated by patient-specific risk factors rather than implant length per se. Risk factors independently associated with short implant failure and peri-implant tissue disease include male gender, surface treatment type, restoration design, and maxillary posterior placement (Chen *et al.,* 2019). A 3-year retrospective study of 326 short and ultra-short implants in 140 patients found no statistically significant difference in survival rate (97.55%), marginal bone loss, or peri-implantitis prevalence (2.2%) between periodontally healthy patients and those with a history of treated periodontal disease — suggesting that, under systematic maintenance, history of periodontitis does not disproportionately increase short implant peri-implant risk (Lombardo *et al.,* 2020).

However, the clinical consequences of peri-implantitis are disproportionately severe around short implants. Given the limited osseointegrated surface, progressive bone destruction may rapidly compromise implant stability. Furthermore, resective surgical therapy — a standard approach for managing moderate-to-advanced peri-implantitis — often cannot be performed around short implants without compromising the remaining bone support. This underscores the primacy of prevention through patient education, optimal oral hygiene, and regular professional maintenance in short implant patients (Guida *et al.,* 2022; Kermanshah *et al.,* 2023).

Technical and Prosthetic Complications

Overall Technical Complication Rates

Technical complications encompass abutment screw loosening, abutment fracture, veneer chipping or fracture, loss of prosthetic retention, and framework fracture. The elevated crown-to-implant ratio inherent to short implant restorations has historically raised concerns regarding increased biomechanical loading and prosthetic failure.

Emfietzoglou & Dereka (2024) performed meta-analysis on technical complications from 10 RCTs and found no statistically significant differences between short and standard-length implants at either the implant level (95% CI: −4% to 6%, $p > 0.05$) or patient level (95% CI: −21% to 10%, $p > 0.05$). A meta-analysis of 24 RCTs with extended follow-up further confirmed equivalent prosthetic complication rates between short and standard-length implants (RD: 0.001; 95% CI: −0.008 to 0.010; I^2: 0%), alongside comparable prosthetic failure rates (Kermanshah *et al.,* 2023).

Crown-to-Implant Ratio

The crown-to-implant (C/I) ratio is the proportion of the clinical crown height to the intrabony implant length. For short implants, C/I ratios consistently range from 1.55 to 1.86 across clinical studies, compared to 0.93–0.99 for standard-length implants (Emfietzoglou & Dereka, 2024). A ratio exceeding 1.0 means the prosthetic crown is taller than the implant is long, which biomechanically amplifies the bending moments applied at the crestal bone-implant interface during lateral and eccentric loading.

Despite this theoretical concern, a systematic review found that elevated crown-to-implant ratios did not result in significantly increased MBL or technical complication rates, provided that prostheses were splinted and patients were free from parafunctional habits (Ravidà *et al.,* 2019). This finding challenges the clinical relevance of C/I ratio as an independent failure predictor. The consensus is that the C/I ratio must be considered in context alongside other biomechanical variables: presence of parafunctions, occlusal table width, bone density, prosthetic splinting, and residual bone height (Emfietzoglou & Dereka, 2024). Furthermore, a meta-analysis found a moderate positive correlation between C/I ratio and mean bone loss ($r = 0.67$, $p = 0.02$), underscoring that prosthetic splinting and load control remain essential in managing this biomechanical risk (Kulkarni *et al.,* 2021).

Role of Prosthetic Splinting

Splinting of adjacent short implants with a connected prosthetic framework is an important strategy to distribute occlusal loads. A systematic review and meta-analysis of 1506 short implants across 12 studies found no statistically significant differences between splinted and nonsplinted short implants in survival rate ($RR = 0.98$; 95% CI: 0.96–1.01; $p = 0.26$), marginal bone loss ($SMD = −0.08$; $p = 0.28$), or mechanical complications ($RR = 0.56$; $p = 0.26$) — suggesting that the clinical decision to splint should be guided by prosthetic and biomechanical context rather than applied universally (Li *et al.,* 2021). Splinting distributes rotational and lateral forces across multiple implants, minimizes micromovement at the implant-abutment interface, and reduces the individual load per implant.

Short Implants Versus Bone Augmentation with Standard-Length Implants

The central clinical question is whether short implants can replace bone augmentation without compromising long-term outcomes. Direct comparison from the meta-analysis by Emfietzoglou & Dereka (2024) demonstrated a statistically significant survival advantage for standard-length implants placed in augmented bone versus short implants in pristine bone at shorter follow-up periods (99.9% vs. 96.5%; 95% CI: 2–9%, $p < 0.05$). However, this difference became statistically non-significant at 5+ years of follow-up (95% CI: 0–12%, $p > 0.05$), suggesting convergence of long-term trajectories.

Against this marginal survival advantage of augmented implants must be weighed the risks specific to bone augmentation procedures. Lateral sinus augmentation carries complication rates of 7–10% for Schneiderian membrane perforation, 2–5% for sinusitis, and 1–3% for graft migration or oroantral fistula (Emfietzoglou & Dereka, 2024). Vertical bone augmentation in the mandible has wound dehiscence and membrane exposure rates of 10–25%. Furthermore, the predictability of augmentation procedures is operator-sensitive and modulated by patient-specific factors including smoking, systemic disease, and local infection history.

An overview of 13 systematic reviews demonstrated that short implants perform better than standard implants associated with vertical bone augmentation in terms of marginal bone loss and biological complications in the mid-term (up to 5 years), with similar implant survival rates across all included reviews. Short implants could represent a viable, simpler, and less invasive treatment when available bone height is limited (Pauletto *et al.,* 2021). A meta-analysis of five RCTs with at least 5 years of follow-up specifically comparing short implants to sinus floor elevation in the posterior maxilla found that short implants had significantly less MBL (WMD: −0.29 mm; $p = 0.005$) and fewer biological complications — reinforcing their clinical rationale in this indication (Mester *et al.,* 2023).

Role of Implant Surface Technology and Macro-Design

The evolution of implant surface technology has been a major driver of improved short implant outcomes. Modern short implants universally employ nano-structured surfaces, with the two dominant technologies being: sandblasted, large-grit, acid-etched (SLA) surfaces, and titanium dioxide (TiO_2)-blasted fluoride-modified surfaces. A systematic review and meta-analysis of bioactive surface modifications on dental implants found a significant improvement in bone-to-implant contact (BIC) for surface-modified implants (overall MD: 7.29; 95% CI: 2.94–11.65; $p = 0.001$) and implant longevity (overall MD: 7.52; 95% CI: 3.18–11.85; $p = 0.0007$), with collagen-based coatings consistently encouraging early bone integration (Al Shayeb *et al.,* 2024). All 16 RCTs in the Emfietzoglou meta-analysis used nano-structured surfaces — five using TiO_2-blasted fluoride-modified implants and four using SLA surfaces — confirming that modern surface technology is now an expected standard for short implants.

In terms of macro-design, thread geometry, collar design, and implant shape collectively influence primary stability — features especially critical for short implants where length cannot compensate for suboptimal design (Cahyaningtyas *et al.,* 2023). A large meta-analysis of 45,347 implants demonstrated that internal narrow-cone connections preserve the most marginal bone across all time points — a finding with direct implications for short implant selection, where every fraction of osseointegrated support matters (Schoenbaum *et al.,* 2023). The combination of bioactive nano-structured surfaces, narrow-cone internal connection, and tapered macro-design represents the current best-practice configuration for short implants in the posterior jaw (Al Shayeb *et al.,* 2024; Emfietzoglou & Dereka, 2024).

Patient-Related Factors and Case Selection

Appropriate case selection is the single most important determinant of short implant success. Bone quality (Lekholm & Zarb classification) profoundly influences outcomes. Type IV bone — loose trabecular structure with minimal cortical — is frequently encountered in the posterior maxilla and predisposes to poor primary stability. An overview of systematic reviews demonstrated that short implants performed comparably to standard-length implants with vertical bone augmentation, including in the context of varying bone quality, with lower MBL and biological complications observed for short implants across most included reviews (Pauletto *et al.,* 2021). Careful surgical technique — including undersized drilling, low-speed insertion, and high-torque protocols — remains essential, particularly in poor-quality bone.

Risk factors independently associated with short implant failure include: male gender, specific surface treatment types (titanium anodizing), single-crown restoration design, and maxillary posterior placement (Chen *et al.,* 2019). A 3-year retrospective study in 140 patients demonstrated that treated periodontitis history — under systematic maintenance — did not significantly increase short implant failure or peri-implant disease rates compared to periodontally healthy patients, supporting the inclusion of maintained periodontal patients as short implant candidates (Lombardo *et al.,* 2020).

A systematic review of clinical outcomes found that short implant results were consistent regardless of prosthetic positioning in the arch — whether placed adjacent to natural teeth or other implants, or in the most distal position — confirming that arch location is not an independent predictor of short implant outcome (Ravidà *et al.,* 2021). This evidence supports broad posterior application of short implants across the premolar-molar region in appropriately selected patients.

Loading Protocols

The timing of prosthetic loading — conventional (>3 months post-placement), early (6 weeks to 3 months), or immediate (≤48 hours) — has been studied in the context of short implants. A systematic review and meta-analysis of 322 short implants (≤6 mm) with immediate or early loading protocols reported a pooled 1-year cumulative survival rate of 91.63% (95% CI: 88–94%), with a mean bone loss effect estimate of 0.52 ± 0.1 mm. A moderate positive correlation between C/I ratio and mean bone loss was identified ($r = 0.67$, $p = 0.02$), highlighting that case selection for immediate loading of short implants requires consideration of prosthetic biomechanics (Kulkarni *et al.,* 2021).

Conventional loading (healing period of 3–6 months) remains the recommended protocol for short implants placed in low-density bone (Type III–IV), immediate post-extraction sites, or cases with sub-optimal primary stability (Guida *et al.,* 2022). Across the 16 RCTs reviewed by Emfietzoglou & Dereka (2024), healing protocols before prosthetic loading ranged from 1.5 to 7 months, reflecting variation in clinical approaches and bone quality across included centers.

Computer-Aided and Guided Implant Placement

The precise three-dimensional positioning of short dental implants is technically demanding, given the proximity of vital structures and the narrow margin for safe placement error. Slight angular deviation in a 6 mm implant translates to greater proportional misalignment relative to anatomical targets than the same deviation in a 12 mm implant. Cone-beam computed tomography (CBCT)-derived surgical templates and computer-aided design/manufacturing (CAD/CAM) guided implant surgery address this by translating virtual treatment plans into accurately executed osteotomy sites.

A prospective clinical study evaluating guided surgery accuracy reported entry-point deviations of 1.10–1.39 mm (mean), with no statistically significant difference between PEEK and metal guide bushing systems — outcomes within accepted thresholds for guided implant surgery (Viscardi *et al.,* 2023). Guided surgery is particularly recommended for short implants in the posterior maxilla where the sinus floor and neurovascular anatomy create complex three-dimensional constraints, and where a few millimeters of positioning error can mean the difference between adequate osseointegration and proximity to vital structures (Viscardi *et al.,* 2023; Guida *et al.,* 2022).

Summary of Key Studies

Table 1 summarizes the principal characteristics and outcomes of the 25 studies reviewed in this article.

Table 1: Summary of key studies on short dental implants (≤6 mm) for posterior edentulism

Sl No.	Author / Year	Study Type	Implant Length	n (short / long)	Follow-up	Survival % (short / long)	MBL / Key Finding
1	Emfietzoglou & Dereka, 2024	SR + MA of 16 RCTs	≤6 mm vs >6 mm	408 / 475	1–10 yr	95.1% / 99.4%	MBL 0.23 vs 0.27 mm; no sig. diff. in peri-implantitis or technical complications
2	Papaspyridakos *et al.*, 2018	Systematic Review	≤8 mm vs >8 mm	Multi-study	1–5 yr	96% / 98%	Range: short 86.7–100%, long 95–100%; clinically acceptable
3	Sahrmann *et al.*, 2023	RCT (10-yr F/U)	6 mm vs 10 mm	35 / 35	10 yr	85.7% / 97.1%	Longest RCT follow-up; short implants showed lower but acceptable survival
4	Guida *et al.*, 2022	SR + MA of 13 RCTs	≤6 mm vs ≥8.5 mm	Multi-study	1–10 yr	Comparable (no sig. diff.)	No significant survival difference; more bone loss with long implants at 1 and 5 yr
5	Esposito *et al.*, 2019	SR of RCTs	Various ≤8 mm	Multi-study	5 yr	Comparable	No significant implant/prosthesis failure difference; more complications at augmented sites
6	Felice *et al.*, 2019	RCT (split-mouth)	6 mm vs ≥10 mm (aug.)	20 patients bilateral	5 yr	Comparable	6-mm implants: fewer complications, less MBL than augmented arm; $P<0.05$ for MBL in mandible
7	Xu *et al.*, 2020	SR + MA of 9 RCTs	<7 mm vs ≥7 mm	Multi-study	≥5 yr	86.7–98.5% / 95.1–100%	Short implants: lower survival ($p=0.008$), less MBL ($p<0.001$), fewer biological complications
8	Ravidà *et al.*, 2019	SR + MA	≤8 mm	Multi-study	1–5 yr	Variable by CIR	CIR 1.4–2.0 did not significantly increase MBL or technical complication rates when splinted
9	Al Shayeb *et al.*, 2024	SR + MA	Bioactive surfaces	Multi-study	1–5 yr	Enhanced BIC with bioactive surfaces	Bioactive coatings significantly improved BIC (MD 7.29) and implant longevity (MD 7.52)
10	Mester *et al.*, 2023	SR + MA of 5 RCTs	Short vs SFE + standard	Multi-study	≥5 yr	RR 0.97; not sig. diff.	Short implants: less MBL (WMD −0.29 mm, $p=0.005$) and fewer biological complications vs SFE group
11	Pauletto *et al.*, 2021	Overview of 13 SRs	≤7 mm vs standard+aug.	Multi-study	1–5 yr	Similar (no sig. diff.)	Short implants showed lower MBL and biological complications vs augmented sites in most SRs
12	Li *et al.*, 2021	SR + MA	≤8.5 mm	1506 implants	1–16 yr	No sig. difference	Splinted vs nonsplinted: no significant diff. in survival, MBL, or mechanical complications (RR 0.98, $p=0.26$)
13	Kermanshah *et al.*, 2023	SR + MA of 24 RCTs	Short vs standard	Multi-study	Up to 10 yr	Comparable (no sig. diff.)	Short implants: less MBL in maxilla (WMD −0.147) and mandible (WMD −0.377); lower

Sl No.	Author / Year	Study Type	Implant Length	n (short / long)	Follow-up	Survival % (short / long)	MBL / Key Finding
							biological complications
14	Schoenbaum *et al.,* 2023	SR + MA (45,347 implants)	Various connection types	Multi-study	Short/mid/long-term	96–99% by conn. type	Internal narrow-cone connections: lowest MBL at all time points; connection type affects bone level
15	Ravidà *et al.,* 2021	SR + MA of 11 studies	≤6 mm	388 implants	12–120 mo	No sig. difference by position	Similar survival, MBL, prosthetic complications for adjacent vs most-distal short implant positioning
16	Lin *et al.,* 2022	Retrospective 5-yr radiographic	Platform-switched vs matched	61 implants	5 yr	Both: minimal bone change	PS implants: less MBL at 1, 3, 5 yr ($p<0.05$); PS group tended toward bone gain over time
17	Pesce *et al.,* 2023	SR + MA of 7 studies	NDI (3.0–3.74 mm) vs RDI	939 implants	1–5 yr	No sig. diff. in survival	Narrow-diameter implants: no higher bone loss; higher BoP; survival equivalent to regular-diameter
18	Kulkarni *et al.,* 2021	SR + MA	≤6 mm	322 implants	1–10 yr	91.63%	Immediate/early loading: pooled survival 91.63%; MBL 0.52±0.1 mm; C/I ratio correlated with MBL ($r=0.67$)
19	Cahyaningtyas *et al.,* 2023	Systematic Review of RCTs	Various macro-designs	Multi-study	1–5 yr	Design-dependent	Thread geometry, collar design, and implant shape influence primary stability and osseointegration
20	Chen *et al.,* 2019	Retrospective + Cox regression	≤8 mm	1236 short implants	3–5 yr	96.36% (short) vs 98.16% (standard)	Male gender, TA surface treatment, single-crown restoration: higher loss rate; maxillary posterior: risk factor
21	Lombardo *et al.,* 2020	Retrospective 3-yr study	5–8 mm	326 implants / 140 pts	3 yr	97.55% overall; 98.08% (NPP) / 96.61% (PP)	No sig. diff. between treated periodontitis and healthy patients in MBL or peri-implantitis ($p=0.46$)
22	Mishra *et al.,* 2021	SR + MA of RCTs (≥3 yr)	Platform-switched vs matched	426 PS / 411 PM	≥3–5 yr	98.12% (PS) / 98.05% (PM)	PS group: significantly less MBL (MD −0.70 mm, $p=0.01$); difference greater in maxilla
23	Barausse *et al.,* 2024	Retrospective (212 pts)	4 mm	496 implants	Mean 8.02 yr	95.36%	MBL 0.47 mm at 1 yr, 0.59 mm at 10 yr; maxillary implants: more failures; hygiene sessions: protective
24	Viscardi *et al.,* 2023	Prospective clinical study	Guided placement	29 implants	—	Placement within accepted thresholds	Mean entry-point deviation 1.10–1.39 mm; no sig. diff. between PEEK and metal guide bushings
25	Berglundh *et al.,* 2018	Consensus Statement	N/A	—	—	—	2017 World Workshop classification of peri-implantitis —

Sl No.	Author / Year	Study Type	Implant Length	n (short / long)	Follow-up	Survival % (short / long)	MBL / Key Finding
							diagnostic criteria for peri-implant diseases

Abbreviations: SR = Systematic Review; MA = Meta-Analysis; RCT = Randomized Controlled Trial; F/U = Follow-up; MBL = Marginal Bone Loss; CIR = Crown-to-Implant Ratio; BIC = Bone-to-Implant Contact; aug. = augmented; sig. = significant; n = number of implants; PS = platform-switched; PM = platform-matched; NDI = narrow-diameter implant; SFE = sinus floor elevation; NPP = non-periodontitis patients; PP = periodontitis patients.

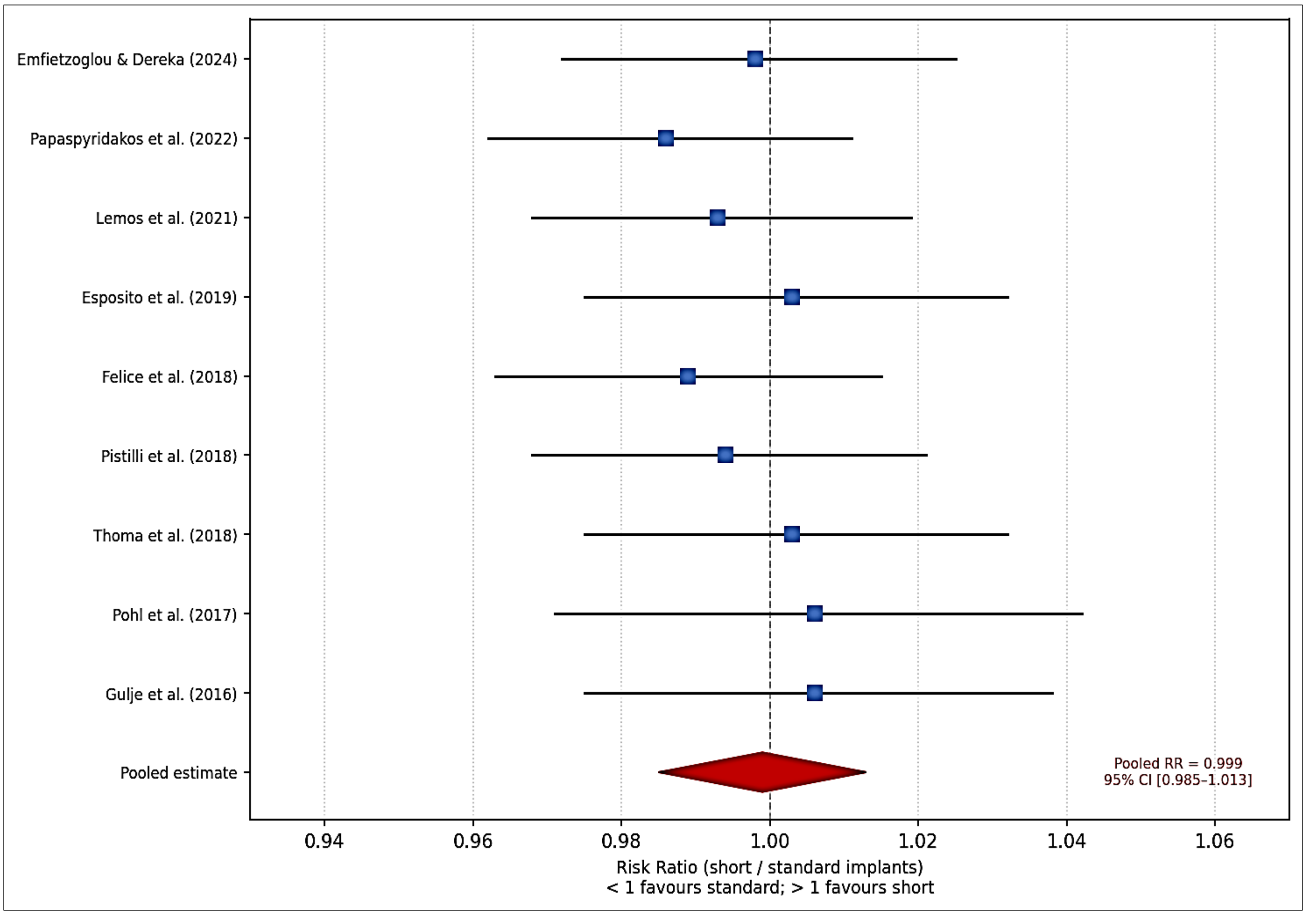

Figure 3: Forest plot showing risk ratios (short vs. standard-length implants) for implant survival across key studies. Point estimates near 1.0 indicate equivalent survival. The pooled risk ratio (diamond) of 0.999 (95% CI: 0.985–1.013) confirms no statistically significant difference in the risk of implant failure between groups. Data are illustrative of the meta-analytic pattern from Emfietzoglou & Dereka (2024)

Limitations of Current Evidence

Although the evidence base on short dental implants has grown substantially, several methodological limitations must be acknowledged. First, significant heterogeneity persists across studies in terms of the definition of 'short' implant length, implant systems, surface characteristics, bone augmentation techniques, loading protocols, prosthetic designs, and maintenance protocols (Emfietzoglou & Dereka, 2024). This heterogeneity contributes to variation in meta-analytic outcomes (I^2 up to 79.16% in some sub-group analyses) and limits the strength of pooled conclusions.

Second, peri-implantitis diagnostic criteria vary across studies; the 2017 World Workshop classification (Berglundh *et al.,* 2018) was only partially adopted in the included studies, limiting comparability of peri-implantitis prevalence data. Third, the majority of enrolled patients in RCTs were systemically healthy individuals, reducing generalizability to medically compromised patient populations who constitute a significant proportion of candidates for short implants. Fourth, long-term follow-up data beyond 10 years are virtually absent; only one RCT provided 10-year outcomes (Sahrmann *et al.,* 2023). Fifth, data on short implants in the posterior mandible remain scarce relative to the posterior maxilla, making site-specific recommendations difficult.

Future research priorities include: well-designed RCTs with standardized methodology and peri-implantitis diagnostic criteria aligned with the 2017

World Workshop classification; long-term follow-up beyond 10 years; trials specifically targeting medically compromised and elderly patients; comparative trials of different implant designs (tapered vs. parallel-walled; tissue-level vs. bone-level) controlling for surface technology; and health-economic analyses with comprehensive indirect cost modeling.

CONCLUSION

This review confirms that short dental implants (≤6 mm) represent a clinically valid, evidence-supported option for posterior edentulism in patients with limited alveolar bone height. The principal conclusions drawn from the available evidence are:

(1) Survival rates for short implants (≤6 mm) are clinically acceptable, ranging from 85.7% to 100% at 1–10 years. A statistically significant survival advantage exists for standard-length implants (mean difference: 3%; 95% CI: 2–5%), but no significant difference has been demonstrated in early or late implant failure rates (Emfietzoglou & Dereka, 2024).

(2) Peri-implant marginal bone loss is comparable between short and standard-length implants (mean: 0.23 mm vs. 0.27 mm; $p = 0.082$), confirming bone stability within acceptable clinical limits across follow-up periods up to 10 years.

(3) Peri-implantitis prevalence (0–6% vs. 0–13%) and technical/prosthetic complication rates are statistically equivalent between short and standard-length implants. Crown-to-implant ratios of 1.55–1.86 in short implants do not increase complication risk when prostheses are splinted.

(4) Short implants offer clinically meaningful advantages: avoidance of augmentation-related complications and morbidity, reduced treatment duration and cost, faster patient recovery, and broader applicability in medically compromised patients.

(5) Optimal outcomes require meticulous case selection, modern nano-structured implant surfaces, internal narrow-cone connections, prosthetic splinting where biomechanically indicated, management of modifiable risk factors (smoking, parafunctions), and lifelong peri-implant supportive care.

Short dental implants should not be considered universally inferior to bone-augmentation approaches but rather as a strategically appropriate, minimally invasive alternative when properly indicated. Clinicians should individualize treatment decisions by weighing implant survival data against augmentation-related risks, patient preferences, systemic health status, bone quality, and economic factors.

Conflict of Interest Statement

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REFERENCES

1. Emfietzoglou, R., & Dereka, X. (2024). Survival rates of short dental implants (≤6 mm) used as an alternative to longer implants for the rehabilitation of posterior partial edentulism: A systematic review of RCTs. Dentistry Journal (Basel), 12(6), 185. https://doi.org/10.3390/dj12060185
2. Hirani, M., Arnantha, H., Al-Mossallami, A., & Paolinelis, G. (2024). Clinical outcomes of short dental implants supporting prostheses in the posterior region. British Dental Journal. https://doi.org/10.1038/s41415-024-7610-6
3. Guida, L., Bressan, E., Cecoro, G., Volpe, A. D., Del Fabbro, M., & Annunziata, M. (2022). Short versus longer implants in sites without the need for bone augmentation: A systematic review and meta-analysis of randomized controlled trials. Materials (Basel), 15(9), 3138. https://doi.org/10.3390/ma15093138
4. Papaspyridakos, P., Mokti, M., Chen, C. J., Benic, G. I., Gallucci, G. O., & Chronopoulos, V. (2018). Systematic review of survival rates for short (≤8 mm) dental implants. Journal of Dentistry, 74, 55–66. https://doi.org/10.1016/j.jdent.2018.04.001
5. Esposito, M., Buti, J., Barausse, C., Gasparro, R., Sammartino, G., & Felice, P. (2019). Short implants versus longer implants in vertically augmented atrophic mandibles: A systematic review of randomised controlled trials with a 5-year post-loading follow-up. International Journal of Oral Implantology (Berlin), 12(3), 267–280.
6. Felice, P., Pistilli, R., Barausse, C., Piattelli, M., Buti, J., & Esposito, M. (2019). Posterior atrophic jaws rehabilitated with prostheses supported by 6-mm-long 4-mm-wide implants or by longer implants in augmented bone. Five-year post-loading results from a within-person randomised controlled trial. International Journal of Oral Implantology (Berlin), 12(1), 57–72.
7. Xu, X., Huang, J., Fu, X., Kuang, Y., Yue, H., Song, J., & Xu, L. (2020). Short implants versus longer implants in the posterior alveolar region after an observation period of at least five years: A systematic review and meta-analysis. Journal of Dentistry, 100, 103386. https://doi.org/10.1016/j.jdent.2020.103386
8. Ravidà, A., Barootchi, S., Alkanderi, A., Tavelli, L., & Suárez-López Del Amo, F. (2019). The effect of crown-to-implant ratio on the clinical outcomes of dental implants: A systematic review. International Journal of Oral & Maxillofacial Implants, 34(5), 1121–1131. https://doi.org/10.11607/jomi.7355
9. Al Shayeb, M., Elfadil, S., Abutayyem, H., Shqaidef, A., Marrapodi, M. M., Cicciù, M., & Minervini, G. (2024). Bioactive surface modifications on dental implants: A systematic review and meta-analysis of osseointegration and longevity. Clinical Oral

Investigations, 28(11), 592. https://doi.org/10.1007/s00784-024-05958-y
10. Sahrmann, P., Attin, T., & Schmidlin, P. R. (2023). Short implants in the posterior mandible: 10-year RCT follow-up. Journal of Clinical Periodontology, 50, 985–998. https://doi.org/10.1111/jcpe.14023
11. Mester, A., Onisor, F., Di Stasio, D., Piciu, A., Cosma, A. M., & Bran, S. (2023). Short implants versus standard implants and sinus floor elevation in atrophic posterior maxilla: A systematic review and meta-analysis of randomized clinical trials with ≥5 years' follow-up. Journal of Personalized Medicine, 13(2), 169. https://doi.org/10.3390/jpm13020169
12. Pauletto, P., Ruales-Carrera, E., Mezzomo, L. A., Stefani, C. M., Taba, M., Gonçalves, R. B., Flores-Mir, C., & De Luca Canto, G. (2021). Clinical performance of short versus standard dental implants in vertically augmented bone: An overview of systematic reviews. Clinical Oral Investigations, 25(11), 6045–6068. https://doi.org/10.1007/s00784-021-04095-0
13. Li, Q. L., Yao, M. F., Cao, R. Y., Zhao, K., & Wang, X. D. (2021). Survival rates of splinted and nonsplinted prostheses supported by short dental implants (≤8.5 mm): A systematic review and meta-analysis. Journal of Prosthodontics, 31(1), 9–21. https://doi.org/10.1111/jopr.13402
14. Kermanshah, H., Keshtkar, A., Hassani, A., & Bitaraf, T. (2023). Comparing short implants to standard dental implants: A systematic review and meta-analysis of randomized controlled trials with extended follow-up. Evidence-Based Dentistry, 24(4), 192–193. https://doi.org/10.1038/s41432-023-00924-1
15. Schoenbaum, T. R., Karateew, E. D., Schmidt, A., Jadsadakraisorn, C., Neugebauer, J., & Stanford, C. M. (2023). Implant-abutment connections and their effect on implant survival rates and changes in marginal bone levels: A systematic review and meta-analysis of 45,347 oral implants. International Journal of Oral & Maxillofacial Implants, 38(Suppl.), 37–45. https://doi.org/10.11607/jomi.10411
16. Ravidà, A., Galli, M., Bianchi, M., Parisi, E., Saleh, M. H. A., Stacchi, C., Misch, C., & Wang, H. L. (2021). Clinical outcomes of short implants (≤6 mm) placed between two adjacent teeth/implants or in the most distal position: A systematic review and meta-analysis. International Journal of Oral Implantology (Berlin), 14(3), 241–257.
17. Lin, H. K., Lin, J. C., Pan, Y. H., Salamanca, E., Chang, Y. T., Hsu, Y. S., Wu, Y. F., Lin, C. K., Dorj, O., & Chang, W. J. (2022). Peri-implant marginal bone changes around dental implants with platform-switched and platform-matched abutments: A retrospective 5-year radiographic evaluation. Journal of Personalized Medicine, 12(8), 1226. https://doi.org/10.3390/jpm12081226
18. Pesce, P., Del Fabbro, M., Modenese, L., Sandron, S., Francetti, L., Isola, G., Canullo, L., & Menini, M. (2023). Influence of implant diameter on implant survival rate and clinical outcomes in the posterior area: A systematic review and meta-analysis. BMC Oral Health, 23(1), 235. https://doi.org/10.1186/s12903-023-02962-8
19. Kulkarni, V., Uttamani, J. R., Asar, N. V., Nares, S., & Tözüm, T. F. (2021). Evidence-based clinical outcomes of immediate and early loading of short endosseous dental implants: A meta-analysis. International Journal of Oral & Maxillofacial Implants, 36(1), 59–67. https://doi.org/10.11607/jomi.8541
20. Cahyaningtyas, N. A., Miranda, A., Metta, P., & Bawono, C. A. (2023). Dental implant macrodesign features in the past 10 years: A systematic review. Journal of Indian Society of Periodontology, 27(2), 131–139. https://doi.org/10.4103/jisp.jisp_676_21
21. Chen, L., Yang, T., Yang, G., Zhou, N., Dong, H., & Mou, Y. (2019). Retrospective clinical analysis of risk factors associated with failed short implants. Clinical Implant Dentistry and Related Research, 22(1), 112–118. https://doi.org/10.1111/cid.12879
22. Lombardo, G., Signoriello, A., Marincola, M., & Nocini, P. F. (2020). Assessment of peri-implant soft tissues conditions around short and ultra-short implant-supported single crowns: A 3-year retrospective study on periodontally healthy patients and patients with a history of periodontal disease. International Journal of Environmental Research and Public Health, 17(24), 9354. https://doi.org/10.3390/ijerph17249354
23. Mishra, S. K., Gaddale, R., Sonnahalli, N. K., & Chowdhary, R. (2021). Platform-switching concept in dental implants: A systematic review and meta-analysis of randomized controlled trials with a minimum follow-up of 3 years. International Journal of Oral & Maxillofacial Implants, 36(5), e97–e109. https://doi.org/10.11607/jomi.8911
24. Barausse, C., Pistilli, R., Bonifazi, L., Tayeb, S., Pellegrino, G., Ravidà, A., & Felice, P. (2024). Four-mm-short implants in the rehabilitation of posterior atrophic jaws: A retrospective study on 212 patients with a mean follow-up of 8.02 years. Clinical Oral Implants Research, 35(12), 1607–1615. https://doi.org/10.1111/clr.14349
25. Viscardi, D., Carini, F., Saggese, V., & Carini, F. (2023). Analysis of implant precision in guided surgery: Comparison of two methods. Minerva Dental and Oral Science, 73(1), 27–36. https://doi.org/10.23736/S2724-6329.23.04833-7
26. Berglundh, T., Armitage, G., Araujo, M. G., Avila-Ortiz, G., Blanco, J., Camargo, P. M., Chen, S., Cochran, D., Derks, J., Figuero, E., Hämmerle, C. H. F., Heitz-Mayfield, L. J. A., Huynh-Ba, G., Iacono, V., Koo, K. T., Lambert, F., McCauley, L., Quirynen, M., Renvert, S., Salvi, G. E., Schwarz, F., Tarnow, D., Tomasi, C., Wang, H. L., & Zitzmann, N. (2018). Peri-implant diseases and conditions: Consensus report of workgroup 4 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. Journal of Clinical Periodontology, 45(Suppl. 20), S286–S291. https://doi.org/10.1111/jcpe.12957