

The soft tissue esthetic outcome with and without immediate provisionalization in immediate implants: A systematic review and meta-analysis

Priyanka Vaibhav Sutariya, Shruti Parthiv Mehta, Hemil Hitesh Upadhyay, Mansoor Khan Rafikahmed Pathan, Surbhi Ravi Patel, Yashpreetsingh Amarjitsingh Bhatia

Department of Prosthodontics, College of Dental Sciences and Research Centre, Ahmedabad, Gujarat, India

Abstract

Aim: This systematic review and meta-analysis aimed at checking influences of immediate provisionalization on the primary esthetic outcome by Pink Esthetic Score (PES) as well as other secondary soft tissue outcomes such as bleeding on probing, probing depth, plaque index, mesial papillary recession, distal papillary recession, and midfacial mucosal recession of the peri-implant mucosa around immediately placed implants in the anterior maxilla.

Setting and Design: This systematic review and meta-analysis was evaluated using the Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines.

Materials and Methods: The relevant studies were found in the databases such as MEDLINE (PubMed), the Cochrane Central Register of Controlled Trials, Science Direct, and Google Scholar. The search was restricted to studies published in English only, with no time constraints. A second hand search was conducted on individual journals and study reference lists. The Evidence Project risk-of-bias tool was used to assess the risk of bias in included studies. The level of evidence was determined using the GRADEpro GDT: GRADEpro Guideline Development Tool (software). McMaster University, 2020 (developed by Evidence Prime, Inc.)

Statistical Analysis Used: The statistical meta-analysis was conducted by using Review Manager (RevMan) (Computer Program). Version 5.4. Copenhagen: The Nordic Cochrane Centre, the Cochrane Collaboration, 2020.

Results: Nine studies were finalized. Seven studies were selected out of nine in the meta-analysis for PES. The results of the current meta-analysis for primary outcome observed that immediate implant placement (IIP) followed by immediate provisionalization improves the esthetic outcome, with forest plot favoring immediate provisionalization and demonstrating a statistically significant difference (mean difference [MD] = 1.54, [95% confidence interval (CI): 0.82–2.27], $P < 0.0001$). Statistically insignificant result was observed for secondary outcomes; bleeding on probing (MD = 4.00, [95% CI: -1.15–9.15], $P = 0.13$), probing depth (MD = 0.17, [95% CI: -0.13–0.48], $P = 0.26$), plaque index (MD = -1.00, [95% CI: -7.56–5.56], $P = 0.77$), mesial papillary recession (MD = -0.10, [95% CI: -0.31–0.10], $P = 0.33$), midfacial mucosal

Address for correspondence: Dr. Hemil Hitesh Upadhyay, Department of Prosthodontics, College of Dental Sciences and Research Centre, Opposite Pleasure Club, Ghuma-Bopal Road, Ahmedabad - 380 052, Gujarat, India.

E-mail: hemilupadhyay05@gmail.com

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recession (MD = -0.47 , [95% CI: $-1.01-0.07$], $P = 0.09$). However, for distal papillary recession (MD = -0.32 , [95% CI: $-0.50-0.13$], $P = 0.0007$), the result was statistically significant with forest plot favoring immediate provisionalization.

Conclusion: When the implant is placed in the esthetic zone, IIP with immediate provisionalization provides the best gingival (pink) esthetics.

Keywords: Anterior maxilla, immediate implant placement, immediate provisionalization, pink aesthetics

INTRODUCTION

Replacing missing teeth has become one of the most critical requirements for restoring appearance and function.^[1] Patients increasingly demand restorations that are functional as well as esthetic. Replacing missing teeth with the implant-supported fixed prosthesis in the esthetic zone is a well-known treatment method. Esthetic implant restoration mimics natural teeth in all aspects.^[2] The clinician should know various concepts and techniques to attain a good implant esthetic outcome.^[3] Due to the growing demand for immediate esthetics, practitioners led to a focus even further by providing restorations immediately following implant placement.^[4]

Preserving alveolar bone and interproximal soft tissues following tooth extraction remains a challenge to achieve optimum esthetic. It is prudent to preserve the socket dimensions, shape, and gingival tissue height.^[5] With rising patient needs and expectations, efforts were made to decrease the total treatment time by placing implants immediately following tooth extraction. Placing implants immediately to replace teeth in the esthetic zone has become a commonly used strategy for treatment. When compared to conventional implant placement, immediate implant placement (IIP) reduces the healing time while maintaining a high success rate.^[6]

Various surgical factors affect the level of crestal bone and soft tissue around the immediate implant, which influences the final esthetic outcome.^[6] Factors that influence implant esthetic outcome are the medical status of the patient, smoking habits, lip line, gingival biotype, soft tissue anatomy, the width of edentulous span, restorative status of neighboring tooth, infection at the site of implant placement, bone level at the adjacent tooth, bone anatomy of alveolar crest, and patient's esthetic expectations.^[7] Abutment materials also influence peri-implant tissue color. When compared to metal abutments, ceramic abutments improve color matching between soft tissue around the implant and natural teeth.^[8] Excess cement around the implant–mucosal interface causes bleeding when probed.

Excess cement must be removed after the cementation procedure to prevent peri-implant inflammation.^[9] If there is a sharp edge of provisional restoration remains, then it might irritate the peri-implant mucosa and cause inflammation. Connective tissue grafts are frequently used in conjunction with IIP and provisionalization to improve the soft tissue outcome and reduce peri-implant mucosal recession in the esthetic zone.^[10] Over the last decade, IIP with immediate restoration has grown in popularity.^[6] Immediate provisional restoration may improve the soft tissue contour in the immediate postextraction site, resulting in superior esthetic results.^[11]

Esthetic indices are the tools for evaluating hard and soft tissue based on implant esthetic outcomes. One such tool to evaluate implant esthetic outcomes is Pink Esthetic Score (PES).^[12] Peri-implant mucosa can be assessed with the help of PES after the implant treatment. PES is determined by seven factors: the mesial papilla, the distal papilla, the soft-tissue level, the soft-tissue contour, the alveolar process deficiency, the soft-tissue color, and the texture.^[13]

The provisional fixed dental prosthesis provides several advantages right from treatment planning at the diagnostic stage to the luting of final restorations. It helps to assess occlusal, functional, and esthetic parameters at the time of diagnosis, ultimately helping to identify an optimal treatment outcome, before the final prosthesis is delivered. It provides a template to define contour, esthetics, proximal contacts, and occlusion of the final restoration. It can also be an essential tool in the psychological management of patients with aesthetic concerns to visualize the final results of the treatment.^[14] Provisional restorations are designed to stabilize and/or function for a limited time and then must be replaced with a permanent prosthesis.^[15]

Implant-supported interim restorations are a practical and necessary component of a successful implant restoration, especially in cases where the peri-implant gingiva in the esthetic area must be preserved and

require manipulation.^[16,17] Immediate provisionalization replaces the natural contours of the teeth and supports the gingival architecture during the healing process, thus improving the overall prognosis of the treatment.^[18] A thin buccal bone plate with a thin gingival biotype and exposure of peri-implant mucosa and future prosthesis when smiling or speaking are all common risk factors in the esthetic zone.^[16] By understanding the nature of the tissue biotype, the clinician can employ appropriate surgical and periodontal procedures to reduce alveolar resorption and create a more favorable environment for implant placement.^[19]

There have been mixed results regarding the esthetic benefits of immediate provisional restoration of dental implants in peri-implant tissue. The impact of provisionalization on peri-implant mucosal changes has been studied in recent studies, but no specific data were reported for an esthetic outcome. As a result, the purpose of this systematic review was to compare the esthetic outcome of implants placed immediately with and without immediate provisionalization in the maxillary anterior region. The null hypothesis for this systematic review was that there would be no difference in the aesthetic outcome of the soft tissue with immediate provisionalization compared to nonprovisionalization in immediately placed implants in the esthetic zone.

MATERIALS AND METHODS

Preferred Reporting Items for Systematic Review and Meta-Analysis guidelines were used to conduct the current systematic review.^[20] The research question formulated for the study was “Does immediate provisionalization have any influence on aesthetic outcome of the peri-implant mucosa around immediately placed implants in the anterior maxillary region?” The research question for the study was formulated based on population/participants, intervention, comparison, outcome, time, study design (PICOTS) structure.

This translated to:

- Population/participants: Anterior maxilla (at least between maxillary first premolars)
- Intervention: IIP with immediate provisionalization
- Comparison: IIP with and without immediate provisionalization
- Outcomes: (A) Primary outcome: Esthetic outcome with PES; (B) Secondary outcome: Soft-tissue outcome (bleeding on probing, probing depth, mesial papillary recession, distal papillary recession, midfacial mucosal recession, plaque index)

- Time: Studies that evaluate esthetic outcome at least 12 months after functional loading of implants
- Study design: Randomized controlled clinical trials (RCTs), prospective and retrospective clinical studies performed in humans.

Search strategy

Using the MESH terminologies, “Aesthetics, Dental Implants, Single-Tooth, Maxilla,” an electronic search of various databases such as the National Library of Medicine (MEDLINE-PubMed), The Cochrane Central Register of Controlled Trials, Science Direct, and Google Scholar was performed. Other terminologies used for searches were “Immediate provisionalisation, Immediate implant placement, Peri-implant tissue, and Aesthetic outcome.” These terminologies were searched with the Boolean operator “AND” and “OR.” In addition to an online search, a hand search of review and clinical study bibliographies was performed on the topic of “immediate implant provisionalisation.”

Inclusion and exclusion criteria

In the current systematic review, studies that met the following criteria were included.

1. Conducted on human participants
2. Full-text articles published solely in the English language
3. Include soft tissue and aesthetic outcome
4. Include IIP
5. Include immediate provisionalization
6. Include single implant placement in the anterior maxilla
7. Minimum follow-up period of 1 year
8. The implant must be placed at least from the premolar-to-premolar region
9. Minimum or no flap elevation during implant placement.

Studies were excluded if:

1. It was an *in vitro* study
2. The study was published other than the English language
3. Delayed implant placement was carried out
4. The study did not include soft tissue and esthetic outcome
5. If provisionalization was done in the posterior maxillary region
6. Follow-up <1 year
7. Presence of periodontal disease
8. Nonclinical studies, reviews, case reports, letters to editors, and technical notes were excluded from this systematic review.

Data collection and extraction

The data collection form for intervention reviews developed by Cochrane was used in the present study by two different authors (HU, MP) for data collection and extraction.^[21] Data for primary and secondary outcomes were extracted from the included study. The following study data were gathered from each included study (based on inclusion and exclusion criteria): (1) author and year of publication; (2) type of study and randomization method; (3) control and treatment groups; (4) the size of the patient and implant samples; (5) the arch in which the implant is placed; (6) the timing of implant placement; (7) the time of provisionalization; (8) the follow-up period; and (9) the treatment outcome.

The titles and abstracts of the research were verified for possible inclusion by three independent authors (YB, HU, and SP). The authors then retrieved the full texts of all studies for independent review. All disagreements were resolved by discussion. Moreover, if an agreement could not be reached, another two investigators (PS, SM) resolve the conflict.

Quality assessment of included studies

“The Evidence Project risk-of-bias tool” was used to check the study rigors in both RCTs and non-RCTs.^[22] The tool evaluated the validity and randomization of the studies. To assess the risk of bias, eight domains were used: (1) cohort, (2) control or comparison group, (3) prepost intervention data, (4) random assignment of participants to the intervention, (5) random selection of participants for assessment, (6) follow-up rate of 80% or higher, (7) comparison groups equivalent on sociodemographics, and (8) comparison groups equivalent on outcome measures at the baseline.

Statistical analysis

The variations in soft tissue esthetic outcomes with and without immediate provisionalization in immediately placed implants were investigated through meta-analysis. The differences in Mean (mean difference [MD]) values reported for esthetic outcome with 95% confidence interval (CI) were considered effective measures. *P* value was used to check the significance of the result between the two groups. If the *P* < 0.05, then there was a statistically significant difference in esthetic outcome when compared immediate provisionalization with nonprovisionalization in immediately placed implants. To analyze these effects and create a forest plot, Review Manager (RevMan) (Computer Program). Version 5.4. Copenhagen: The Nordic Cochrane Centre, Denmark, The Cochrane Collaboration, 2020. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2020 was used.

Data were collected from studies of different geographic regions. Thus, assuming heterogeneity of population exists, a random effect model was chosen for meta-analysis of included studies.

Summary of findings

To create the “Summary of findings” table, GRADE criteria were used to evaluate evidence quality, and the GRADE profiler (GRADEpro GDT) was used to import information from Review Manager 5.4. It was also used to evaluate the evidence’s reliability, incompleteness, inaccuracy, and publication bias. The GRADE pro-GDT [Software] was used to generate the evidence profile table (Developed by Evidence Prime, Inc. Available from grade.pro.org). The Medical Information Network Distribution Service, a Japanese GRADE education center, provided us with advice on how to use the GRADE system. Two reviewers (PS and SM) discussed the possibility of bias and agreed with the final decision.

RESULTS

Study selection

The initial electronic database search identified 213 possible publications. 46 were removed based on duplicate records (26) and full text not available (20). The remaining 167 articles were screened. From these 167 articles, 96 were excluded after evaluating their title and abstract. Following a full-text review of the remaining 71 articles, 62 were ruled out due to inclusion and exclusion criteria. As a result, the final nine articles were chosen for this systematic review [Figure 1].

Characteristics of included studies

Table 1 depicts the characteristics of the nine studies. There were four RCTs, four prospective studies, and one retrospective study among the nine included studies. The nine studies included 404 patients and 435 implants with a follow-up period of a minimum of 1 year [Table 1].

Risk of bias within studies

All nine studies have a low risk of bias (100%). In Figure 2, green color denotes Yes. Red color denotes No. Yellow color denotes Not applicable/Not reported [Table 2 and Figure 2].

Primary outcome

Meta-analysis 1: Esthetic outcome with and without immediate provisionalization by Pink Esthetic Score

A total of seven studies evaluated esthetic outcome with immediate provisionalization from which two studies compared the esthetic outcome with and

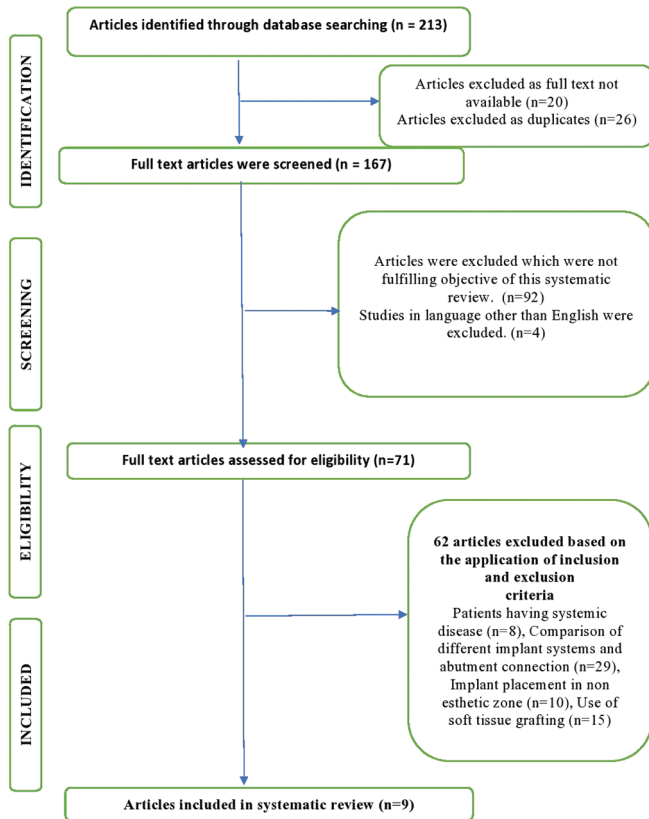


Figure 1: Study selection

without provisionalization. All implants were placed and provisionalized immediately after extraction. These studies evaluated/included 365 immediately placed implants with provisionalization with a minimum 1 year of follow-up. All the studies calculated esthetic outcomes by PES with the scores 0, 1, and 2. The higher the score, the better the esthetics. In the meta-analysis performed on the PES [Figure 3], a statistically significant difference was observed ($P < 0.0001$) with favorable PES when the implant was placed immediately and provisionalized (MD = 1.54, [95% CI: 0.82–2.27]). Heterogeneity was high ($I^2 = 83\%$) because only two studies had a comparison group out of 7 studies.

Secondary outcome

Meta-analysis 2: Bleeding on probing with and without immediate provisionalization

Two studies calculated bleeding on probing with provisionalization. From which, only one study calculated bleeding on probing compared with and without immediate provisionalization. In the meta-analysis performed on bleeding on probing [Figure 4], statistically insignificant difference ($P = 0.13$) was found in bleeding on probing when provisionalization was done or not done after IIP (MD = 4.00, [95% CI: -1.15–9.15]).

	cohort	control or comparison group	pre-post intervention data	random assignment of participants to the intervention	random selection of participants for assessment	follow-up rate of 80% or more	comparison groups equivalent on sociodemographic	comparison groups equivalent at baseline on outcome measures
Tim Derouck et al ²³ 2009	●	●	●	●	●	●	●	●
Jan Cosyn et al ²⁴ 2011	●	●	●	●	●	●	●	●
Jens Hartlev et al ²⁵ 2013	●	●	●	●	●	●	●	●
Van Nimwegen et al ²⁶ 2016	●	●	●	●	●	●	●	●
Noelken et al ²⁷ 2018	●	●	●	●	●	●	●	●
Himanshu Arora et al ²⁸ 2018	●	●	●	●	●	●	●	●
David Furze et al ¹⁶ 2019	●	●	●	●	●	●	●	●
Edith Groenendijk et al ²⁹ 2019	●	●	●	●	●	●	●	●
Hsun-Liang Chan et al ³⁰ 2020	●	●	●	●	●	●	●	●

Figure 2: Graphical representation of quality assessment of risk of bias in included studies

Meta-analysis 3: Probing depth around implants with and without immediate provisionalization

Three authors have evaluated probing depth is immediately placed implants and provisionalization, from which two studies calculated probing depth compared with and without immediate provisionalization. It was calculated in millimeters. In the meta-analysis performed on probing depth [Figure 5], statistically insignificant difference ($P = 0.26$) was found with high probing depth when the implant was placed immediately and provisionalized (MD = 0.17, [95% CI: -0.13–0.48]). Heterogeneity was moderate ($I^2 = 73\%$).

Meta-analysis 4: Plaque index around implants with and without immediate provisionalization

Two studies had evaluated plaque score in immediately placed implants and provisionalization, from which one study calculated plaque score compared with and without immediate provisionalization. It was calculated in percentage (%). In the meta-analysis performed on plaque index [Figure 6], statistically insignificant difference ($P = 0.77$) was found in plaque index when provisionalization was done immediately after implant placement and when provisionalization was not done (MD = -1.00, [95% CI: -7.56–5.56]).

Table 1: Characteristics of the included studies

Author	Study design	Outcome	Number of implants	Arch	Timing of implant placement	Gingival biotype	Time period after which data were collected	Measurement site	Pink Esthetic Score (mean±SD)
De Rouck et al. ⁽²³⁾	RCT	Soft tissue dimension, probing depth, bleeding on probing, implant survival, patient esthetic satisfaction	49	Maxillary anterior region	Immediate	Thick	3, 6, 12 months	Clinical	-
Cosyn et al. ⁽²⁴⁾	Prospective study	PES	30	Maxillary anterior region	Immediate	Thick gingival biotype	3-year follow-up	Clinical	10.48±2.47
Hartlev et al. (2014) ⁽²⁵⁾	Prospective study	PES	68	Maxillary anterior region	Immediate	-	Mean follow-up 33 months	Clinical	Mean: 9.9
Van Nimwegen et al. ⁽²⁶⁾	Retrospective study	Bleeding on probing, PES	51	Maxillary anterior region	Immediate	-	5-year follow-up	Clinical	7.35±1.23
Noelken et al. (2018) ⁽²⁷⁾	Prospective study	PES	37	Maxillary anterior region	Immediate	All	1-, 2-, 5-year follow-up	Clinical	11.7±2
Arora et al. (2018) ⁽²⁸⁾	RCT	Probing depth, PES	40	Maxillary anterior region	Immediate	-	12-month follow up	Clinical	Group A: 11.1±2.08 (immediate provisionalization) Group B: 10.3±2.23 (without provisionalisation)
Furze et al. ⁽¹⁶⁾	RCT	PES	20	Maxillary anterior region	Immediate	-	3, 12, 36 months	Clinical	Group 1: 8.1±1.6 (with provisionalization) Group 2: 5.5±1.93 (without provisionalisation)
Groenendijk et al. (2020) ⁽²⁹⁾	Prospective study	PES	100	Maxillary anterior region	Immediate	-	1-year follow-up	Clinical	12.081±1.633
Wang et al. ⁽³⁰⁾	RCT	3D-ridge change: Bone crest Bone thickness Ginivva volume	40	Maxillary anterior region	Immediate	Thick	12-month follow-up	Clinical	-

PES: Pink esthetic score, RCT: Randomized controlled clinical trial, 3D: Three-dimensional, SD: Standard deviation

Table 2: Results for quality assessment of risk of bias in included studies

Study	Cohort	Control or comparison group	Pre/post intervention data	Random assignment of the participants to the intervention	Random selection of participants for assessment	Follow-up rate of 80% or more	Follow-up (%)	Comparison groups equivalent on sociodemographic	Comparison groups equivalent at baseline on disclosure	Risk of bias
De Rouck et al. ^[23]	Y	Y	Y	Y	Y	Y	94	NR	NR	Low
Cosyn et al. ^[24]	Y	N	Y	N	Y	Y	83	NA	NA	Low
Hartlev et al. (2014) ^[25]	Y	N	Y	N	Y	Y	81	NA	NA	Low
Van Nimwegen et al. ^[26]	Y	N	Y	N	Y	Y	80	NA	NA	Low
Noelken et al. (2018) ^[27]	Y	N	Y	N	Y	Y	90	NA	NA	Low
Arora et al. (2018) ^[28]	Y	Y	Y	Y	Y	Y	100	NR	NR	Low
Furze et al. ^[16]	Y	Y	Y	Y	Y	Y	95	NR	NR	Low
Groenendijk et al. (2020) ^[29]	Y	N	Y	N	Y	Y	98	NA	NA	Low
Wang et al. ^[30]	Y	Y	Y	Y	Y	Y	95	NR	NR	Low

NA: Not available, NR: Not reported

Meta-analysis 5: Mesial papillary recession around implants with and without immediate provisionalization

Three studies have evaluated mesial papilla in immediately placed implants and provisionalization, from which two studies calculated mesial papilla compared with and without immediate provisionalization. It was calculated in millimeters. In the meta-analysis performed on mesial papillary recession [Figure 7], statistically insignificant difference ($P = 0.33$) was observed in mesial papillary recession when the implant was placed immediately and provisionalized and when provisionalization was not done after implant placement (MD = -0.10, [95% CI: -0.31-0.10]). Heterogeneity was low ($I^2 = 35\%$).

Meta-analysis 6: Distal papillary recession around implants with and without immediate provisionalization

Three studies have evaluated distal papilla in immediately placed implants and provisionalization, from which two studies calculated distal papilla compared with and without immediate provisionalization. It was calculated in millimeters. In the meta-analysis performed on distal papillary recession [Figure 8], a statistically significant difference ($P = 0.0007$) was observed with the low distal papillary recession when the implant was placed immediately and provisionalized (MD = -0.32, [95% CI: -0.50--0.13]). Heterogeneity was low ($I^2 = 0\%$).

Meta-analysis 7: Midfacial mucosal recession around implants with and without immediate provisionalization

Three studies have evaluated midfacial mucosa in immediately placed implants and provisionalization, from which two studies calculated midfacial mucosa compared with and without immediate provisionalization. It was calculated in millimeters. In the meta-analysis performed on midfacial mucosal recession [Figure 9], statistically insignificant difference ($P = 0.09$) was found in midfacial mucosal recession when the implant was placed immediately and provisionalized and when no provisionalization was done after implant placement (MD = -0.47, [95% CI: -1.01-0.07]). Heterogeneity was high ($I^2 = 89\%$).

Summary of findings

GRADEpro software was used to generate quality of evidence [Figure 10]. Total nine studies included in this meta-analysis for primary (esthetic outcome) and secondary aesthetic outcome (bleeding on probing, plaque index, probing depth, mesial papillary recession, midfacial mucosal recession, and distal papillary recession) gave data of 404 patients. The trials included in the present meta-analysis provided mean and standard deviation for all aesthetic outcomes. Thus, chances of missing summary statistics, which introduce bias and imprecision,

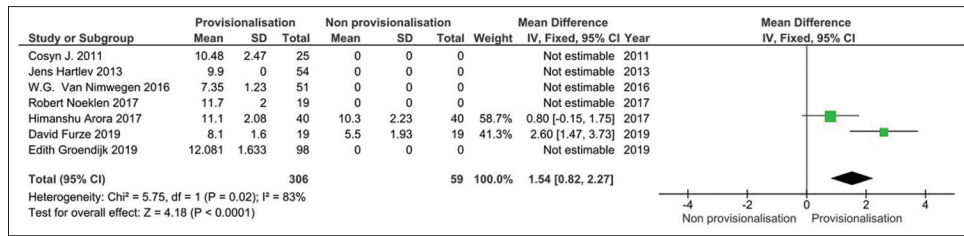


Figure 3: Forest plot for aesthetic outcome with and without immediate provisionalization

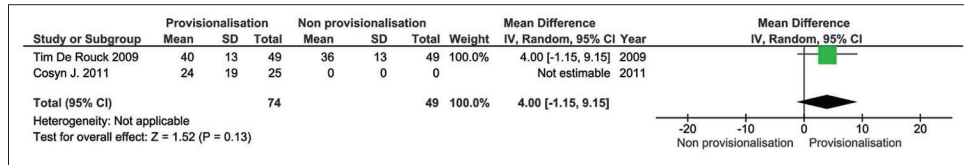


Figure 4: Forest plot for bleeding on probing with and without immediate provisionalization

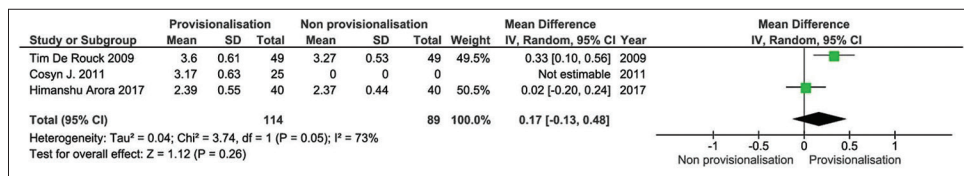


Figure 5: Forest plot for probing depth with and without immediate provisionalization

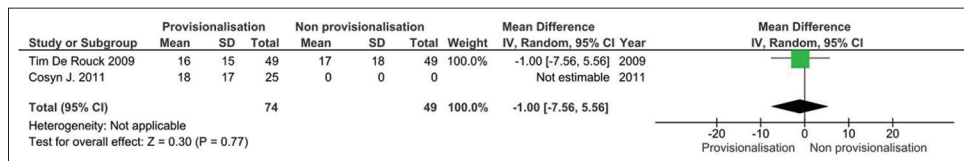


Figure 6: Forest plot for plaque index with and without immediate provisionalization

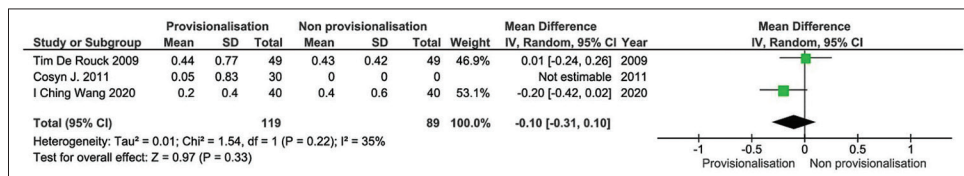


Figure 7: Forest plot for mesial papillary recession with and without immediate provisionalization

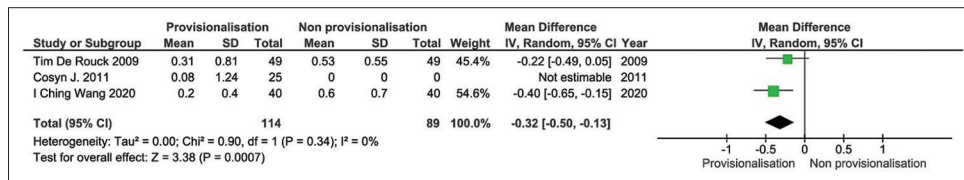


Figure 8: Forest plot for distal papillary recession with and without immediate provisionalization

are less in the present meta-analysis. According to the GRADE criteria, all nine studies included did not show inconsistency or indirectness, but although imprecision was present, the GRADE profiler (GRADEpro GDT) software determined that studies were at low risk of bias and generated moderate level of evidence. All the findings of included studies showed consistent results of immediate

provisionalization for the esthetic outcome of peri-implant mucosa. These findings showed a positive influence of immediate provisionalization on peri-implant tissue.

DISCUSSION

The interim treatment phase is usually the longest and the most challenging.^[31] The objective of this phase is to contour

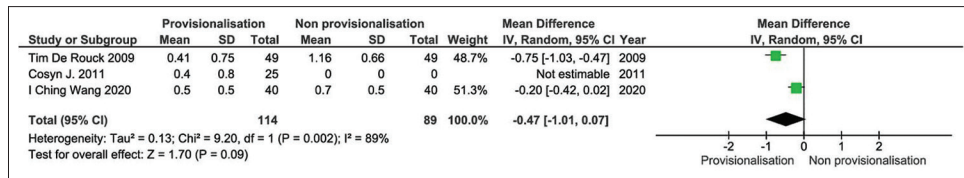


Figure 9: Forest plot for midfacial mucosal recession with and without immediate provisionalization

Certainty assessment							No. of patients		Effect		Certainty
No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other considerations	Immediate provisionalisation	non provisionalisation	Relative (95% CI)	Absolute (95% CI)	
Esthetic outcome (PES)											
7	randomised trials	not serious	not serious	not serious	serious *	none	306	59	-	MD 1.54 higher (0.82 higher to 2.27 higher)	⊕⊕⊕⊙ MODERATE
Plaque index											
2	randomised trials	not serious	not serious	not serious	serious *	none	74	49	-	MD 1 lower (7.56 lower to 5.56 higher)	⊕⊕⊕⊙ MODERATE
Bleeding on probing											
2	randomised trials	not serious	not serious	not serious	serious *	none	74	49	-	MD 4 higher (1.15 lower to 9.15 higher)	⊕⊕⊕⊙ MODERATE
Probing depth											
3	randomised trials	not serious	not serious	not serious	serious *	none	114	89	-	MD 0.17 higher (0.13 lower to 0.48 higher)	⊕⊕⊕⊙ MODERATE
Mesial papilla											
3	randomised trials	not serious	not serious	not serious	serious *	none	114	89	-	MD 0.1 lower (0.31 lower to 0.1 higher)	⊕⊕⊕⊙ MODERATE
Distal papilla											
3	randomised trials	not serious	not serious	not serious	serious *	none	114	89	-	MD 0.32 lower (0.5 lower to 0.13 lower)	⊕⊕⊕⊙ MODERATE
Mid facial mucosa											
3	randomised trials	not serious	not serious	not serious	serious *	none	114	89	-	MD 0.47 lower (1.01 lower to 0.07 higher)	⊕⊕⊕⊙ MODERATE

CI: Confidence interval; MD: Mean difference
 Explanations
 a. Imprecise due to confidence intervals included the potential for important harm or benefit.

Figure 10: Summary of findings

the peri-implant mucosa before taking the final impression. An application of a provisional phase is preferable in the esthetic zone.^[32] However, it is time-consuming and might require additional cost. The structure of peri-implant tissue is affected by provisional restoration.^[33] Implant-supported provisional restoration can alter the peri-implant mucosal architecture's emergence profile. It also aids in the development of interdental papillae. It has been suggested that the technique of immediate placement and provisionalization offers advantages for the aesthetic outcome of single tooth anterior implant restoration.^[34] Because of improved implant surface treatment and a good knowledge of implant healing, IIP has become a predictable process.

IIP has a number of benefits, including fewer surgical procedures, shorter treatment times, and higher patient satisfaction. There are also disadvantages such as mid-facial recession, papillary height loss, and crestal bone loss.^[35] Wittneben *et al.*^[32] used digital analysis to look at changes in mucosa profile pre- and post-soft tissue conditioning with implant provisional restoration using the dynamic compression technique. A significant difference was discovered when the structural changes in the mucosa and the emergence profile were compared. When compared to the original profile of the healing abutments, the change was more than doubled. Hence, it is essential to implement

the distinct provisional phase. There are different techniques available for the generation of peri-implant tissue by provisional restoration. One of the most common methods is the “Dynamic Compression Technique”.^[36] This procedure begins by applying pressure to the soft tissue to guide and “squeeze” it into the proper posture. The interim restoration is then gradually lowered to allow soft tissue to fill in. This will help to grow peri-implant tissue and improve pink esthetics. A recent systematic review was done by the author Kinaia *et al.*,^[35] in which the author has evaluated soft-tissue outcome around immediately placed implants, but the esthetic outcome was not evaluated. As a result, the present systematic review sought to check the influence of immediate provisionalization on peri-implant tissue in immediately placed implants in the esthetic zone.

This systematic review included seven studies that showed implant esthetic outcomes with PES. These studies showed that implant esthetic outcome is better when the implant was immediately placed and provisionalized in the anterior maxilla (MD = 1.54, [95% CI: 0.82, 2.27]). This is because provisional restoration molds the gingiva according to the contours of the restoration. Hence, this will improve the peri-implant esthetics, which will lead to an increase in PES. There was also statistically insignificant difference in bleeding on probing, probing depth, mesial papillary recession, midfacial mucosal recession, and plaque index

when provisionalization was performed immediately after implant placement versus when provisionalization was not performed immediately after implant placement in the maxillary anterior region. However, a highly significant difference was seen in distal papillary recession with less recession when immediate provisionalization was done after implant placement (MD = -0.32, [95% CI: -0.50, -0.13]).

Several factors influence the overall prognosis of the treatment plan, including (1) selection of patient, (2) position of tooth, (3) root position of adjacent teeth, (4) biotype of gingiva, tooth shape and the crestal bone height, (5) osseous anatomy of the implant site, (6) implant position, and (7) facial anatomy. Provisional implant restorations are important tools for restorative dentists to make an attempt to obtain the best aesthetic result for implant restorations.^[3]

Noelken *et al.*^[27] found that with IIP and provisionalization technique, implant region with facial bony inadequacies could be handled effectively with favorable esthetic results and stable marginal bone levels. After a 12-month follow-up, the success rates, marginal bone levels, and esthetic results of their study demonstrate proof of principle for preserving marginal bone height with immediately placed and provisionalized implants. Concerning soft tissue change following implant placement, De Rouck *et al.*^[6] came to the conclusion that papilla levels could be managed predictably. Interproximal tissue levels are thought to be related to neighboring tooth connective tissue contacts and bone levels. Nariman *et al.*^[37] concluded that if the tooth is extracted atraumatically, preserving the papillae and the bone and provisionalized immediately, the esthetic contour of the tooth is maintained, which is comparable with the natural tooth. Chandra Sekar *et al.*^[38] concluded that IIP and loading could achieve predictable esthetic results than delayed placement.

Apart from the positive findings of immediate placement with provisionalization, there are also some limitations. Lack of control over the implant's final position, difficulty achieving primary stability, inadequate soft tissue coverage, difficulty to inspect all areas of the extraction site for defects or infections, and difficulties preparing the osteotomy due to the drill's movement against the extraction site's walls are all disadvantages of IIP.^[39] If primary stability is lacking, then it is difficult to immediately provisionalize the implants.^[40-42] If implant site is lacking soft and hard tissue, the optimum esthetic outcome might not be achieved and may require soft and hard tissue grafting procedures.^[43] All the factors that influence the

esthetic outcome should be checked thoroughly before planning the IIP and restoration.

In the present systematic review, articles published in the English language only were included; thus, data from studies published in other languages could not be compared. Although data on the soft tissue esthetic outcome with immediate provisionalization in IIP in the anterior maxilla have been published with acceptable conclusive findings, still well-conducted RCTs with long-term follow-up are needed to derive absolute evidence for the treatment.

CONCLUSION

We found moderate-quality evidence for positive esthetic outcomes of peri-implant mucosa with immediate provisionalization and IIP in the anterior maxilla. Moderate-quality evidence for soft tissue outcomes indicates that IIP with immediate provisionalization protocol is beneficial when the implant is placed in the esthetic zone. It minimizes soft tissue changes and molds the peri-implant tissue to the provisional restoration's contours. In patients with thin and scalloped gingival biotypes and bony defects, soft and hard tissue augmentation procedures should be performed to improve the esthetic outcome. To achieve the best esthetic result in implant treatment, the right surgical procedure, restorative procedure, and clinical experience are all important.

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Conflicts of interest

There are no conflicts of interests

REFERENCES

1. Al-Quran FA, Al-Ghalayini RF, Al-Zu'bi BN. Single-tooth replacement: Factors affecting different prosthetic treatment modalities. *BMC Oral Health* 2011;11:34.
2. Higginbottom FL, Wilson TG Jr. Three-dimensional templates for placement of root-form dental implants: A technical note. *Int J Oral Maxillofac Implants* 1996;11:787-93.
3. Tischler M. Dental implants in the esthetic zone. *Contin Educ* 2004;518:793-3160.
4. de Castro LGR. Nonsurgical with immediate provisionalization: The future in implant dentistry. *J Indian Prosthodont Soc* 2018;18:S4.
5. Jung RE, Ioannidis A, Hämmerle CH, Thoma DS. Alveolar ridge preservation in the esthetic zone. *Periodontology* 2000 2018;77:165-75.
6. De Rouck T, Collys K, Cosyn J. Single-tooth replacement in the anterior maxilla by means of immediate implantation and provisionalization: A review. *Int J Oral Maxillofac Implants* 2008;23:897-904.
7. Levine R, Martin W. Esthetic risk assessment in implant dentistry. *Inside Dent* 2012;8:66-71.
8. Pitta J, Zarauz C, Pjetursson B, Sailer I, Liu X, Pradies G. A systematic review and meta-analysis of the influence of abutment material on

- peri-implant soft tissue color measured using spectrophotometry. *Int J Prosthodont* 2020;33:39-47.
9. Korsch M, Obst U, Walther W. Cement-associated peri-implantitis: A retrospective clinical observational study of fixed implant-supported restorations using a methacrylate cement. *Clin Oral Implants Res* 2014;25:797-802.
 10. Atieh MA, Alsabeeha NH. Soft tissue changes after connective tissue grafts around immediately placed and restored dental implants in the esthetic zone: A systematic review and meta-analysis. *J Esthet Restor Dent* 2020;32:280-90.
 11. 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.
 12. 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.
 13. Fürhauser R, Florescu D, Benesch T, Haas R, Mailath G, Watzek G. Evaluation of soft tissue around single-tooth implant crowns: The pink aesthetic score. *Clin Oral Implants Res* 2005;16:639-44.
 14. Digholkar S, Madhav VN, Palaskar J. Evaluation of the flexural strength and microhardness of provisional crown and bridge materials fabricated by different methods. *J Indian Prosthodont Soc* 2016;16:328-34.
 15. Nivedita S, Prithviraj DR. A comparative study to evaluate the marginal accuracy of provisional restorations fabricated by light polymerized resin and autopolymerized resin: A scanning electron microscope study. *J Indian Prosthodont Soc* 2006;6:122.
 16. Furze D, Byrne A, Alam S, Brägger U, Wismeijer D, Wittneben JG. Influence of the fixed implant-supported provisional phase on the aesthetic final outcome of implant-supported crowns: 3-year results of a randomized controlled clinical trial. *Clin Implant Dent Relat Res* 2019;21:649-55.
 17. Ou SF, Li-Deh Wang TM. CRC5: Soft Tissue Moulding Technique in Immediate Implant Placement and Provisionalization. *J Indian Prosthodont Soc* 2018;18(Suppl 1):S37.
 18. Neves FD, Silveira-Júnior CD, Coró V, Silva-Neto JP, Simamoto-Júnior PC, Prado CJ. Gingival conditioning in an implant-supported prosthesis: A clinical report. *J Oral Implantol* 2013;39:483-5.
 19. Nagaraj KR, Savadi RC, Savadi AR, Prashanth Reddy GT, Srilakshmi J, Dayalan M, *et al.* Gingival biotype - Prosthodontic perspective. *J Indian Prosthodont Soc* 2010;10:27-30.
 20. Moher D, Altman DG, Liberati A, Tetzlaff J. PRISMA statement. *Epidemiology* 2011;22:128.
 21. Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). *Cochrane Handbook for Systematic Reviews of Interventions*. 2nd ed. Chichester (UK): John Wiley and Sons, 2019.
 22. Kennedy CE, Fonner VA, Armstrong KA, Denison JA, Yeh PT, O'Reilly KR, *et al.* The evidence project risk of bias tool: Assessing study rigor for both randomized and non-randomized intervention studies. *Syst Rev* 2019;8:3.
 23. De Rouck T, Colls K, Wyn I, Cosyn J. Instant provisionalisation of immediate single-tooth implants is essential to optimize aesthetic treatment outcome. *Clin Implant Dent Relat Res* 2009;20:566-70.
 24. Cosyn J, Eghbali A, De Bruyn H, Colls K, Cleymaet R, De Rouck T. Immediate single-tooth implants in the anterior maxilla: 3-year results of a case series on hard and soft tissue response and aesthetics. *J Clin Periodontol* 2011;38:746-53.
 25. Hartlev J, Kohberg P, Ahlmann S, Andersen NT, Schou S, Isidor F. Patient satisfaction and aesthetic outcome after immediate placement and provisionalisation of single-tooth implants involving a definitive individual abutment. *Clin Oral Implants Res* 2014;25:1245-50.
 26. Van Nimwegen WG, Goené RJ, Van Daelen AC, Stellingsma K, Raghoobar GM, Meijer HJ. Immediate implant placement and provisionalisation in the aesthetic zone. *J Oral Rehabil* 2016;43:745-52.
 27. Noelken R, Moergel M, Kunkel M, Wagner W. Immediate and flapless implant insertion and provisionalisation using autogenous bone grafts in the aesthetic zone: 5-year results. *Clin Oral Implants Res* 2018;29:320-7.
 28. Arora H, Ivanovski S. Clinical and aesthetic outcomes of immediately placed single-tooth implants with immediate vs. delayed restoration in the anterior maxilla: A retrospective cohort study. *Clin Oral Implants Res* 2018;29:346-52.
 29. Groenendijk E, Staas TA, Bronkhorst E, Raghoobar GM, Meijer GJ. Immediate implant placement and provisionalisation: Aesthetic outcome 1 year after implant placement. A prospective clinical multicenter study. *Clin Implant Dent Relat Res* 2020;22:193-200.
 30. Wang IC, Chan HL, Kinney J, Wang HL. Volumetric facial contour changes of immediately placed implants with and without immediate provisionalisation. *J Periodontol* 2020;91:906-16.
 31. Priest G. Esthetic potential of single-implant provisional restorations: Selection criteria of available alternatives. *J Esthet Dent* 2006;18:326-38.
 32. Wittneben JG, Brägger U, Buser D, Joda T. Volumetric calculation of supraimplant submergence profile after soft tissue conditioning with a provisional restoration. *Int J Periodontics Restorative Dent* 2016;36:785-90.
 33. Schoenbaum TR, Chang YY, Klokkevold PR, Snowden JS. Abutment emergence modification for immediate implant provisional restorations. *J Esthet Dent* 2013;25:103-7.
 34. den Hartog L, Raghoobar GM, Stellingsma K, Meijer HJ. Immediate loading and customized restoration of a single implant in the maxillary esthetic zone: A clinical report. *J Prosthet Dent* 2009;102:211-5.
 35. Kinaia BM, Ambrosio F, Lambie M, Hope K, Shah M, Neely AL. Soft tissue changes around immediately placed implants: A systematic review and meta-analyses with at least 12 months of follow-up after functional loading. *J Periodontol* 2017;88:876-86.
 36. Wittneben JG, Buser D, Belser UC, Brägger U. Peri-implant soft tissue conditioning with provisional restorations in the aesthetic zone: The dynamic compression technique. *Int J Periodontics Restorative Dent* 2013;33:447-55.
 37. Nariman RH, Pai UY, Soumya MK, Hegde R. A clinical assessment of the volume of interproximal papilla after definitive prosthesis around immediate and delayed loading implants placed in the maxillary esthetic zone: An *in vivo* study. *J Indian Prosthodont Soc* 2018;18:168-73.
 38. Chandra Sekar A, Praveen M, Saxena A, Gautam A. Immediate implant placement: A case report. *J Indian Prosthodont Soc* 2012;12:120-2.
 39. Bholra M, Neely AL, Kolhatkar S. Immediate implant placement: Clinical decisions, advantages, and disadvantages. *J Prosthodont* 2008;17:576-81.
 40. Pilliar RM, Lee JM, Maniopoulos CD. Observations on the effect of movement on bone ingrowth into porous-surfaced implants. *Clinical orthopaedics and related research*. 1986;(208):108-13.
 41. Nemcovsky CE, Artzi Z, Moses O, Gelernter I. Healing of marginal defects at implants placed in fresh extraction sockets or after 4-6 weeks of healing. A comparative study. *Clin Oral Implants Res* 2002;13:410-9.
 42. Schropp L, Kostopoulos L, Wenzel A. Bone healing following immediate versus delayed placement of titanium implants into extraction sockets: A prospective clinical study. *Int J Oral Maxillofac Implants* 2003;18:189-99.
 43. Shetty M. Peri-implant bone augmentation in the esthetic zone with j shaped block bone allograft: Case report with a 2 year follow up. *J Indian Prosthodont Soc* 2018;18 Suppl 2:S99.