

Effect of Two Implant-supported Partial Overdenture Attachment Design on the Periodontal Health

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ABSTRACT

Objective: This study aimed to evaluate and compare the effect of locator attachment and ball and socket (BS) attachment on the peri-implant and periabutment supporting structures on clinical pocket depth and gingival index in cases of limited interarch spaces in mandibular Kennedy class I implant-supported removable partial overdentures.

Materials and methods: A comparative clinical trial was conducted among twenty partially edentulous patients aged 30–60 years. The study participants were randomly divided into two study groups based on the attachment system used: group I – locator attachment, and group II – BS attachment. Two implants were positioned in the 1st or 2nd molar area following the two-stage surgical protocol. Evaluation of the peri-implant and periabutment supporting structures was done at the time of overdenture insertion and after 6, 12, and 18 months by measuring the pocket depth and gingival index. Inter- and intragroup comparisons were done using independent-samples *t* test and paired-sample *t* test respectively. $p < 0.05$ was considered statistically significant.

Results: It was observed that there was a statistically significant increase in the pocket depth around the implant as well as the abutment in both groups at 6, 12, and 18 months when compared to baseline. Intergroup comparison for pocket depth and gingival index revealed nonsignificant results. However, the values were higher in the BS group.

Conclusion: The locator attachment group had lower, though statistically not significant, pocket depth and gingival index scores around both the dental implant and the natural abutment as compared with the BS attachment.

Clinical significance: Gingival health surrounding dental implant attachments is very crucial for the long-term success of dental implant, this could help the clinician to select the proper design for implant attachment underneath the over denture prosthesis.

Keywords: Ball and socket attachment, Gingival index, Locator system, Overdentures, Pocket depth.

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INTRODUCTION

Removable partial dentures (RPDs) are a common treatment option for restoring a long-span or distal extension edentulous area whenever fixed partial dentures are not indicated.¹ Kennedy class I that is bilateral missing posterior teeth is a situation that requires careful planning and consideration.² The distal extension base of free-end RPDs derives its support from the abutment teeth and alveolar ridge (dual support) and hence suffers from the problem of support and stability. This is due to the difference in the resiliency of the mucoperiosteum and the teeth which warrants the need for some form of stress redirection in the partial denture design.³

Implant-supported RPDs are now a well-accepted treatment modality for edentulous patients to overcome the limitations of conventional RPDs. The use of dental implants has become widely accepted, and many studies have demonstrated better stability and improved patient satisfaction with implant-supported RPDs.^{4,5} The implants in implant-supported RPDs are placed in the edentulous ridge to stabilize the RPD and minimize the resultant rotational movement. Also, implant support helps prevent the displacement of distal extension RPDs and decreased pressure on soft tissues, thus preventing bone loss in the alveolar ridge.^{4,6}

The attachment systems are considered the pillars of overdenture treatment. An overdenture attachment permits movement during function and removal from the mouth. Ideally, the attachment should offer the possibility of controlling the degree of retention provided.⁷ A wide variety of commercially available attachment systems are used to connect implants to overdentures. The selection of the attaching mechanism for an implant-retained overdenture depends on cost-effectiveness, retention, durability,

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ease of oral hygiene maintenance, amount of available bone, patient's social status, patient's expectation, interimplant distance, and status of the opposing jaw. The attachments used to retain implant overdenture include stud, bar, magnets and telescopic attachments.^{8–10}

The BS attachments consist of a metal ball (male portion) which is screwed into the fixture, whereas the female part is incorporated in the denture. The BS attachment is the simplest and one of the most commonly used attachment systems.⁸ Various studies have proven that the stresses on the peri-implant bone are considerably less when BS is used when compared to other attachment systems.^{11,12} The locator system is a relatively new attachment system that offers dual retention and a self-aligning feature. It is particularly advantageous in cases with reduced interocclusal space because of its shorter height.¹⁰

An exhaustive literature search revealed no studies comparing the effects of BS and locator attachment systems on the peri-implant and the periabutment periodontium. Hence the present study was conducted to evaluate and compare the effect of locator and BS attachment on implants and natural abutments supporting structures on clinical pocket depth and gingival index in cases of limited interarch spaces in mandibular Kennedy class I implant-supported removable partial overdentures. The null hypothesis is that there is no difference between the effect of locator and BS attachment system on the clinical pocket depth and the gingival index of peri-implant and the periabutment periodontium.

MATERIALS AND METHODS

Study Design

A comparative clinical trial was conducted among twenty partially edentulous patients, aged 30–60 years, attending the outpatient clinic of the Removable Prosthodontic Department, Faculty of Dental medicine, King Abdul-aziz University, Jeddah, Kingdom of Saudi Arabia.

Ethical Clearance and Informed Consent

Ethical clearance was obtained from the Institutional Review Board. All the patients were informed about the study procedure in the local language. Written informed consent was obtained from all the study participants.

Inclusion Criteria

- Kennedy class I lower partially edentulous ridges with the first or second premolars as abutments,
- No signs of periodontal disease
- No signs of attrition or abrasion
- Remaining residual ridges with adequate height and width
- Firm mucosa with no signs of inflammation or ulceration
- Inadequate interarch space distance as determined by tentative diagnostic jaw relation records.

Study Protocol

Preoperative intraoral examinations, laboratory investigations, and radiographic evaluation of each case were conducted. The intraoral occlusal record and face bow record for the correction of evaluation of the occlusal plane were used to mount the diagnostic casts on a semi-adjustable articulator. The interarch space was measured by an endodontic plugger with a stopper and ruler.

Presurgical panoramic radiographs were obtained, and mouth preparation was done. For the selection of the implant size, diameter, and site, ridge mapping was done on the diagnostic casts. A transparent acrylic stent was made for the installation of a 3.75 mm and 10 mm Pitt Easy V-TPS implant system. The implant system was to be placed at the mandibular molar area.

The study participants were then randomly divided into two study groups based on the attachment system used:

- Group I – locator attachment
- Group II – BS attachment

The remaining overdenture design was similar for both the study groups.

The locator attachment was placed intraorally over the integrated implant using the locator tool. The locator female housing was fixed into the fitting surface of the removable partial overdenture using the pickup technique followed by placing and securing the overdenture in its position until the acrylic resin was

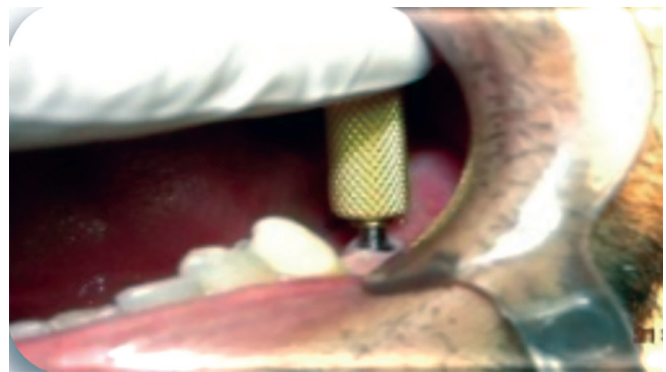


Fig. 1: Placement of locator attachment using the locator tool

set. The overdenture was finished and polished after the placement of the selected nylon cap into the locator attachment female housing (Fig. 1). A similar technique was used for the placement of the BS attachment.

The finished removable partial overdenture for both groups was inserted and delivered to the patients after occlusal adjustment. Postinsertion instructions were given to all the patients.

Evaluation Criteria

Pocket Depth Evaluation

William's graduated periodontal probe was used to measure the pocket depth around natural abutments and implants. For natural main abutment teeth, the pocket depth was measured at midbuccal, midlingual, and middistal.¹³ For the implants, the depth was measured at midbuccal, midlingual, midmesial, and middistal. The mean pocket depth for both the abutment and implant was obtained (Figs 2 to 4).

Gingival Index¹⁴

The gingival index depends on one or more of the following criteria: gingival contour, gingival color, gingival bleeding, the extent of the gingival involvement, and crevicular fluid flow. The gingival index is based on grading the gingival condition from 0 to 3 as follows: Grade 0—Normal gingiva free from any sign of inflammation without bleeding on probing.

Grade 1—Slight change in color and texture of the gingiva with slight bleeding with probing.

Grade 2—Moderate gingival inflammation with cardinal signs.

Grade 3—Severe inflammation with ulcers and spontaneous bleeding.

The measurements were carried out at 6, 12, and 18 months postinsertion. The pocket depth changes and gingival index at different intervals were obtained by calculating the difference at the intervals from the baseline measurement.

Statistical Analysis

The data were collected and entered in Microsoft Excel worksheets. Statistical analysis was performed using GraphPad Prism-4 statistics for Windows. Intragroup and intergroup comparisons were carried out using paired-samples *t* test and independent-samples *t* test respectively. *p* < 0.05 was considered to be statistically significant.

RESULTS

Pocket Depth

Table 1 summarizes the changes in the pocket depth around the implant in both the groups. It was observed that there was an



Fig. 2: Pocket depth measurements around the implants with locator (group I)



Fig. 4: Pocket depth measurements around implant with BS attachment (group II)

increase in the pocket depth in both groups at 6, 12, and 18 months when compared to baseline. The difference between the baseline and subsequent measurements in the pocket depth was statistically significant in both the study groups ($p < 0.05$).

Intergroup comparison was conducted using independent-samples t test. It was observed that the mean difference in the pocket depth from baseline to the subsequent time intervals was higher in the BS group than the locator group. However, this observation was not statistically significant ($p > 0.05$).

Table 2 depicts the changes in the pocket depth around the abutment in both the groups, and results similar to those around the implant were observed. The intragroup comparison showed a statistically significant increase in the pocket depth as compared to baseline in both the groups. However, no statistical significance was observed in intergroup comparison.

Gingival Index

The result of the gingival index is summarized in Figure 1. A statistically significant rise in the mean index value over time was observed in both the study groups ($p < 0.05$). The intergroup comparison revealed higher index values in the locator group as compared to the BS group. However, this difference was not statistically significant ($p > 0.05$).

DISCUSSION

The present study was conducted to evaluate and compare the effect of locator and BS attachment systems on the peri-implant

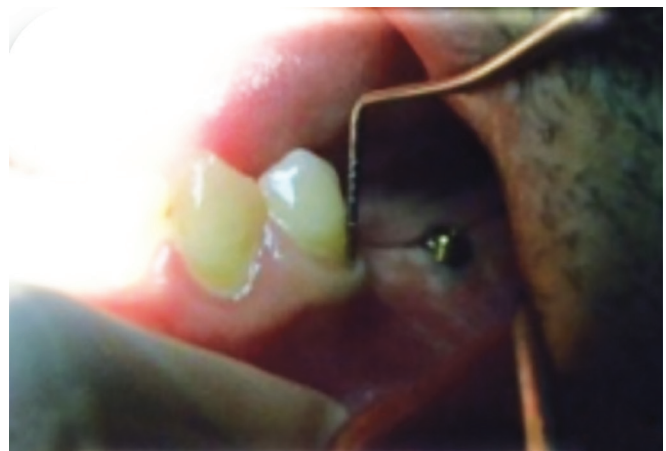


Fig. 3: Pocket depth measurements around main abutment for group I

and periabutment periodontium by measuring pocket depth and

Table 1: Comparison of pocket depth change for both study groups around implant from the baseline values at different time intervals

		6 m-BL	12 m-BL	18 m-BL
Locator	Mean difference	0.406	0.669	1.031
	Mean% change	32.48	53.52	82.48
	Paired t value	6.8	4.6	13.1
	p value	0.0065*	0.0194*	0.0010*
BS	Mean difference	0.453	0.688	1.05
	Mean% change	36.24	55.04	84
	Paired t value	4.01	3.3	9.2
	p value	0.0274*	0.0452*	0.0027*
Locator vs BS				
Unpaired t test	t value	0.4	0.1	0.13
	p value	0.7246 NS	0.9434 NS	0.8965 NS

*Significant ($p < 0.05$)

NS, nonsignificant ($p > 0.05$)

Table 2: Comparison of pocket depth change for the study groups around abutment from the baseline values at different time intervals

		6 m-BL	12 m-BL	18 m-BL
Locator	Mean difference	0.413	0.68	0.988
	Mean% change	34.41667	56.66667	82.33333
	Paired t value	14.01	22.6	20.2
	p value	0.0001*	0.000*	0.000*
BS	Mean difference	0.456	0.68	1.033
	Mean% change	38	56.66667	86.08333
	Paired t value	5.898	9.830	14.12
	p value	0.000*	0.000*	0.000*
Locator vs BS				
Unpaired t test	t value	0.2419	0.0298	0.1278
	p value	0.8102 NS	0.9764 NS	0.8990 NS

*Significant ($p < 0.05$)

NS, nonsignificant ($p > 0.05$)

gingival index in Kennedy class I cases. There was an increase in pocket depth as well as worsened gingival index in both the study

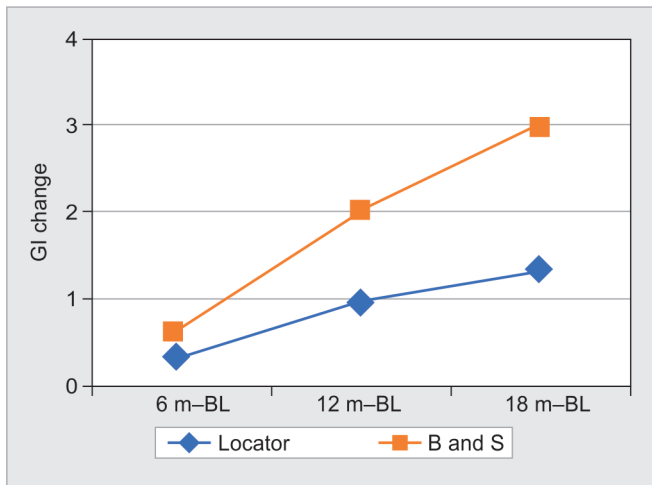


Fig. 5: Comparison between gingival index difference in both groups

groups. The worsening of the periodontium was higher in the BS group when compared to the locator group; however, the difference between the two groups was not statistically significant. Hence, the null hypothesis is accepted (Fig. 5).

Kennedy class I is one of the most commonly encountered cases clinically. Due to the problem of support and stability, these cases also pose a challenge to the clinician.¹⁵ Hence, all the selected patients in the study belonged to this classification. Also, the patients had a limited interarch space between the upper and lower arches in the area of the free end saddle. Determination of the interarch limitation was achieved through mounting the upper and lower casts on an articulator.¹⁶

In this study, the dental implants were placed distally in the first or second molar area. This was done to transform the class I situation to a class III situation, which is more favorable clinically and easier to manage as proven by previous studies on implant-supported distal extension RPDs.^{15,16} Additionally, it has been theorized that, for maximum support, the implants should be located as distally as possible. This distal placement ensures the stabilization of the prosthesis in a vertical direction and diminishes the rotational stress transferred to the abutment teeth.^{15,17,18}

A two-stage implant technique was used in this study to reduce the risk of bacterial infection, prevent apical migration of epithelium along the body of the implant, and decrease the risk of loading the implant early.¹⁹ 3 months' healing period was allowed after fixture installation and before partial denture construction to ensure successful osseointegration.¹⁹

Although several studies^{20–23} showed no significant difference between the early and delayed implant loading in mandibular overdentures, the outcomes of long-term clinical studies^{24–26} using a delayed loading protocol implies successful osseointegration. This occurs when implants placed in the mandible were not loaded for at least 3 months. Accordingly, a similar protocol was used for the present study.

Fixed reference points (midbuccal, midlingual, middistal, and midmesial) were used for measuring changes in pocket depth for standardization. These points were used to measure the actual pocket depth changes resulting from apical migration of the epithelial attachment and not from false pocket due to gingival enlargement.²⁷

A wide variety of commercially available attachment systems are used to connect implants to overdentures. Ball attachments are among

the most popular of all attachments. The advantages of BS attachments include low cost, ease of handling, less chairside time and versatility that permits usage in both root and implant-supported RPDs.²⁸

The locator attachment system requires a minimum of two implants. It has several beneficial features such as resilience, improved retention, durability, low vertical profile for use in cases with reduced interarch space, pivoting action of the metal housings over the male inserts, and built-in angulation compensation.²⁹ Improved patient satisfaction has been reported with the use of locator system due to its ease of removal and insertion. These studies have also reported that patients with locator-retained RPDs have a better oral health-related quality of life than patients with complete dentures.^{30,31} However, it has also been observed that the retention of such RPDs diminishes over time and warrants regular maintenance.³²

In the present study, the difference in the pocket depth and the mean gingival index between the locator and the BS group was not statistically significant. The BS is the most widely used attachment system; hence, this comparison proves the locator system is an equally good attachment system. Also, it is of advantage in cases with a reduced interarch space due to its low vertical profile. The difference in the measured parameters was not statistically significant; yet, clinically, the values were lower for the locator group. This difference could have been due to the slight difference in the resiliency of the two systems. Schneider³³ and Chikunov et al.³⁴ have reported that the locator system is a resilient attachment that helps to rectify the divergence between the dental implants carrying an overdenture and allows better stress distribution.

Though not statistically significant, the gingival index values were also lower in the locator group as compared to the BS group. This could be attributed to the ease of removal and insertion of locator-based RPDs. It has been reported that no specific manual skills are required to remove locator-based RPDs for cleaning, and poor oral hygiene is the main culprit in causing gingivitis.²⁹

The present study was conducted using the clinical measures of periodontal disease. Further research by measuring the amount of bone loss is recommended. Also, the results of the present study might have been nonsignificant due to the smaller sample size. Hence, a larger sample size with other attachment systems can be compared to understand the best-suited attachment system for distal extension implant-supported removable partial dentures.

CONCLUSION

Within the limitation of the results of this study, it could be concluded that the implant-supported partial overdenture restored with the locator attachment group had lower, though statistically not significant, pocket depth and gingival index scores around both the dental implant and the natural abutment as compared with the BS attachment.

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