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ORIGINAL ARTICLE

COMPARISON OF SOFT AND HARD TISSUE RESPONSE BETWEEN SCREW RETAINED AND CEMENT RETAINED IMPLANT PROSTHESIS: AN IN-VIVO STUDY

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ABSTRACT

Introduction: *To mitigate the negative consequences of tooth loss, it's essential to consider tooth replacement. Implants have emerged as a leading treatment modality for effectively restoring lost dentition, meeting both functional and aesthetic demands with remarkable success. This study aimed to assess and compare the soft tissue and hard tissue responses around screw-retained and cement-retained implant prostheses.*

Materials and methods: *A prospective in vivo study was conducted, involving ten screw-retained and ten cement-retained implant prostheses placed in selected patients. Clinical parameters, including gingival bleeding index and marginal plaque index, were recorded. Radiographs were taken at 3, 6, and 9 months follow up to evaluate bone loss mesial and distal to each implant using ImageJ software. Statistical analysis was performed, and quantitative data were compared using the Kruskal-Wallis test.*

Results: *Significant increases in the gingival bleeding index, marginal plaque index, and mean marginal bone loss were observed around both screw-retained and cement-retained prostheses throughout the study period.*

Conclusion: *Although both retention types showed acceptable clinical performance over 9 months, statistically significant differences in soft and hard tissue responses suggest that clinical outcomes may be influenced by the type of prosthesis. Individual patient factors and clinical conditions should guide the choice of retention method.*

Keywords: *Bone Resorption, Dental Implants, Prosthesis and Implants*

INTRODUCTION

The absence of one or more teeth can significantly impact oral health, affect structural balance, oral function, and aesthetics while also lead to changes in the position of remaining dentition within the oral cavity.[1] To mitigate these adverse effects, the replacement of lost teeth becomes necessary. The choice of prosthesis for tooth replacement depends on various factors including age, bone quality, health of abutment teeth, systemic health, and socioeconomic status.[1]

Implants have emerged as a leading treatment modality for effectively restoring lost dentition, meeting both functional and aesthetic demands with remarkable success.[2] The attachment of the prosthesis to the implant can be achieved through two primary methods: direct screwing of the prosthesis to the implants or screwing of the abutment to the implant onto which the prosthesis is cemented.[3] Screw-retained implant prostheses are recommended for cases with multiple abutments due to easier cleaning and repair, while cement-retained prostheses are preferred when aesthetics take precedence.[4] Cement-retained prostheses are commonly favoured, particularly for single crowns, although the

careful removal of excess cement is crucial to avoid inflammation.[5]

However, the choice between screw and cement retention methods has long been a subject of debate. Both approaches can lead to soft and hard tissue damage, potentially resulting in implant failure.[6,7] Thus, this study aimed to evaluate and compare the responses of soft and hard tissues to screw and cement-retained dental implant prostheses.

MATERIALS AND METHODS

This in-vivo study was conducted in the Department of Prosthodontics and Crown & Bridges of Teerthanker Mahaveer Dental College & Research Center (TMDC & RC), Moradabad, Uttar Pradesh, India. The duration of the study was 18 months.The study adhered to the principles of the Declaration of Helsinki for the medical protocol and ethics, and received approval from Institutional Ethics Committee of Teerthankar Mahaveer University (Approval No.: TMU/IEC/2018/36).Written informed consent was obtained from all the patients selected for the study.

The sample size for the study included 20 implants placed on 20 patients. This pilot study utilized 10 implants per group based on feasibility and precedent in similar exploratory studies. Formal power calculation was not performed, which is a limitation of the study.The samplewas classified into two groups as follows:

Group 1: included 10 implants with screw retained implant prosthesis.

Group 2: included 10 implants with cement retained implant prosthesis.

Allocation to groups was performed using a simple randomization (coin toss). Outcome assessor was blinded to the type of prosthesis to reduce bias. The study included patients aged between 18-60 years, with good oral hygiene and willing to undergo restoration with dental implants and adequate bone height and width to accommodate an implant of appropriate dimension. Patients withthe presence of active infection around the adjacent tooth and history of alcohol, smoking and medically compromising conditions which prohibit implant surgery, such as stroke, recent infarction, severe bleeding disorders, diabetes, osteoporosis, cancer and dental history of bruxism, parafunctional habit were excluded from the study.

Treatment protocol

Surgical Phase

Conventional two stage surgery was planned for every patient.

Prosthetic Phase:

Implants used in this study were from the Adin Dental Implant System (Touareg-S, Israel), with surface treatment via SLA (sandblasted, large grit acid-etched). Straight titanium RS abutments were used for cement-retained prostheses and RS plastic cylinder casting abutments for screw-retained prostheses. Implant insertion torque was standardized at 30 Ncm.The prostheses were cemented using dual-cure adhesive luting cement (G-CEM LinkForce, GC Corp).

After 14 days of second stage surgery when a satisfactory gingival collar was formed around the gingival former, the gingival former was removed and an implant level impression was made with the help ofclosed tray technique. The impression analogue was placed in the implant with the notch of impression analogue facing labially. The impression was made using silicone elastomeric impression material (Photosil, DPI India).The impression was then removed from the patient's mouth and the impression analogue was also removed and oriented in the impression with the notch. The implant analogue was screwed on to it and master cast was poured with die stone.

When the cast was retrieved the impression analogue was removed leaving the implant analogue in the cast, the castable abutment used in screw retained prosthesis (Fig. 1.a) and prefabricated abutment used in cement retained prosthesis, abutment was then fitted onto this implant analogue and necessary milling was done to the abutment. Finally, the metal coping was fabricated with lost wax technique (Fig. 1.b) and veneering was done with feldspathic porcelain (Vita Zahnfabrik). After placement of the prosthesis, occlusion was re-evaluated and the interference was selectively removed from the prosthesis before final polishing and cementation (Fig. 1.c).


Figure 1.a

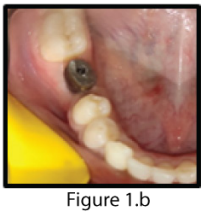
Figure 1.b


Figure 1.c

Evaluation criteria

Post-operative evaluation of the screw and cement retained implants prosthesis included following parameters to assess the objectives of the study.

1. Soft tissue changes can be assessed with recording the:
    a. Gingival index
    b. Marginal plaque index
2. Height of marginal bone loss were evaluated by:
    a. Intraoral periapical radiographs
    b. Digital radiovisiography
    c. ImageJ software

Recommended follow ups were performed according to a specific protocol of base line, 3rd month, 6th month and 9th month interval after the implant prosthesis placement. Although the follow-up after prosthesis placement was 9 months, the implants had been placed 3-4 months earlier, bringing the total observation period close to 12-13 months. Soft tissue was examined by Gingival bleeding index and Marginal plaque index and score were recorded at the mesial, distal, buccal and palatal aspect of each implant. Gingival bleeding index score 0 for healthy /normal gingiva, 1 for no bleeding on probing, 2 for bleeding on probing, 3 for spontaneous bleeding on probing and Marginal plaque index score recognized by running a probe across implant, 0 for no plaque, 1 for a film of plaque adhering to the free gingival margin, 2 for moderate accumulation of soft deposits within the gingival pocket, 3 for abundance of soft matter within the gingival pocket.

Mean marginal bone levelwas examined by radiographs like, radiovisiography (RVG)/IOPAR and the bone changes was measured by consecutive radiovisiography and paralleling technique with Xtension cone paralleling (XCP) holder. Rubber base materials/acrylic occlusal jig was taken for angulating as well as positioning of the x-ray film to the x-ray beam. Crestal bony level for mesial and distal surfaces at every follow-up was assessed by the apical end of the implant's shoulder as the reference point and the changes was measured. All image data were retrieved and analysed on the ImageJ software (Ver1.52a).

RESULTS

The obtained data was not normally distributed so non parametric test i.e., Kruskal-Wallis test was applied for comparison of the obtained mean values.

Gingival bleeding index

Table 1 shows the comparison of the gingival bleeding index of screw retained and cement retained implant prosthesis at baseline, 3 months, 6 months, and 9 months follow ups. Statistically significant difference was found at 3 months, 6 months and 9 months (p=0.047; 0.046; and 0.021 respectively). The mean gingival bleeding index of 0, 3, 6 and 9 months was significantly more among cement retained implant group.

Table 1: Comparison of gingival bleeding index of screw and cement retained prosthesis

	Screw Retained		Cement Retained		Mean Diff	p-value
Gingival bleeding index	Mean	S.D.	Mean	S.D.		
0 months	0.00	0.00	0.00	0.00	0.00	1.000
3 months	0.63	0.46	0.78	0.45	-0.15	0.047*
6 months	0.70	0.48	0.83	0.47	-0.13	0.046*
9 months	0.75	0.47	1.05	0.56	-0.30	0.021*

* Kruskal-Wallis test,p<0.05 was considered statistically significant.

Marginal plaque index

Table 2 shows the comparison of the marginal plaque index of screw retained and cement retained implant prosthesis at baseline, 3 months, 6 months, and 9 months follow ups. There was statistically significant difference at 3 months, 6 months and 9 months (p= 0.046; 0.049; and

0.025 respectively). Mean marginal plaque index of 0, 3, 6 and 9 months was significantly more among cement retained implant group.

Table 2: Comparison of marginal plaque index of screw and cement retained prosthesis

	Screw Retained		Cement Retained		Mean Diff.	p-value
Marginal plaque index	Mean	S.D.	Mean	S.D.		
0 months	0.00	0.00	0.00	0.00	0.00	1.000
3 months	0.55	0.41	0.76	0.40	-0.21	0.046*
6 months	0.60	0.41	0.82	0.41	-0.22	0.049*
9 months	0.59	0.40	0.88	0.51	-0.27	0.025*

* Kruskal-Wallis test, p<0.05 was considered statistically significant.

Marginal bone loss

Table 3 shows the comparison of overall marginal bone loss of screw retained and cement retained implant prosthesis at baseline, 3 months, 6 months, and 9 months follow ups. There was statistically significant difference at 3 months, 6 months and 9 months (p= 0.002; 0.004; and 0.001 respectively). The mean marginal bone loss (over-all) at 0, 3, 6 and 9 months was significantly more among screw retained implant group.

Table 3: Comparison of overall marginal bone loss of screw and cement retained prosthesis

	Screw Retained		Cement Retained		Mean Diff.	p-value
Marginal bone loss (Over-all)	Mean	S.D.	Mean	S.D.		
0 months	0.00	0.00	0.00	0.00	0.00	1.000
3 months	0.29	0.07	0.19	0.06	0.10	0.002*
6 months	0.50	0.11	0.35	0.06	0.14	0.004*
9 months	1.28	0.20	0.92	0.17	0.36	0.001*

* Kruskal-Wallis test, p <0.05 was considered statistically significant.

The radiographic status of screw retained and cement retained implant prosthesis at various follow up intervals are shown in Figure 2 and Figure 3 respectively.

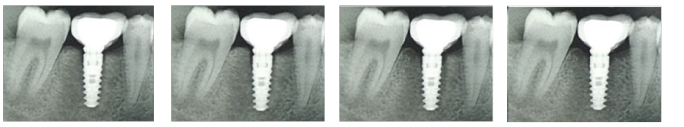

Figure 2.a: At the time of prosthesis placement | Figure 2.b:3 months follow up | Figure 2.c:6 months follow up | Figure 2.d:9 months follow up

Figure 2: Radiographic status of screw retained implant prosthesis

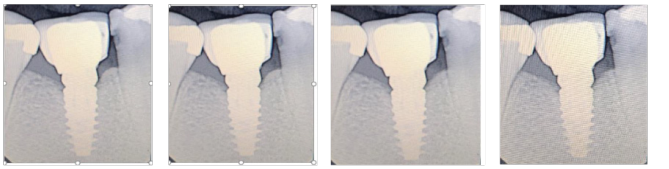

Figure 3.a: At the time of prosthesis placement | Figure 3.b: 3 months follow up | Figure 3.c: 6 months follow up | Figure 3.d: 9 months follow up

Figure 3: Radiographic status of cement retained implant prosthesis

DISCUSSION

Dental implant has become one of the revolutionary treatment options for replacing missing teeth. It is being widely accepted by both the patients and clinicians.[6] The clinical success and survival of dental implants depends upon the health of the surrounding tissues that is soft tissue and bone. Healthy soft tissue with good amount of crestal bone is usually a promising factor for dental implant health.[7,8]

Since the past few years, various implant parts have been introduced which allows prosthesis to be cemented to the abutments. Both cement retained and screw retained prosthesis has certain limitations. A precise placement of implant is required in case of screw retained prosthesis in order to achieve an accessible screw hole.[9,10]Any change from the precise position and angle may result in an unesthetic prosthesis. Also, the screw holes tend to make the porcelain weak near the openings as well as around the cusp.[11]Even cement-retained restorations have certain limitations. As it exhibits a large marginal gap it becomes troublesome when the implants are deeply placed hence the prosthesis margin gets hidden below. In these cases, removing access cement becomes difficult as well as maintaining the oral hygiene is troublesome. These patients are more prone to get peri-implantitis.[12]

The current studywas carried out to clinically assess the peri-implants soft tissue health and radiographically

analyse the difference in bone height mesial and distal to the screw and cement retained prosthesis for nine months, after prosthesis placement.Patient selection was done by the inclusion and exclusion criteria. After prosthesis placement, the patients were subjected to clinical and radiographic evaluation at baseline (at the time of prosthesis placement), 3 months, 6 months and 9 months.Although the follow-up period after prosthesis placement was 9 months, the implants had been placed 3 to 4 months prior, resulting in a total observation period of approximately 12 to 13 months.

Jepsen et al.suggested that bleeding on probing can be correlated with the presence of inflammation and peri implant mucositis around the implant.[13]In this study,gingival bleeding index given by Silness and Loe was selected as one of the criteria to assess the soft tissue around the implant.[14]

In the present study, mean gingival bleeding index scores aroundscrew retained prosthesis was at 0.63 ± 0.46 at 3 moths, 0.70 ± 0.48 at 6 months and 0.75 ± 0.47 at 9 months. It is closer to the previous study in which the mean gingival bleeding index scores were found to be 0.51± 0.13 at 3 months, 0.15±0.13 at 6 months and 0.12 ± 0.13 at 12 months interval.[1]Also, in the study of Al Amri et al. the mean gingival bleeding index scores of screw-retained prostheses was 8.6 ± 0.4 during 5 years follow up whereas in the current study the mean gingival bleeding index score for screw retained prosthesis at the end of 9 months was 0.75 ± 0.47.[4] However, further follow up is required for better comparison.

Mean gingival bleeding index scores around the cement retained prosthesis was 0.78 ± 0.45 at 3 months, 0.83 ± 0.47 at 6 months, and 1.05 ± 0.56 at 9 months. It is nearer to the study of Weber et al. in which the mean gingival bleeding index scores were found to be 0.73 ± 0.12 at 3 months, 0.85 ±0.12 at 6 months and 1.26 ± 0.12 at 12 months interval.[15]Similarly, previous study found the mean gingival bleeding index score around cement retained prosthesis to be 10.2 ± 0.6 during 5 years follow up whereas in the current study the mean gingival bleeding index score for cement retained prosthesis at the end of 9 months was 1.05 ± 0.56.[4]

Schou et al. suggested that microbial biofilms form an inactive surface in an aqueous surrounding.[16] Mombelli and coworkers modified the original plaque index given by Silness and Loeto evaluate the presence of biofilm at marginal area surrounding the implant.[14,17]In the current study, the mean marginal plaque index scores around the screw retained prosthesis was 0.55 ± 0.41 at 3 months, 0.60 ± 0.41 at 6 months, and 0.59 ± 0.40 at 9 months. This result is closer to the study of Weber et al. in which the mean marginal plaque index score was found to be 0.68 ± 0.13 at 3 months, 0.43 ±0.13 at 6 months and 0.51 ± 0.13 at 12 months interval.[15]Sheriff et al.found that the mean marginal plaque index score of screw retained prosthesis was 0.12 ± 0.39 during 5 years follow up whereas in our study the mean marginal plaque index scores for screw retained prosthesis at the end of 9 months was 0.59 ± 0.40.[18]Thus, further study is required for meaningful comparison.

The mean marginal plaque index score around the cement retained prosthesis was found to be 0.76 ± 0.40 at 3 months, 0.82 ± 0.41 at 6 months and 0.88 ± 0.51 at 9 months in this study. These results are in line to the previous study in which the mean marginal plaque index scores were found to be 0.75 ± 0.12 at 3 months, 0.64 ±0.12 at 6 months and 0.9 ± 0.12 at 12 months interval.[15]Furthermore, Sherif et al.obtained the mean marginal plaque index scores of cement retained prosthesis to be 0.22 ± 0.35 during 5 years follow up whereas in the present study the mean marginal plaque index score for cement retained prosthesis at the end of 9 months was 0.88 ± 0.51.[18]Therefore, more follow up data of our study is needed.

Albrektsson et al. and Smith et al. proposed that the mean crestal bone changes of more than 1.5 mm for 1st year after loading as well as greater than ≥ 0.2 mm per year,afterwards.[19,20] This has been proposed as one of the major success criteria for dental implants.Bragger et al. and Fourmousis et al. suggested use of digital image analysis for evaluating the peri implant bone level.[21,22]In this study, digital image analysis using ImageJ software was used for better accuracy in interpreting the radiovisiography.

In this study, the overall mean marginal bone loss around the screw retained prosthesis at 3 months was 0.29 ± 0.07, 6 months was 0.50 ± 0.11, and 9 months was 1.28 ± 0.20.Al Amri et al.found the mean marginal bone loss for

screw retained prosthesis at the mesial aspect was 1.7 ± 0.5and 1.7 ± 0.3 on the distal aspect whereas the overall score was 1.7 ± 0.4 over 5 years follow up.[4]Similarly, the overall mean marginal bone loss around the cement retained prosthesis in the present study at 3 months was 0.19 ± 0.06, 6 months was 0.35 ± 0.06, and 9 months was 0.92 ± 0.17 whereas that obtained by Al Amri et al. for the mesial aspect was 1.8 ± 0.6 and distal aspect was 1.6 ± 0.4 and overall was 1.7 ± 0.5 over 5 years follow up.[4] Thus, more long-term data is needed for better contrast of results.

The increased plaque and bleeding indices in cement-retained prostheses may be attributed to residual cement, which is a known risk factor for peri-implantitis. Conversely, the higher bone loss in screw-retained prostheses may be related to the microgap at the screw interface and repeated mechanical loading. Retrievability of screw prostheses, while advantageous, may influence occlusal stability and torque loss over time.

Thecurrent study had few limitations. Although the follow-up after prosthesis placement was 9 months, the implants had been placed 3-4 months earlier, bringing the total observation period close to 12–13 months. Nonetheless, longer-term follow-ups are recommended for future research.The sample size of the study was limited. No histological evaluation was carried out to assess the osseointegration at the implants to bone interface. Further clinical and histological longitudinal studies with large samples are necessary to evaluate the hard or soft tissues health for a success of the endosseous dental implants.

CONCLUSION

Although both retention types showed acceptable clinical performance over 9 months, statistically significant differences in soft and hard tissue responses suggest that clinical outcomes may be influenced by the type of prosthesis. Individual patient factors and clinical conditions should guide the choice of retention method.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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