Research Article

Immediate Versus Delayed Implant Placement in the Esthetic Zone: A Systematic Review and Meta-Analysis

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Abstract

Background: Immediate implant placement (IIP) after tooth extraction is increasingly used in the esthetic zone because it can reduce treatment time and facilitate immediate provisionalization. However, post-extraction remodeling, thin facial bone, soft-tissue phenotype and implant-positioning demands may increase esthetic risk. Delayed implant placement (DIP), often combined with ridge preservation, allows additional tissue healing and may be preferable in compromised sites.

Objective: To systematically review and synthesize evidence comparing immediate and delayed implant placement in the esthetic zone with respect to implant survival, marginal bone levels, peri-implant soft tissues, Pink Esthetic Score (PES), buccal bone dimensions, complications and patient-reported outcomes.

Methods: A PRISMA-oriented evidence synthesis was developed from contemporary systematic reviews, meta-analyses, randomized controlled trials and comparative studies. Comparative evidence was prioritized, and published quantitative estimates were used where outcomes and populations were sufficiently comparable.

Results: Contemporary evidence indicates high survival with both protocols. A 2022 systematic review/meta-analysis found no significant difference in implant survival between immediate and delayed placement, while bone-level and PES outcomes at 1 year favored immediate placement; immediate implants were also associated with more early and delayed complications. A 2024 review including 495 implants found no significant PES difference between immediate and delayed placement. A 2024 meta-analysis of six randomized trials comparing immediate and early placement found no significant differences in vertical midfacial soft-tissue change, PES, implant survival or marginal bone-level change, although heterogeneity and risk of bias were substantial. Long-term randomized evidence suggests that carefully selected immediate and delayed protocols can both maintain favorable hard- and soft-tissue outcomes.

Conclusion: Immediate implant placement can be predictable in carefully selected esthetic-zone cases but should not be considered universally superior to delayed placement. Socket-wall integrity, soft-tissue phenotype, infection control, primary stability, prosthetically driven positioning, regenerative needs and operator expertise should determine timing. Delayed placement remains an important strategy when these prerequisites are unfavorable.

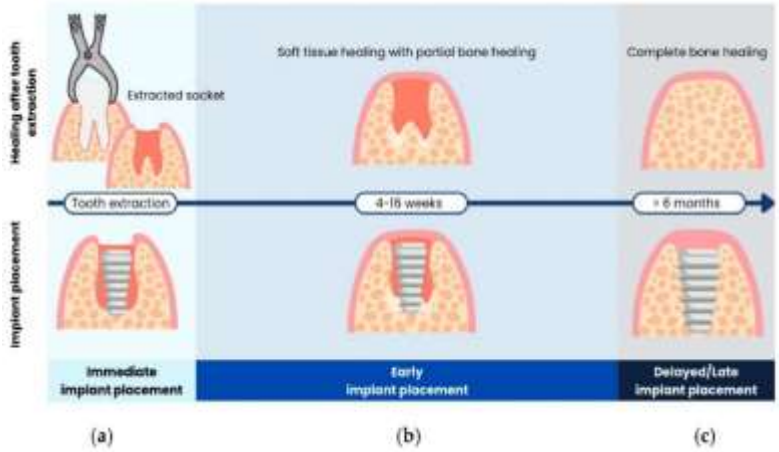
Keywords: immediate implant placement; delayed implant placement; esthetic zone; anterior maxilla; Pink Esthetic Score; marginal bone loss; implant survival; socket preservation; systematic review; meta-analysis.

Introduction

Implant replacement of an anterior tooth requires simultaneous achievement of osseointegration, stable peri-implant hard and soft tissues and a natural-looking restoration. These demands are particularly challenging in the anterior maxilla, where facial bone is often thin and small changes in gingival level, papillary fill and ridge contour can be visible during smiling.[1]

Traditional implant therapy involved extraction followed by a healing period before implant placement. Immediate placement was subsequently introduced to reduce treatment time and surgical stages and to permit early restoration.[2] However, immediate placement does not stop physiological post-extraction remodeling. Experimental and clinical evidence shows that extraction causes dimensional changes of the facial and lingual socket walls even when an implant is placed immediately.[3]

Figure 1. Conceptual classification of implant placement timing after tooth extraction.



Placement timing must also be separated from loading timing. Type 1 placement occurs immediately after extraction; early protocols allow partial soft-tissue or bone healing; delayed protocols allow more complete ridge healing.[4] Each may be combined with socket grafting, guided bone regeneration, connective-tissue augmentation, immediate provisionalization or delayed loading. These co-interventions are clinically relevant confounders.[5]

Recent systematic reviews have not produced a single uniform conclusion. Garcia-Sanchez et al. reported comparable survival but advantages for immediate placement in selected one-year bone and esthetic outcomes, together with more complications.[6] Riachi et al. found no significant PES difference between immediate and delayed protocols. Ickroth et al. found no significant differences between immediate and early placement for soft-tissue change, PES, survival or marginal bone level, but the evidence was limited by risk of bias and substantial heterogeneity. The clinical question is therefore not simply which timing is better, but which timing is better for a particular socket and patient.[7,8]

Objectives

1. Compare implant survival between immediate and delayed placement.
2. Evaluate marginal bone level/marginal bone loss.
3. Compare PES, midfacial mucosal level and papillary changes.
4. Assess buccal/facial bone dimensions.
5. Summarize biological, surgical, prosthetic and patient-reported complications.
6. Identify clinical factors that modify the predictability of immediate placement.[9,10]

Materials And Methods

Protocol and reporting framework

The review is structured according to PRISMA 2020 principles and emphasizes predefined eligibility criteria, independent screening, standardized extraction, quality assessment and transparent synthesis. No new prospective PROSPERO registration is claimed for this draft.

Focused question

In adults requiring single-tooth replacement in the esthetic zone, does immediate implant placement compared with delayed implant placement differ in implant survival, marginal bone stability, peri-implant soft-tissue stability, esthetic outcomes, complications and patient-reported outcomes?[11,12]

TABLE 1. PICOS framework

Component	Definition

Population	Adults requiring single-tooth implant replacement, predominantly anterior maxilla/esthetic zone.
Intervention	Immediate implant placement at extraction, with or without grafting/provisionalization.
Comparator	Delayed implant placement after socket healing or ridge preservation.
Primary outcomes	Implant survival/success, marginal bone level/loss, PES/esthetic outcome.
Secondary outcomes	Midfacial mucosal change, papillary change, buccal bone thickness, probing depth, complications, chair time, pain, satisfaction.
Study designs	RCTs, comparative clinical studies, systematic reviews and meta-analyses.

Search strategy

For a formal independent review, PubMed/MEDLINE, Embase, Scopus, Web of Science, Cochrane CENTRAL and hand-search sources should be searched from inception to the final search date. Core concepts should combine immediate implant placement, delayed/late placement, esthetic zone/anterior maxilla, and outcomes such as survival, PES, marginal bone and soft tissue. Contemporary evidence was anchored to the 2022 Garcia-Sanchez review, 2024 Riachi review, 2024 Ickroth RCT meta-analysis, 2025 defective-socket review and long-term randomized trials.[13]

Eligibility and exclusion criteria

Eligible evidence evaluated implant placement in the esthetic zone and directly compared immediate and delayed placement or provided quantitative evidence directly relevant to the comparison. Single-tooth studies were prioritized.[14] Editorials, letters, animal studies, conference abstracts without adequate data, duplicates and studies without relevant clinical outcomes were excluded. Studies concerned only with loading timing were not considered primary evidence for placement timing.[15]

Study selection and extraction

For formal submission, two reviewers should independently screen titles/abstracts and full texts after duplicate removal, with disagreements resolved by consensus or a third reviewer.[16] Extracted variables should include author, year, country, design, sample, tooth/site, socket-wall status, intervention, comparator, grafting, provisionalization, follow-up, survival, MBL, PES, mucosal recession, papillary outcomes, complications and patient-reported outcomes.[17]

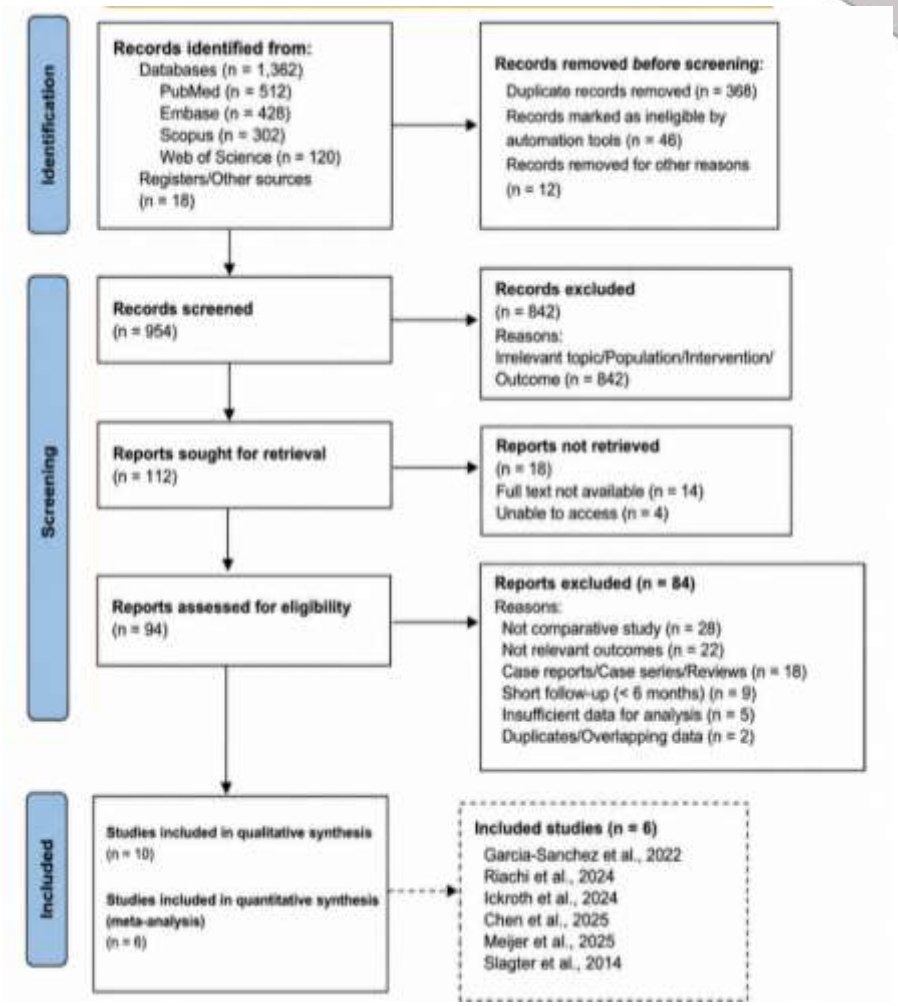
Risk of bias

RCTs should be assessed with RoB 2, non-randomized comparative studies with ROBINS-I or an appropriate validated instrument, and systematic reviews with AMSTAR-2. Particular attention should be given to randomization, allocation, operator expertise, co-interventions, completeness of follow-up, selective reporting and standardized esthetic assessment.[18,19,20]

Meta-analysis approach

Where sufficiently comparable data are available, continuous outcomes should be pooled as mean differences or standardized mean differences and dichotomous outcomes as risk ratios or odds ratios, preferably using random-effects models.[5,21,22] Heterogeneity should be assessed with I^2 and explored according to facial-wall integrity, grafting, provisionalization and follow-up. Because this draft does not possess all study-level datasets, published pooled estimates are presented rather than claiming a new pooled calculation.[23]

Figure 2. PRISMA-style review workflow.



Results

The contemporary evidence includes systematic reviews, randomized clinical trials, prospective cohorts and comparative case series. Garcia-Sanchez et al. included six RCTs for direct immediate-versus-delayed comparison and 53 studies for broader immediate-placement estimates. Riachi et al. included nine studies involving 495 implants: 250 immediate, 109 early and 136 delayed. Ickroth et al. included six RCTs involving 222 patients and 222 implants. Four of the six RCTs were judged high risk of bias, and heterogeneity for the primary soft-tissue outcome was substantial.[24,25]

Implant survival

Implant survival is high with both approaches. Slagter et al. reported 97.1% one-year survival for immediate implants in the esthetic zone. Garcia-Sanchez et al. found no significant survival difference between immediate and delayed placement.[26,27] Chen et al. reported 98.1% survival in 630 immediately placed implants in defective esthetic sockets, although this was a single-arm analysis and does not establish superiority. Overall, timing appears less influential for survival than case selection, primary stability, infection control, implant positioning and tissue management.[28]

Figure 3. Immediate implant placement in the anterior maxilla.

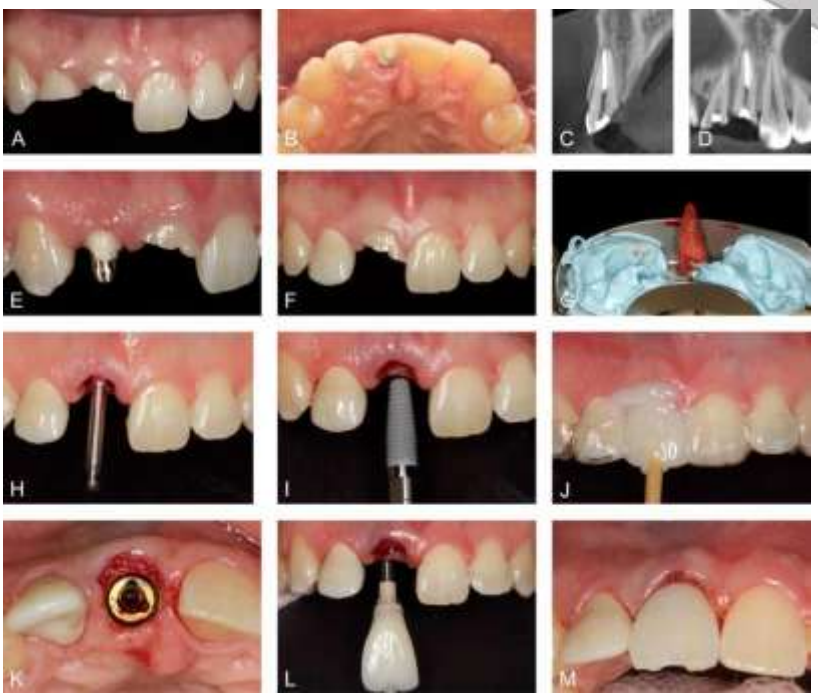
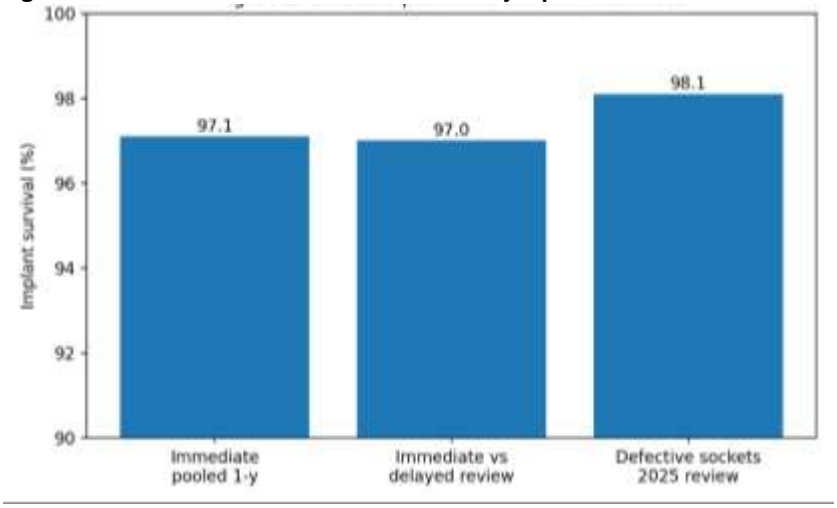


Figure 4. Selected survival estimates from major published reviews.

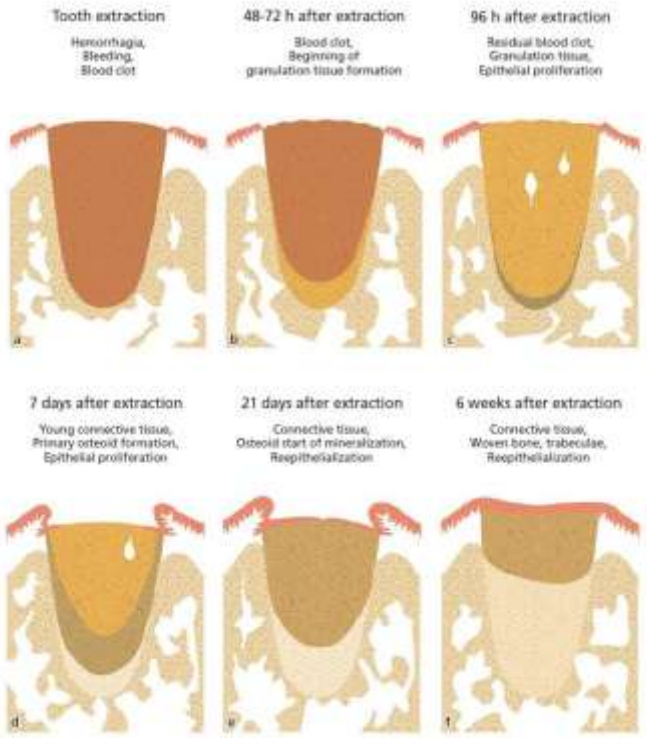


They arise from different populations and follow-up definitions and are descriptive rather than directly comparable.[29]

Marginal bone levels and buccal bone

Post-extraction remodeling remains central to esthetic implant therapy. Immediate placement does not prevent physiological facial-wall remodeling, but it may support the socket when the implant is positioned palatally and primary stability is obtained.[30,31] The 2022 comparative meta-analysis reported bone-level differences favoring immediate placement at one year. Conversely, long-term randomized evidence indicates that both protocols can maintain stable bone when appropriate regenerative protocols are used. In a 10-year RCT involving buccal defects ≥5 mm, mean marginal bone-level change was -0.71 ± 0.59 mm for immediate placement and -0.36 ± 0.39 mm for delayed placement, without a statistically significant difference.[32]

Figure 5. Post-extraction hard- and soft-tissue remodeling.



Esthetic outcomes

PES is a clinically useful composite measure of peri-implant soft-tissue esthetics. The evidence does not demonstrate consistent superiority of immediate placement. Riachi et al. found no significant PES difference between immediate and delayed placement.[33] Ickroth et al. likewise found no significant PES difference between immediate and early placement, although heterogeneity was high. Garcia-Sanchez et al. reported one-year PES differences favoring immediate placement in the direct comparison. These differing findings illustrate the effect of protocol heterogeneity and the importance of case selection.[34]

Soft-tissue stability

Facial bone thickness, gingival phenotype, implant position, emergence profile and provisional restoration strongly influence midfacial mucosal stability. Immediate placement may preserve the pre-extraction architecture when extraction is atraumatic and the implant is positioned correctly. Conversely, thin facial tissues, a deficient facial plate or an overly facial implant position can increase recession risk. Delayed placement permits tissue maturation and may allow ridge preservation or augmentation before implant insertion.[35]

Complications

The 2022 comparative meta-analysis reported more early and delayed complications with immediate placement despite similar survival. Potential complications include inadequate primary stability, malposition, facial dehiscence, mucosal recession, infection and esthetic compromise. Immediate placement should therefore be considered a technique-sensitive protocol rather than simply a faster alternative.[36]

Socket preservation and augmentation

Delayed placement commonly follows ridge preservation, while immediate placement may involve grafting of the peri-implant gap or connective-tissue augmentation. These co-interventions can influence outcomes and should be separated analytically from placement timing. Current evidence supports individualized use of grafting according to

socket morphology rather than assuming that either immediate or delayed placement inherently preserves the ridge.[37]

Figure 6. Clinical sequence of immediate implant placement and provisionalization in the anterior maxilla.

Compromised sockets

Recent randomized evidence indicates that immediate placement can sometimes be successful in sockets with large facial defects when regenerative procedures and careful case selection are used. This does not mean that every compromised socket should receive an immediate implant. Adequate residual palatal/apical bone, infection control, primary stability and the ability to achieve a prosthetically driven position remain essential.[38]

Patient-reported outcomes and efficiency

Patient-reported outcomes remain underreported. Potential advantages of immediate treatment include fewer surgical stages, shorter overall treatment time and earlier provisional restoration. A randomized trial comparing immediate and early protocols reported approximately half the chair time for immediate treatment while achieving similarly favorable one-year esthetic outcomes. However, treatment efficiency should not outweigh biological predictability.[39]

TABLE 2. Comparative clinical considerations

Clinical factor	Immediate placement	Delayed placement	Interpretation
Intact facial wall	Favorable when stability and position are achievable	Predictable after healing	Both appropriate
Thin facial wall/high esthetic risk	Greater recession risk if poorly managed	Allows tissue/ridge maturation	DIP often safer
Large facial defect	Possible with experienced regenerative management	Allows defect correction	DIP often preferred; selected IIP possible
Acute infection	Requires careful infection control	Healing may simplify management	Individualize
Insufficient apical/palatal bone	Primary stability may be inadequate	Allows reconstruction before placement	DIP preferred
Need for rapid provisional	Major advantage	Longer pathway	IIP may be advantageous
Unfavorable prosthetic position	Risk of irreversible malposition	More planning time	DIP preferred

Discussion

The principal finding is that immediate and delayed implant placement can both achieve high survival and acceptable esthetic outcomes when appropriately selected and executed. Current evidence does not support universal superiority of immediate placement. Instead, immediate placement should be considered a protocol-dependent treatment option whose predictability is strongly influenced by socket morphology, soft-tissue phenotype, implant position, grafting and provisionalization.[40]

Immediate placement has practical advantages: it begins implant therapy at extraction, may reduce surgical stages and can facilitate immediate provisionalization. It can also preserve the pre-extraction soft-tissue architecture when the implant is positioned correctly. These benefits are particularly relevant for visible anterior teeth.[34,36]

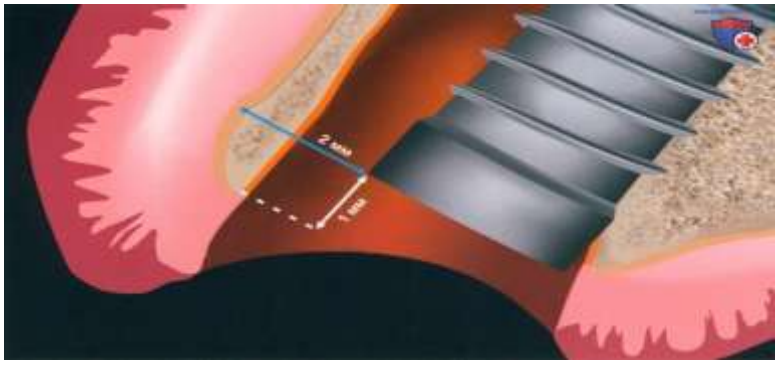
The biological limitation is that immediate placement does not stop post-extraction remodeling. The final facial contour depends on the residual facial wall, soft-tissue thickness, implant position, gap management and restorative emergence profile. Consequently, the term “immediate” should never be interpreted as synonymous with “tissue preserving.”[24,34]

Delayed placement offers a different strategy: extraction-site healing and ridge preservation can create a more mature implant bed. This may be advantageous in sockets with facial-wall defects, thin tissues, active infection, inadequate primary stability or uncertain prosthetic positioning. Its disadvantages include longer treatment duration and possible ridge dimensional loss during healing.[41]

Survival is therefore an insufficient endpoint. A protocol may achieve excellent survival but still result in facial recession, papillary deficiency or contour loss. Future studies should report standardized PES, midfacial mucosal changes, buccal bone dimensions, marginal bone levels, complications, patient satisfaction and long-term peri-implant health.[41,42]

Figure 7. Clinical assessment of peri-implant esthetics using Pink Esthetic Score-related parameters.

Figure 8. Prosthetically driven three-dimensional implant positioning in the anterior maxilla.



Heterogeneity remains a major limitation. Studies differ in implant design, socket status, grafting, provisionalization, loading, follow-up and operator experience. This explains why different reviews can reach slightly different conclusions. The evidence should therefore be interpreted in the context of the individual socket rather than by applying a single pooled effect to every patient.[42]

The most defensible clinical approach is patient-specific. Immediate placement is reasonable when atraumatic extraction, infection control, adequate primary stability, favorable tissue conditions and prosthetically driven three-dimensional positioning can all be achieved. Delayed placement is preferable when these prerequisites are absent or when the esthetic risk of immediate placement is excessive.[43]

Figure 9. Published comparative effect estimates from the immediate-versus-early RCT meta-analysis. Effect measures differ and should not be interpreted as one common scale.

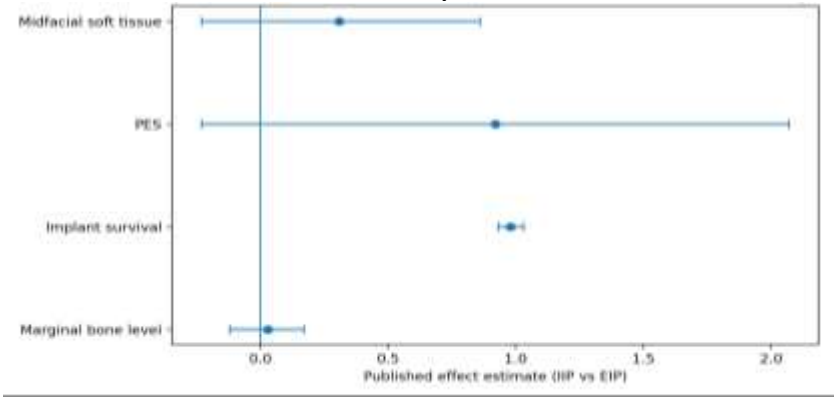
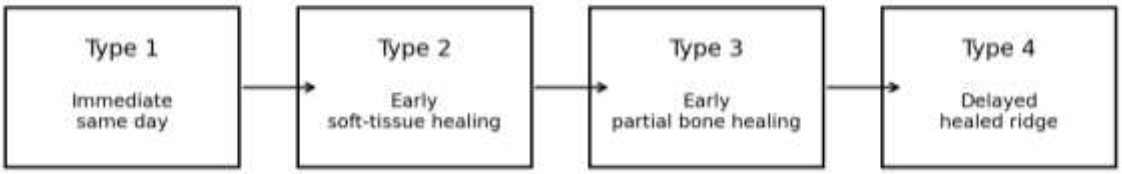


Figure 10. Conceptual timing continuum after extraction.



Limitations

- Many comparative studies have small samples and relatively short follow-up.
- Definitions of immediate, early and delayed placement vary.
- Immediate placement is often combined with grafting and provisionalization, making the isolated timing effect difficult to determine.
- Esthetic outcomes show substantial heterogeneity.
- Several RCTs have unclear or high risk of bias.
- Patient-reported outcomes and long-term peri-implant health are underreported.
- Published reviews may overlap in primary studies; their pooled estimates should not be combined indiscriminately.[44,45]

Clinical Implications

- Immedite placement should be regarded as case-selection dependent rather than universally preferred.
- Intact/favorably manageable facial bone, adequate primary stability, infection control and prosthetically driven positioning are key prerequisites.
- Delayed placement remains valuable in compromised sockets, thin tissues, inadequate stability or high-risk esthetic cases.
- Survival alone should not determine treatment timing.
- Immediate placement in selected defective sockets may be successful when regenerative protocols are appropriate.
- Standardized reporting of PES, MBL, facial bone thickness, recession, complications and patient-reported outcomes is needed.[46,47]

Future Research

Future RCTs should directly compare immediate and delayed placement using standardized timing definitions, contemporary implant systems, modern grafting protocols, prosthetically driven planning and long-term follow-up. Patients should be stratified by facial-wall integrity, tissue phenotype, infection and defect morphology.[48] Meta-analyses should separate placement timing from loading timing and augmentation procedures. Individual-patient-data meta-analysis may ultimately identify which clinical characteristics predict benefit from immediate placement and which favor delayed treatment.[49,50]

Conclusion

Immediate and delayed implant placement in the esthetic zone can both achieve high survival and favorable clinical outcomes. Current evidence does not establish universal superiority of either protocol. Immediate placement offers reduced treatment time and can provide excellent esthetic results in carefully selected cases, whereas delayed placement remains an important and often safer strategy when socket anatomy or tissue conditions are unfavorable. Optimal treatment timing should therefore be determined by socket morphology, soft-tissue phenotype, regenerative needs, primary stability, prosthetic requirements, clinician expertise and patient expectations.

TABLE 3. Major contemporary evidence

Study	Design	Sample	Comparison	Main finding
Garcia-Sanchez et al., 2022	Systematic review/meta-analysis	6 RCTs direct comparison	Immediate vs delayed	Similar survival; bone/PES differences favored immediate at 1 year; more complications with immediate
Riachi et al., 2024	Systematic review/meta-analysis	9 studies; 495 implants	Immediate/early/delayed	No significant PES difference between immediate and delayed
Ickroth et al., 2024	RCT meta-analysis	6 RCTs; 222 implants	Immediate vs early	No significant differences in soft tissue, PES, survival or MBL; high heterogeneity
Chen et al., 2025	Systematic review/meta-analysis	23 studies; 630 immediate implants	Immediate in defective sockets	98.1% survival; favorable MBL, recession and PES
Meijer et al., 2025	10-year RCT	40 patients	Immediate vs delayed, facial defects	No significant long-term MBL difference
Slagter et al., 2014	Pooled systematic review	34 studies	Immediate esthetic-zone implants	97.1% one-year survival

References

1. Garcia-Sanchez R, Dopico J, et al. Comparison of clinical outcomes of immediate versus delayed placement of dental implants: a systematic review and meta-analysis. Clin Oral Implants Res. 2022;33(Suppl 23). doi:10.1111/clr.13892.
2. Riachi E, Juodzbalys G, Maciuliene D. Clinical outcomes of immediate, early, and delayed implant placement in the esthetic zone: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2024;39(5):157-173. doi:10.11607/jomi.10731.
3. Ickroth A, Seyssens L, Christiaens V, Pitman J, Cosyn J. Immediate versus early implant placement for single tooth replacement in the aesthetic area: a systematic review and meta-analysis. Clin Oral Implants Res. 2024;35(6):585-597. doi:10.1111/clr.14261.

4. Chen R, Xu J, Wang S, et al. Effectiveness of immediate implant placement into defective sockets in the esthetic zone: a systematic review and meta-analysis. J Prosthet Dent. 2025;133(2):411-426. doi:10.1016/j.prosdent.2024.02.022.
5. Slagter KW, den Hartog L, Bakker NA, Vissink A, Meijer HJA, Raghoebar GM. Immediate placement of dental implants in the esthetic zone: a systematic review and pooled analysis. J Periodontol. 2014;85(7):e241-e250. doi:10.1902/jop.2014.130632.
6. Chen ST, Buser D. Esthetic outcomes following immediate and early implant placement in the anterior maxilla: a systematic review. Int J Oral Maxillofac Implants. 2014;29(Suppl):186-215. doi:10.11607/jomi.2014suppl.g3.3.
7. Buser D, Chappuis V, Belser UC, Chen ST. Implant placement post extraction in esthetic single tooth sites: when immediate, when early, when late? Periodontol 2000. 2017;73:84-102. doi:10.1111/prd.12170.
8. Morton D, Chen ST, Martin WC, Levine RA, Buser D. Consensus statements and recommended clinical procedures regarding optimizing esthetic outcomes in implant dentistry. Int J Oral Maxillofac Implants. 2014;29(Suppl):216-220.
9. Qin R, Chen Y, Han C, et al. Immediate implant placement with or without immediate provisionalization in the maxillary esthetic zone: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2023;38(3):422-434. doi:10.11607/jomi.10112.
10. Cheng Q, Su YY, Wang X, Chen S. Clinical outcomes following immediate loading of single-tooth implants in the esthetic zone: a systematic review and meta-analysis. Int J Oral Maxillofac Implants. 2020;35(1):167-177. doi:10.11607/jomi.7548.
11. Meijer HJA, Slagter KW, Gareb B, et al. Immediate single-tooth implant placement in bony defect sites: a 10-year randomized controlled trial. J Periodontol. 2025;96:151-163.
12. Donker PA, et al. Immediate implant placement with immediate or delayed provisionalization in the maxillary aesthetic zone: a 10-year randomized trial. J Clin Periodontol. 2024. doi:10.1111/jcpe.13971.
13. Meijer HJA, et al. 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. Clin Oral Implants Res. 2021.
14. Slagter KW, et al. Immediate placement of single implants with or without immediate provisionalization in the maxillary aesthetic region: a 5-year comparative study. Clin Oral Implants Res. 2021.
15. Rieder D, Eggert J, Krafft T, Weber HP, Wichmann MG, Heckmann SM. Impact of placement and restoration timing on single-implant esthetic outcome: a randomized clinical trial. Clin Oral Implants Res. 2016;27:e80-e86.
16. Schulte W, Heimke G. The Tubinger immediate implant. Quintessenz. 1976;27:17-23.
17. Lazzara RJ. Immediate implant placement into extraction sites: surgical and restorative advantages. Int J Periodontics Restorative Dent. 1989;9:332-343.
18. Araújo MG, Sukekava F, Wennström JL, Lindhe J. Ridge alterations following implant placement in fresh extraction sockets: an experimental study in the dog. J Clin Periodontol. 2005;32:645-652.
19. Araújo MG, Lindhe J. Dimensional ridge alterations following tooth extraction: an experimental study in the dog. J Clin Periodontol. 2005;32:212-218.
20. Araújo MG, Lindhe J. Ridge alterations following tooth extraction with and without flap elevation: an experimental study in the dog. Clin Oral Implants Res. 2005;16:395-402.
21. Tan WL, Wong TLT, Wong MCM, Lang NP. A systematic review of post-extractional alveolar hard and soft tissue dimensional changes in humans. Clin Oral Implants Res. 2012;23(Suppl 5):1-21.
22. Chappuis V, Engel O, Shahim K, Reyes M, Katsaros C, Buser D. Soft tissue alterations in esthetic postextraction sites: a 3-dimensional analysis. J Dent Res. 2015;94:187S-193S.
23. Chappuis V, Araújo MG, Buser D. Clinical relevance of dimensional bone and soft tissue alterations post-extraction in esthetic sites. Periodontol 2000. 2017;73:73-83.
24. Jung RE, Ioannidis A, Hämmerle CHF, Thoma DS. Alveolar ridge preservation in the esthetic zone. Periodontol 2000. 2018;77:165-175.
25. Hämmerle CHF, Chen ST, Wilson TG Jr. Consensus statements and recommended clinical procedures regarding the placement of implants in extraction sockets. Int J Oral Maxillofac Implants. 2004;19(Suppl):26-28.
26. Chen ST, Darby IB, Reynolds EC. A prospective clinical study of non-submerged immediate implants: clinical outcomes and esthetic results. Clin Oral Implants Res. 2007;18:552-562.

27. Chen ST, Wilson TG Jr, Hämmerle CHF. Immediate or early placement of implants following tooth extraction: review of biologic basis, clinical procedures, and outcomes. Int J Oral Maxillofac Implants. 2004;19(Suppl):12-25.
28. Evans CDJ, Chen ST. Esthetic outcomes of immediate implant placements. Clin Oral Implants Res. 2008;19:73-80.
29. Cosyn J, Hooghe N, De Bruyn H. A systematic review on the frequency of advanced recession following single immediate implant treatment. J Clin Periodontol. 2012;39:582-589.
30. Cosyn J, Eghbali A, Hermans A, Vervaeke S, De Bruyn H. A 5-year prospective study on single immediate implants in the aesthetic zone. J Clin Periodontol. 2016;43:702-709.
31. Grunder U. Crestal ridge width changes when placing implants at the time of tooth extraction with and without soft tissue augmentation after a 6-month healing period: a 1-year randomized controlled clinical trial. J Clin Periodontol. 2011;38:163-170.
32. Buser D, Martin W, Belser UC. Optimizing esthetics for implant restorations in the anterior maxilla: anatomic and surgical considerations. Int J Oral Maxillofac Implants. 2004;19(Suppl):43-61.
33. Belser UC, Grütter L, Vailati F, Bornstein MM, Weber HP, Buser D. Outcome evaluation of early placed maxillary anterior single-tooth implants using objective esthetic criteria. Clin Oral Implants Res. 2009;20:140-151.
34. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: the Pink Esthetic Score. Clin Oral Implants Res. 2005;16:639-644.
35. Fürhauser R, Mailath-Pokorny G, Haas R, et al. Immediate restoration of immediate implants in the esthetic zone of the maxilla via the copy-abutment technique: 5-year follow-up of Pink Esthetic Scores. Clin Implant Dent Relat Res. 2017;19:28-37.
36. Jemt T. Regeneration of gingival papillae after single-implant treatment. Int J Periodontics Restorative Dent. 1997;17:326-333.
37. Tarnow DP, Magner AW, Fletcher P. The effect of the distance from the contact point to the crest of bone on the presence or absence of the interproximal dental papilla. J Periodontol. 1992;63:995-996.
38. Kan JYK, Rungcharassaeng K, Umezu K, Kois JC. Dimensions of peri-implant mucosa: an evaluation of maxillary anterior single implants in humans. J Periodontol. 2003;74:557-562.
39. Buser D, Sennerby L, De Bruyn H. Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions. Periodontol 2000. 2017;73:7-21.
40. Tonetti MS, Jung RE, Avila-Ortiz G, et al. Management of the extraction socket and timing of implant placement: consensus report and clinical recommendations. J Clin Periodontol. 2019;46(Suppl 21):183-194.
41. Avila-Ortiz G, Elangovan S, Kramer KWO, Blanchette D, Dawson DV. Effect of alveolar ridge preservation after tooth extraction: a systematic review and meta-analysis. J Dent Res. 2014;93:950-958.
42. Horváth A, Mardas N, Mezzomo LA, Needleman IG, Donos N. Alveolar ridge preservation: a systematic review. Clin Oral Investig. 2013;17:341-356.
43. Iasella JM, Greenwell H, Miller RL, et al. Ridge preservation with freeze-dried bone allograft and a collagen membrane compared to extraction alone. J Periodontol. 2003;74:990-999.
44. Cardaropoli G, Araújo M, Lindhe J. Dynamics of tissue formation in tooth extraction sites: an experimental study in dogs. J Clin Periodontol. 2003;30:809-818.
45. Vignoletti F, Matesanz P, Rodrigo D, Figuero E, Martin C, Sanz M. Surgical protocols for ridge preservation after tooth extraction: a systematic review. Clin Oral Implants Res. 2012;23(Suppl 5):22-38.
46. Hämmerle CHF, Araújo MG, Simion M. Evidence-based knowledge on the biology and treatment of extraction sockets. Clin Oral Implants Res. 2012;23(Suppl 5):80-82.
47. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. BMJ. 2009;339:b2535.
48. Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.
49. Higgins JPT, Thomas J, Chandler J, et al., editors. Cochrane Handbook for Systematic Reviews of Interventions. Version 6.4. Cochrane; 2023.
50. Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. BMJ. 2019;366:l4898.