

Comparative Evaluation between Immediate, Immediate-Delayed, and Delayed Dental Implants

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Abstract

Objective: The aim of the study was to compare the success rates, peri-implant marginal bone level changes, esthetics, and patient satisfaction among immediate, immediate-delayed, and delayed dental implant placement protocols. **Materials and Methods:** A prospective experimental study was conducted with 30 patients in the Department of Oral and Maxillofacial Surgery, People's Dental Academy. Patients were divided into three groups: Group I (immediate implant placement), Group II (immediate-delayed implant placement after 4–6 weeks), and Group III (delayed implant placement after several months). Clinical and radiographic parameters, including success rate, peri-implant marginal bone level changes, esthetics, and patient satisfaction, were assessed at 4 months post-loading. Statistical analysis was performed using SPSS version 25.0, with significance set at $P < 0.05$. **Results:** The success rate was 100% in the delayed implant group, with no crown failures, compared to 90% in the immediate and immediate-delayed groups. However, the differences were not statistically significant ($P = 0.585$). Peri-implant marginal bone level changes showed no significant differences between groups in both width and height dimensions ($P = 0.659$ and $P = 0.614$, respectively). Esthetic evaluation using the Pink Esthetic Score (PES) revealed significantly higher scores in the immediate implant group ($P = 0.000$). Patient satisfaction was high across all groups, with no statistically significant differences ($P = 0.749$). **Conclusion:** Delayed implant placement exhibited the highest success rate, while immediate implant placement showed superior esthetic outcomes. All three methods resulted in high patient satisfaction. The choice of implant timing should consider individual patient needs, clinical conditions, and esthetic goals to optimize treatment outcomes.

Keywords: Esthetics, Delayed implant placement, Dental implants, Immediate implant placement, Immediate-delayed implant placement, Patient satisfaction, Peri-implant bone level.

INTRODUCTION

Restoration of form and function has been the ever-lasting prerequisite in dentistry and the maxillofacial region. Rehabilitation of missing tooth/teeth through dental implants plays a pivotal role in cosmesis, restoring masticatory function, preventing resorption of the alveolar bone, and maintaining overall oral health and structure.^[1,2] Given achieving functional efficacy and esthetic excellence, it becomes crucial to determine the accurate timing for dental implant placement.^[3,4]

The timing of placing the implant after extraction can be divided into three predominant methodologies; immediate implant refers to the insertion of the implant immediately after tooth extraction. This method is time-efficient, allows the preservation of alveolar bone and soft-tissue, results in better esthetic outcomes, and offers fewer post-operative complications but it comes with the risk of implant failure if the surgical site gets infected and also requires surgical expertise.^[5-10] Immediate-delayed implant refers to the insertion

of the implant 4–6 weeks after tooth removal, resulting in soft-tissue healing but before substantial bone resorption occurs, striking a middle ground between immediate and delayed implant placement protocols.^[11-13] Delayed implant refers to the placement of the implant several months post-extraction, allowing the completion of both soft tissue and bone healing. This ensures that the extraction site is completely healed, devoid of any residual infection. However, this brings challenges of alveolar bone resorption at the surgical site, longer duration of treatment, and poor esthetic outcome as compared to the other two protocols.^[13-15]

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Thus, we conducted a study comparing three different timing methods to explicate the potential benefits and drawbacks of each method, which may guide a clinician to decide and foster the best treatment for their patients.

MATERIALS AND METHODS

Study setting

This prospective experimental study was conducted in the Department of Oral and Maxillofacial Surgery at People's Dental Academy, with ethical clearance and informed consent obtained from patients.

Patient selection

Patients requiring dental implants were screened through case history, clinical examination, and CBCT imaging.

Inclusion criteria

1. Age above 18 years.
2. Signed informed consent.
3. Sufficient space for implants.
4. D2 bone density (Misch classification).

Exclusion criteria

1. Immunocompromised patients
2. Irradiation in the head/neck area
3. Uncontrolled diabetes
4. Pregnancy/lactation
5. Untreated periodontitis
6. Poor oral hygiene
7. Substance addiction
8. Psychiatric disorders
9. Acute infection at implant site.

Study groups

Thirty patients were divided into three groups:

1. Immediate implant placement (10 patients) [Figure 1].
2. Immediate-delayed implant placement (10 patients) [Figure 2].
3. Delayed implant placement (10 patients) [Figure 3].

Procedure

- Group 1: Immediate implant placement with suturing without flap mobilization.
- Group 2: Implant placement 6 weeks post-extraction with mucoperiosteal flap elevation.
- Group 3: Implant placement 4 months post-extraction with socket augmentation if necessary.

Data collection

Baseline periapical radiographs were taken post-implant/augmentation. Implants were left to heal and unloaded for 4 months. Post-surgical care included antibiotics, analgesics, and chlorhexidine mouthwash. Sutures were removed after 1 week, with follow-up every 15 days for the 1st month.

Second-stage surgery

Performed 3–6 months post-implant insertion, with gingival cuff formation and abutment placement. Follow-up evaluations were done at 3 and 6 months.

Assessment parameters

1. Success Rate: Evaluated by implant mobility, pain (VAS), and implant failure.
2. Peri-implant Marginal Bone Level Changes: Measured using CBCT scans.
3. Esthetics: Assessed using the pink esthetic score (PES) based on clinical photographs.
4. Patient Satisfaction: Evaluated through patient feedback on function, esthetics, and willingness to undergo the procedure again.

Patients were reassessed at 4 months post-loading for all parameters.

RESULTS

Data analysis is done using SPSS version 25.0. For data analysis, the Chi-square test, ANOVA test, and Kruskal–Wallis H test were used. In total, 30 participants (17 females, 13 males) were divided into the immediate implant (10), immediate-delayed implant (10), and delayed implant (10) groups. Results show no significant differences in success rates among the three implant placement groups ($P < 0.05$ for significance). Crown failure occurred in 10% of cases in Groups 1 and 2, with no failures in Group 3 (Table 1). Implant mobility was noted in one case each in Groups 1 (grade II) and 2 (grade I), with none in Group 3 (Table 2). Pain levels were low across all groups, with mean VAS scores of 0.20 for Group 1, 0.10 for Group 2, and none in Group 3 (Table 3). Peri-implant marginal bone level changes in width and height were minor and statistically insignificant (Tables 4 and 5). Esthetic evaluations using the PES showed significant differences in mesial and distal papilla scores, soft-tissue levels, and overall PES, with Group 1 scoring the highest (Table 6). Patient satisfaction was high in all groups (90% for Groups 1 and 2, 80% for Group 3), with no significant differences (Table 7).

DISCUSSION

Dental implants are an integral part of prosthetic rehabilitation of missing tooth or teeth fostering esthetics, stability, comfort, and satisfaction of the patients.

We conducted a study to assess and compare immediate, immediate-delayed, and delayed implant insertion based on success rate, peri-implant marginal bone level changes,

Table 1: Comparison of the clinical parameters of success rate–crown failure between the three groups

Groups	n	Crown Failure		P-value
		No n (%)	Yes n (%)	
Immediate post-extractive implant placement group	10	9 (90.0)	1 (10.0)	0.585
Immediate-delayed implant placement group	10	9 (90.0)	1 (10.0)	
Delayed implant placement group	10	10 (100)	0 (0.0)	
Total	30	28 (93.3)	2 (6.7)	

n: Number of subjects

Table 2: Comparison of the clinical parameters of success rate–implant failure (implant mobility) between the three groups

Groups	n	Implant failure (Implant Mobility)				Mean Rank*	P-value
		Grade 0	Grade I	Grade II	Grade III		
Immediate post-extractive implant placement group	10	9	0	1	0	16.05	0.595
Immediate-delayed implant placement group	10	9	1	0	0	15.95	
Delayed implant placement group	10	10	0	0	0	14.50	

*Kruskal–Wallis H test

Table 3: Comparison of the clinical parameters of success rate-(Pain and discomfort) between the three groups

Groups	n	Implant Failure (Pain and Discomfort) Visual analog scale (VAS)			P-value
		Mean±SD	Minimum	Maximum	
Immediate post-extractive implant placement group	10	0.20±0.63	0.00	2.00	0.556
Immediate-delayed implant placement group	10	0.10±0.31	0.00	1.00	
Delayed implant placement group	10	0.00±0.00	0.00	0.00	

VAS score 0-No pain, 0.1–3.9-Slight pain, 4–6.9-Moderate pain, 7–10-Severe pain

Table 4: Comparison of peri-implant marginal bone level changes (linear measurement) width dimension of the alveolar ridge between the three group

Groups	n	Peri-implant marginal bone level changes (linear measurement in mm) “A” width dimension of the alveolar ridge			P-value
		Mean±SD	Minimum	Maximum	
Immediate post-extractive implant placement group	10	0.16±0.09	0.10	0.40	0.659
Immediate-delayed implant placement group	10	0.18±0.06	0.10	0.30	
Delayed implant placement group	10	0.19±0.05	0.10	0.30	

SD: Standard deviation

Table 5: Comparison of peri-implant marginal bone level changes (linear measurement) vertical height of the alveolar ridge between the three group

Groups	n	Peri-implant marginal bone level changes (linear measurement in mm) “B” vertical height of the alveolar ridge			P-value
		Mean±SD	Minimum	Maximum	
Immediate post-extractive implant placement group	10	0.46±0.18	0.30	0.90	0.614
Immediate-delayed implant placement group	10	0.47±0.14	0.30	0.80	
Delayed implant placement group	10	0.52±0.09	0.40	0.70	

Table 6: Comparison of esthetic evaluation using the pink esthetic scores between the three groups

PES variables	Immediate post-extractive implant placement group	Immediate-delayed implant placement group	Delayed implant placement group	F-value	P-value
	Mean±SD	Mean±SD	Mean±SD		
Mesial papilla	1.80±0.42	1.70±0.48	1.10±0.73	4.500	0.021*
Distal papilla	1.80±0.42	1.80±0.42	1.10±0.56	7.230	0.003*
Soft-tissue level	1.90±0.31	1.50±0.52	1.40±0.51	3.259	0.05*
Soft-tissue contour	1.70±0.48	1.40±0.51	1.30±0.48	1.773	0.189
Alveolar process deficiencies	1.80±0.42	1.80±0.42	1.00±0.66	8.000	0.002*
Soft-tissue color	1.80±0.42	1.70±0.48	1.30±0.48	3.259	0.05*
Soft-tissue texture	1.70±0.48	1.60±0.51	1.40±0.69	0.708	0.502
Total PES	12.50±0.70	11.50±1.17	8.60±1.35	33.17	0.000*

esthetics, and patient satisfaction. This investigation addresses the growing preference for shorter treatment periods, a request frequently voiced by patients.

Success rate

In our study, when we compare the clinical parameters of the success rate of implants among three groups through

Table 7: Comparison of patient satisfaction between the three groups

Groups	n	Patient satisfaction		P-value
		Yes n (%)	No n (%)	
Immediate post-extractive implant placement group	10	9 (90.0)	1 (10.0)	0.749
Immediate-delayed implant placement group	10	9 (90.0)	1 (10.0)	
Delayed implant placement group	10	8 (80.0)	2 (20.0)	
Total	30	26 (86.7)	4 (13.3)	

assessment of crown failure, implant mobility, and pain and discomfort; delayed implant placements show 100% success rate with no implant and crown failure as compared to early and immediate implant placements which show 90% success rate. The caveat here is these results might still be statistically insignificant because our sample size is quite small. The result of our study verifies the earlier study of Soydan *et al.*^[11] who conclude that immediate-delayed implant placement is better than immediate implant placement. They find that inadequate soft-tissue volume causes tension during the closure of the mucoperiosteal flap which leads to exposure of the bone graft or membrane and may lead to bone loss and/or implant failure in case of immediate implant placement. Annibali *et al.*^[16] compare the success rates of immediate, immediate-delayed, and delayed placed single implants and conclude that the success rates in the early period using the three techniques are similar and immediate-delayed placement can be an alternative to the immediate placement when the conditions might not be suitable at the time of extraction and can affect the clinical

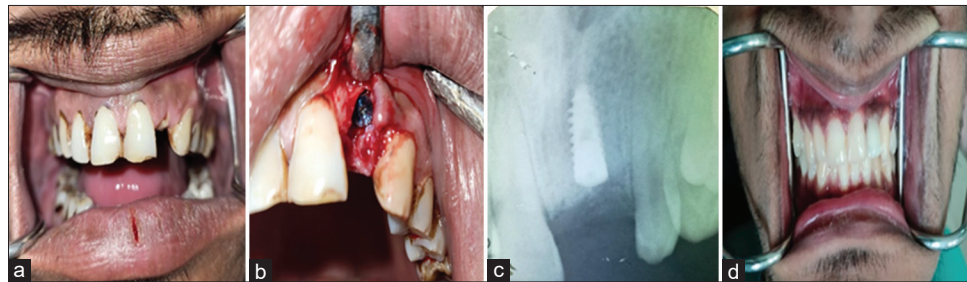


Figure 1: Group I. (a) Fractured left maxillary lateral incisor. (b) Immediate implant placement is done. (c) IOPA radiograph after implant placement. (d) Implant loading three months after implant placement



Figure 2: Group II. (a) Deep distoproximal caries concerning right mandibular first molar. (b) Implant placement done 6 weeks after tooth extraction. (c) IOPA radiograph after implant placement. (d) Implant loading 3 months after implant placement

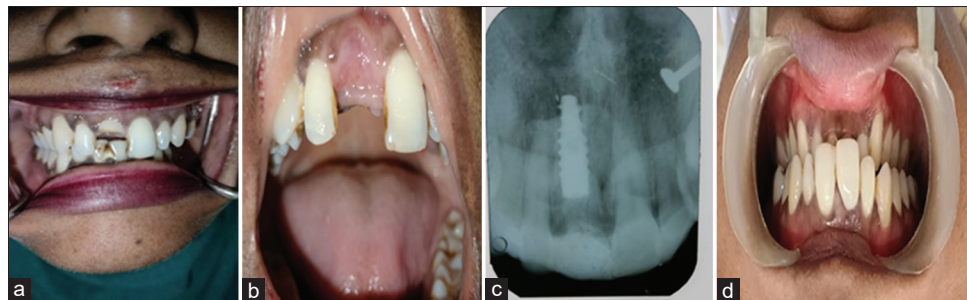


Figure 3: Group III. (a) Periodontally compromised fractured right maxillary central incisor. (b) Healed socket 4 months after extraction of tooth. (c) IOPA radiograph after implant placement. (d) Implant loading 3 months after implant placement

outcome of immediate implant placement, whereas Kim and Yoon^[4] in their study find a higher probability of survival in the immediate implant placement group than in the delayed implant placement group. The failure in the delayed group might be due to a prosthetic or inflammatory factor around the implant rather than a surgical factor. Infection of the tooth or the periodontal tissue may influence the treatment success when replacing the tooth immediately after removal with an implant. Infection could be caused by marginal periodontitis, periapical pathology, failures of endodontic treatments, and root fractures which may compromise the possibility of achieving primary implant stability. Furthermore, it seems sensible to use antibiotics in medically compromised patients. In the present study, the outcome achieved may be due to good soft-tissue healing, absence of peri-implant infection, and carrying out procedures under antibiotic coverage.

Peri-implant marginal bone level changes

In this study, when we compare the changes in peri-implant marginal bone levels through the assessment of vertical height and buccolingual/buccopalatal width of the alveolar ridge among the three groups, the delayed implant group showed maximum changes followed by immediate-delayed implant group, followed by immediate implant group. However, the results were not statistically significant. In our study, vertical bone loss was slightly higher in the delayed placement group (mean 0.52 mm) than in the immediate-delayed (mean 0.47 mm) and immediate placement group (mean 0.46mm). Plausible reasons could be greater pre-existing bone loss in delayed insertion sites and the fact that delayed sites were not subjected to any bone preservation procedures. Similarly, Watzek *et al.*^[17] report that peri-implant bone resorption values are higher for immediate-delayed implant placement than immediate implant placement after 27.1 months of follow-up. Peñarrocha-Diago *et al.*^[10] have compared cervical bone loss (CBL) at 1 year after placement of the immediate and delayed implants in the maxillary molar region. The average CBL was reported to be higher for delayed implants than for immediate implants. Schwartz-Arad *et al.*^[18] compare immediate and delayed implants to examine CBL with a mean follow-up period of 3.5 years. They found that the posterior area in the maxilla and mandible showed higher CBL in the delayed implant group compared to that in the immediate implant group. In contrast, Bassir *et al.*^[9] conclude that significantly lower marginal peri-implant bone loss was found for implants placed according to the early placement protocol compared with those placed immediately into fresh extraction sockets, that is, immediate implant. The greater marginal peri-implant bone loss in the immediate placement group may be attributed to the horizontal and vertical resorption of the extraction socket walls that begin immediately after tooth extraction.

Esthetics

In this study, esthetic evaluation was done using the PES by a blind assessor. The best esthetic outcome was shown by immediate group, followed by immediate-delayed and delayed groups, respectively. Total PES score was highest

for Group 1 (12.50), for Group 2, it was 11.50 and it was lowest for Group 3 and the difference between the three groups was statistically highly significant. Better esthetic outcomes observed with immediate implant placement may be due to the preservation of the alveolar ridge and soft-tissue contours, and the maintenance of the interdental papilla. These factors contribute to a more natural and esthetically pleasing result compared to immediate-delayed and delayed implant placement. Our results are consistent with a systematic review published by Chen and Buser in 2014.^[8] The predominant index used to report on esthetic outcomes was the PES index. The esthetic outcomes for immediate type and immediate-delayed type placements were similar, although significant heterogeneity between studies was observed. The strength of the PES is that it is consistently reproducible in several studies and provides a measure of symmetry of the peri-implant mucosa with the adjacent natural teeth. The PES, however, is a summation of seven soft-tissue-related factors assigned scores on an ordinal scale. The weakness of the PES is that each factor is assumed to carry equal weight in contributing to the overall score; however, this has not been demonstrated in the literature. Bianchi and Sanfilippo^[19] conclude higher success in the group of patients who received immediate implant placement and simultaneous connective tissue grafting, than the patients who were solely treated with immediate implants without any connective tissue grafting. This shows that soft-tissue levels were generally stable following immediate implant placement when connective tissue grafting was performed. Conversely, Botticelli *et al.*^[20] studied the position of the mucosal margin for 5 years. They conclude that 20–25% of the patients who were treated with implants immediately placed into extraction sockets suffered esthetically from the apical displacement of the mucosal margins, although soft-tissue levels seemed to be stable in the long term in the majority of the patients.

Gottfredsen^[21] using a submerged technique find that delayed placement (12 weeks) after tooth extraction performed better than early placement (4 weeks), whereas Schropp *et al.*^[22] conclude that early placement (on average 10 days after extraction) of single-tooth implants may be preferable to delayed implant placement technique (12 weeks) in terms of the early generation of interproximal papillae and the achievement of an appropriate clinical crown height.

Patient satisfaction

High comfort, improved esthetics, better chewing function, and better phonetics are parameters typically considered important while considering patient satisfaction after an implant-supported prosthesis has been given. This study finds that the patients treated with the delayed implant placement protocol are less satisfied (80%) than the ones treated with immediate (90%) and immediate-delayed (90%) implant placement protocols. This may be attributed to better esthetic outcomes and less duration of treatment of immediate and immediate-delayed implant insertion protocols. Our result is in accordance with Schropp *et al.*^[23] who compare early and delayed implant placements, find that the overall satisfaction with the treatment

was highest with the early-placed implants. They concluded reduction of treatment time and fewer surgical interventions are advantages of immediate/immediate-delayed implant placement. Therefore, these protocols might be expected to increase patient satisfaction.

CONCLUSION

Among the three different implant placements, we do not find any statistically significant difference due to the success rate, perimarginal bone levels, and patient satisfaction. However, undoubtedly esthetically immediate implant placement triumphs over the other methods. Thus, we conclude that an immediate implant placement should always be the first choice of treatment in restoring dental tooth or teeth if all conditions are favorable.

REFERENCES

- Esposito M, Grusovin MG, Polyzos IP, Felice P, Worthington HV. Timing of implant placement after tooth extraction: Immediate, immediate-delayed or delayed implants? A cochrane systematic review. *Eur J Oral Implantol* 2010;3:189-205.
- Schropp L, Isidor F. Timing of implant placement relative to tooth extraction. *J Oral Rehabil* 2008;35:33-43.
- Kiyani TM. The relationship between brand trust, customer satisfaction and customer loyalty (Evidence from automobile sector of Pakistan). *Interdiscip J Contemp Res Bus* 2012;4:489-502.
- Kim JK, Yoon HJ. Clinical and radiographic outcomes of immediate and delayed placement of dental implants in molar and premolar regions. *Clin Implant Dent Relat Res* 2017;19:703-9.
- Bhowal K, Ghosh S. Guided bone regeneration in immediate dental implants-review. *Int J Sci Res* 2020;9:1461-5.
- Al Qabbani A, Al Kaway S, Enezei H, Razak N, Al Bayatti S, Samsudin A, *et al.* Biomechanical and radiological assessment of immediate implants for alveolar ridge preservation. *Dent Res J (Isfahan)* 2018;15:420-9.
- Viswambaran M, Arora V, Tripathi RC, Dhiman RK. Clinical evaluation of immediate implants using different types of bone augmentation materials. *Med J Armed Forces India* 2014;70:154-62.
- Chen S, 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.
- Bassir SH, El Kholy K, Chen CY, Lee KH, Intini G. Outcome of 1-year dental implant placement versus other dental implant placement protocols: A systematic review and meta-analysis. *J Periodontol* 2019;90:493-506.
- Peñarrocha-Diogo MA, Maestre-Ferrín L, Demarchi CL, Peñarrocha-Oltra D, Peñarrocha-Diogo M. Immediate versus nonimmediate placement of implants for full-arch fixed restorations: A preliminary study. *J Oral Maxillofac Surg* 2011;69:154-9.
- Soydan SS, Cubuk S, Oguz Y, Uckan S. Are success and survival rates of early implant placement higher than immediate implant placement? *Int J Oral Maxillofac Surg* 2013;42:511-5.
- Felice P, Barausse C, Buti J, Gessaroli M, Esposito M. Immediate, early (6 weeks) and delayed (4 months) single post-extractive implants: 3-year post-loading data from a randomised controlled trial. *Clin Trials Dent* 2019;1:5-23.
- Esposito M, Koukouloupoulou A, Coulthard P, Worthington H. Interventions for replacing missing teeth: Dental implants in fresh extraction sockets (immediate, immediate-delayed and delayed implants). *Cochrane Database Syst Rev* 2006;4:CD005968.
- Clementini M, Morlupi A, Agrestini C, Barlattani A. Immediate versus delayed positioning of dental implants in guided bone regeneration or onlay graft regenerated areas: A systematic review. *Int J Oral Maxillofac Surg* 2013;42:643-50.
- Tonetti MS, Cortellini P, Graziani F, Cairo F, Lang NP, Abundo R, *et al.* Immediate versus delayed implant placement after anterior single tooth extraction: The timing randomized controlled clinical trial. *J Clin Periodontol* 2017;44:215-24.
- Annibaldi S, Bignozzi I, Iacovazzi L, La Monaca G, Paola Cristalli M. Immediate, early, and late implant placement in first-molar sites: A retrospective case series. *Int J Oral Maxillofac Implants* 2011;26:1108-22.
- Watzek G, Haider R, Mensdorff-Pouilly N, Haas R. Immediate and delayed implantation for complete restoration of the jaw following extraction of all residual teeth: A retrospective study comparing different types of serial immediate implantation. *Int J Oral Maxillofac Implants* 1995;10:561-7.
- Schwartz-Arad D, Yaniv Y, Levin L, Kaffe I. A radiographic evaluation of cervical bone loss associated with immediate and delayed implants placed for fixed restorations in edentulous jaws. *J Periodontol* 2004;75:652-7.
- Bianchi AE, Sanfilippo F. Single-tooth replacement by immediate implant and connective tissue graft: A 1-9-year clinical evaluation. *Clin Oral Implants Res* 2004;15:269-77.
- Botticelli D, Renzi A, Lindhe J, Berglundh T. Implants in fresh extraction sockets: A prospective 5-year follow-up clinical study. *Clin Oral Implants Res* 2008;19:1226-32.
- Gotfredsen K. A 5-year prospective study of single-tooth replacements supported by the Astra Tech® implant: A pilot study. *Clin Implant Dent Relat Res* 2004;6:1-8.
- Schropp L, Isidor F, Kostopoulos L, Wenzel A. Interproximal papilla levels following early versus delayed placement of single-tooth implants: A controlled clinical trial. *Int J Oral Maxillofac Implants* 2005;20:753-61.
- Schropp L, Isidor F, Kostopoulos L, Wenzel A. Patient experience of and satisfaction with, delayed-immediate vs. delayed single-tooth implant placement. *Clin Oral Implants Res* 2004;15:498-503.