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Comparative study of prosthetic complications associated with the bar-clip, milled bar, and Locator attachments for implant overdentures: a retrospective study

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ABSTRACT

Comparative study of prosthetic complications associated with the bar-clip, milled bar, and Locator attachments for implant overdentures: a retrospective study

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Purpose. The purpose of this study was to compare the type and frequency of prosthetic complications associated with attachment types for implant overdenture.

Material and methods. In this retrospective study, 38 patients (mean age, 63.5 years) have been treated with implant overdentures from 2007 to 2014. Ten patients received a bar-clip attachment. Eleven patients had received a milled bar with Locator attachment. Seventeen patients had received a Locator attachment. The mean follow-up period was 36.9 months (range, 15-83 months). The type and frequency of prosthetic complications was recorded. The frequency was analyzed to determine the statistical difference among the 3 different attachments by using one-way ANOVA (α = .05) and Bonferroni post hoc method at a 5% level of significance.

Results. The total number of prosthetic complications was higher in the bar-clip attachment (55 events) than in the milled bar with Locator attachment (39 events) and the Locator attachment (34 events). There were no statistically significant differences, and the most common prosthetic complication was the loss of retention. In the bar-clip attachment group, the average frequency of prosthetic complications was 3.0 events per prosthesis during the first year. In the milled bar with Locator attachment and Locator attachment groups, the average frequencies were 1.45 events and 2.35 events, respectively. Statistically significant differences were observed in the frequency of the complication. (p = .043)

Conclusions. Compared to the bar-clip attachment, implant overdentures that use milled bars with the Locator attachment have a significantly lower incidence of prosthetic complications in the first year of follow-up after placement.

Key words : implant overdenture; bar-clip; milled bar; Locator; complication.

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Ⅰ. Introduction

Completely edentulous patients with atrophic residual alveolar ridges often have problems with their conventional prostheses owing to lack of retention and instability. An impaired load-bearing capacity can cause pain in the oral mucosa and insufficient masticatory function.

Implant overdentures are known to be a well-established and accepted clinical method for treating patients with a severely resorbed alveolar ridge. Overdentures have many advantages over conventional complete dentures, including good stability and retention, improved function, and reduced ridge resorption[1, 2]. Other advantages of overdentures over complete-arch fixed implant prostheses are that they require fewer implants, have an easier surgical procedure, and are economical[3].

Various attachment systems have been used with implant overdentures. Selecting the appropriate attachment system depends on the following: state of the residual ridge, shape of the arch, required retention, number of implants, clinician's ability, and patient compliance[4]. The type of attachment system is important(rigid vs. resilient and splinted vs. stud) as it may influence the amount of prosthetic maintenance required.

The bar-clip type of attachment splints implants together and inhibits the displacing forces in the vertical and oblique directions[5]. This system provides stability and retention to removable prostheses. The bar-clip attachment does have some disadvantages including mucosal hyperplasia, hygiene problems, and the need for clip activation[6~8].

Another type of attachment, the milled bar, is supported by 2-4 implants that provide rigid anchorage to the overdenture. The rigidity of the overdenture prevents rotational movement and reduces residual ridge resorption[9, 10]. Additional retention devices(magnet, ERA, Locator) are used to achieve adequate retention. However, in order to produce the milled bar-supported overdenture, complex clinical and laboratory procedures are required.

The Locator attachment(Zest Anchors, Escondido, CA, USA) is a resilient type of attachment as it allows for movement of the denture. This system is self-aligning, has dual retention, and comes in different colors with different levels of retention[4, 11]. Additionally, this system requires a relatively small vertical height [12, 13] and is easier to repair and replace compared to other systems[4].

There are limited clinical studies that have researched prosthetic complications of attachments used for implant overdenture treatment. The aim of the retrospective study was to compare the type and frequency of prosthetic complications associated with the three above-mentioned types of attachments for implant overdentures over a 7-year observation period.

Ⅱ. Material and methods

A total of 38 patients(11 males and 27 females), with an average age of 63.5 years(age range, 42-81 years), were treated with implant

overdentures from January 2007 to December 2014 at the Department of Prosthodontics and Implant Clinic, Dong-A University Hospital, Busan, South Korea. Patients who visited the hospital regularly for maintenance during the 1-year period after prosthesis placement were included for the present retrospective investigation. Patients whose implants failed during the observation period and those who did not visit the hospital during the first year after prosthesis placement were excluded. The follow-up period varied between 15 and 83 months (average follow-up period: 36.9 months). The follow-up period of the "Locator" group(22.35 months) was shorter than that of the "Bar-clip" group(64 months) and "Milled bar and Locator" groups(54 months).

A total of 109 implants(34 in the maxilla, 75 in the mandible) were placed and four implant systems were used: 18 Branemark MKII implant (Nobel Biocare, Göteborg, Sweden) 8 Tapered-Screw Vent implants (Zimmer Dental Inc, Warsaw, Indiana, USA), 28 Cowellmedi INNO implants (Cowellmedi, Busan, South Korea), and 55 Dentis s-clean implants (Dentis, Daegu, South Korea). 22 patients received two implants, 1 patients received three implants, 14 patients received four implants and 2 patients were treated implant both arches(Table 1). The implant length varied from 8 to 12 mm, while the diameter varied from 3.7 to 4.8 mm. The patients were treated using either a 2-stage or a 1-stage loading protocol. Implants were allowed to integrate for 3-6 months. For all implants, no pain was reported, and no implant mobility or peri-implant radiolucency was noted. One implant that was placed in the maxilla failed during the integration phase. This implant was reinserted and was successful thereafter.

The prosthetic procedure for implant overdenture was performed 3-6 months after implant placement. Ten patients(3 maxilla, 7 mandible) received the bar-clip attachment, 11 patients(3 maxilla, 8 mandible) received the milled bar and Locator attachments, and 17 patients(3 maxilla, 12 mandible, 2 both arch) received Locator attachments. All dentures were reinforced with a metal framework. In the "Bar-clip" group(BC), 2-4 implants were connected with a prefabricated bar and denture retention was controlled by clip activation. In the "Milled bar and Locator" group(ML), an additional Locator attachment was used in the posterior or middle of the four-implant milled bar. In the "Locator" group(LO), a Locator attachment was placed on each implant to support and stabilize the overdenture. A Locator blue male part was employed to connect the implant and overdenture. Bilaterally balanced occlusion was performed on all overdentures.

One day after the prosthetic treatment was complete, all patients visited the hospital. Thereafter, the follow-up visits were at 6- to 12-month intervals. During the follow-up period, prosthetic complications associated with the implant overdentures were recorded. A classification system for prosthetic complications was established with the following three categories: 1. repair: addition or replacement of material and teeth (fracture of the

Table 1. Baseline characteristics of the subjects

Attachment system	Sex	Age(y)	Location	No. of implant	Implant system	Opposing dentition
Bar- clip	M	66	Mx.*	2	Branemark	Removable partial denture
	F	64	Mx.	2	Branemark	Removable partial denture
	F	59	Mx.	2	Cowell	Removable partial denture
	F	65	Mn.†	2	Cowell	Complete denture
	M	58	Mn.	2	Cowell	Complete denture
	F	59	Mn.	2	Dentis	Removable partial denture
	M	65	Mn.	2	Dentis	Removable partial denture
	M	64	Mn.	2	Branemark	Removable partial denture
	F	70	Mn.	2	Zimmer	Complete denture
	F	66	Mn.	2	Cowell	Removable partial denture
Milled bar &	F	51	Mx.	4	Dentis	Fixed dental prosthesis
Locator	F	57	Mx.	4	Dentis	Fixed dental prosthesis
	M	61	Mx.	4	Branemark	Removable partial denture
	F	78	Mn.	4	Branemark	Complete denture
	F	53	Mn.	4	Branemark	Fixed partial denture
	F	79	Mn.	4	Cowell	Complete denture
	M	65	Mn.	4	Cowell	Complete denture
	M	42	Mn.	4	Cowell	Fixed dental prosthesis
	F	68	Mn.	4	Cowell	Removable partial denture
	F	59	Mn.	4	Dentis	Fixed dental prosthesis
	F	74	Mn.	4	Dentis	Complete denture
Locator	F	75	Mx.	2	Dentis	Fixed dental prosthesis
	F	59	Mx.	4	Cowell	Fixed dental prosthesis
	M	80	Mx.	4	Dentis	Fixed dental prosthesis
	F	66	Mn.	2	Dentis	Removable partial denture
	F	66	Mn.	2	Dentis	Removable partial denture
	M	71	Mn.	2	Dentis	Implant overdenture
	F	73	Mn.	2	Dentis	Complete denture
	F	81	Mn.	2	Dentis	Complete denture
	M	64	Mn.	4	Dentis	Removable partial denture
	F	70	Mn.	2	Dentis	Complete denture
	F	66	Mn.	2	Dentis	Complete denture
	M	27	Mn.	2	Dentis	Fixed dental prosthesis
	F	59	Mn.	3	Dentis	Fixed dental prosthesis
	F	65	Mn.	2	Dentis	Fixed partial denture
	F	58	Mn.	2	Zimmer	Complete denture
	F	64	Both arch	4(both)	Dentis	Implant overdenture
	F	59	Both arch	2(both)	Dentis	Implant overdenture

*Mx. = Maxilla, †Mn. = Mandible

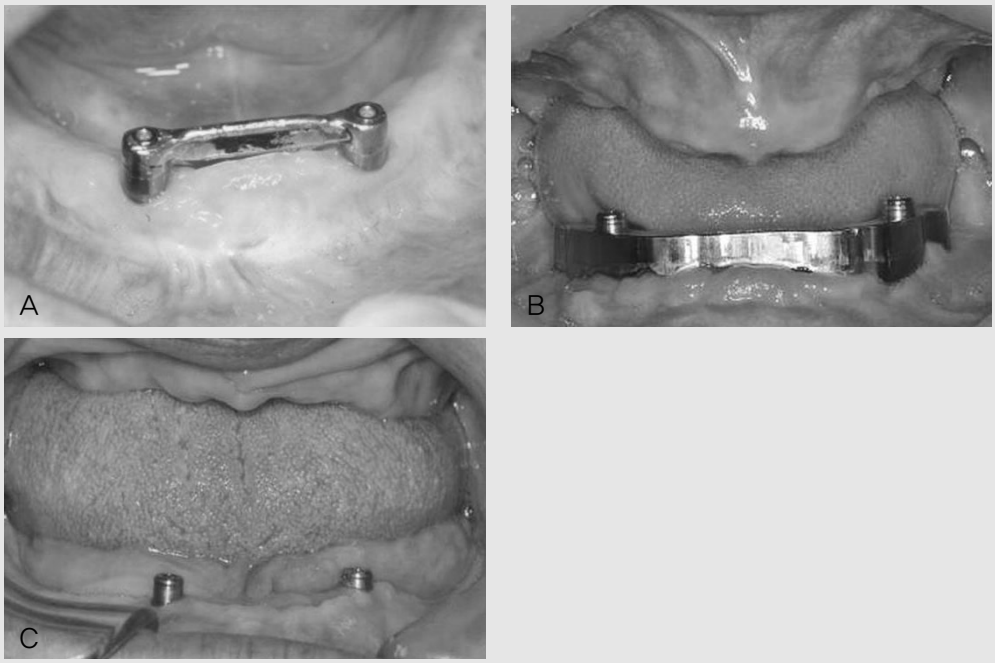

Fig. 1. Clinical view on different attachment system.
(a) Bar-clip type. (b) Milled bar with Locator attachment. (c) Locator attachment.

overdenture base and teeth, fracture of opposing teeth, fabrication of new denture, and renewal of resin teeth); 2. adjustment: modification that did not add new material or replacement of the existing material (hyperplasia, relining, relief, loosening of Locator abutment, removal of Locator cap); and 3. loss of retention (activation of retentive component and replacement of Locator male part)

The frequency of prosthetic complications during the first year and the remaining follow-up period was recorded, tabulated, and statistically compared among the groups. Comparisons of the total number of events that occurred during the follow-up period among the three treatment groups were performed using the cross tabulation data and Pearson's chi-squared test. A one-way analysis of variance(ANOVA) followed by post-hoc tests corrected for multiple comparisons with Bonferroni adjustments was conducted to compare the frequency of prosthetic complications during first year among the groups. For all statistical analyses, SPSS v22.0(SPSS Inc., Chicago, USA) was used. The results were assessed at a 95% confidence interval, at a significance level of .05.

Ⅲ. Results

The frequency of prosthetic complications during the follow-up period is shown in Table 2. As mentioned above, prosthetic complications were classified into three categories. A total of

Table 2. Number of repairs, adjustments, and retentive component complications associated with the implant overdentures in the three treatment groups during the entire follow-up period

Categories		Bar-clip type (n=10)		Milled bar & Locator (n=11)		Locator (n=17)	
		N. of event	N. of patient*	N. of event	N. of patient*	N. of event	N. of patient*
Repair	Opposing dentition fracture	2	2	3	2	0	0
	Denture base fracture	3	2	6	4	1	1
	Resin teeth fracture	3	1	4	2	3	2
	New denture	4	4	2	2	0	0
	Resin teeth renewal	3	3	2	2	1	1
Adjustment	Hyperplasia	5	4	4	4	0	0
	Reline	9	8	4	3	6	6
	Relief	7	7	1	1	6	5
	Loosening of Locator abutment	0	0	0	0	1	1
	Locator cap removal	0	0	0	0	2	2
Loss of retention	Activation of retentive component	19	9	0	0	0	0
	Locator male part change	0	0	13	10	14	10

* Some patients experienced the same problem several times.

128 events were recorded. The same event was repeatedly recorded in the same patient. The total number of events was higher in the BC group(55 events) than in the ML(39 events) and LO(34 events) groups. However, no significant differences were found among the different attachment types. The most common prosthetic complication was the loss of retention.

The total number of repairs, adjustments, and retention complication events were compared to the expected number of events by a cross tabulation analysis. In the BC group, the actual number of repair events was similar to the number of expected events, while the number of adjustment events was higher than the number of expected events. In the ML group, the repair events occurred more than expected, but adjustment events occurred less than expected. However, in the LO group, repair events occurred less than expected, while the adjustment events occurred more than expected(Fig. 2).

The frequency of replacement for the male part of the Locator attachment was higher in the LO group than in the ML group. The first replacement of the Locator blue male part occurred on an average of 12 months after denture placement in the LO group. The second replacement occurred on an average of 23.6 months after placement. In the ML group, the first replacement of the Locator blue male part occurred on an average of 12 months after placement, which was within the same time frame as that in the LO group. However, the second replacement in the ML group occurred on an average of 48.3 months after placement.

The average frequency of prosthetic complica

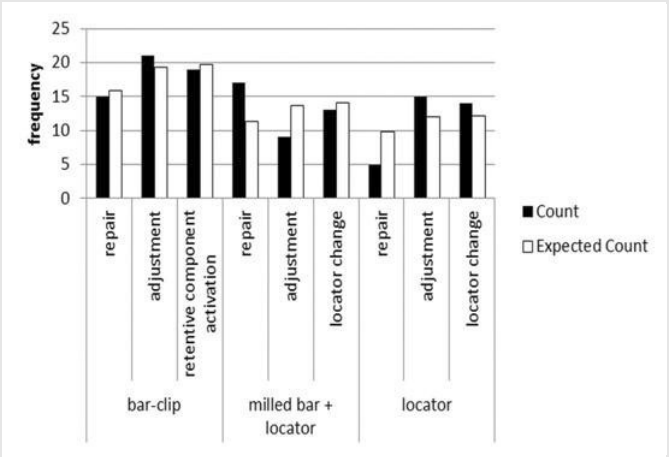

Fig. 2. Comparison of total event of repair, adjustment, retention complications to implant overdenture in 3 treatment groups. Expected count assessed by cross tabulation analysis.

tions during the first year of follow-up is shown Table 3. In the BC group, the average frequency of prosthetic complications was 3.0 events per prosthesis during the first year. In the ML and LO groups, the average frequencies were 1.45 events and 2.35 events, respectively. Statistically significant differences in the frequency of complication events were found among the attachment types($p = .043$). Specifically, the frequency of complications was significantly higher in the BC group than in the ML group($p = .040$)(Table 4). The minimum number of complication events was one, while the maximum was seven.

Ⅳ. Discussion

In the present study, the type and frequency of prosthetic complications that occur after the placement of various types of implant overdenture attachments were observed. It is important for clinicians to know the types and frequency of complications that may occur during the use of implant overdentures in order to select the appropriate treatment stragey[14].

Table 3. The average frequency of prosthetic complications during the first year of follow-up

	No. of patient	Mean of frequency (±SD)
Bar-clip	10	3.00(1.333)
Milled bar &Locator	11	1.45(.934)
Locator	17	2.35(1.579)
Total	38	2.26(1.446)

SD, standard deviation

Table 4. Inferential statistical results for the average frequency of prosthetic complications during the first year in the three treatment groups

ANOVA	SS	df	MS	F	Sig.
Between Groups	12.759	2	6.379	3.456	.043*
Within Groups	64.610	35	1.846		
Total	77.368	37			

Post hoc Bonferroni	Group	Mean Difference	Sig
	Bar-clip - Milled bar & Locator	1.545*	.040
	Milled bar & Locator - Locator	-.898	.289
	Locator - Bar-clip	-.647	.720

ANOVA, analysis of variance; SS, sum of squares; df, degree of freedom; MS, mean squares.
*The mean difference had a significance level of 0.05.

Hemming et al(1994) reported a high incidence of maintenance for implant-supported overdentures in the first year, but noted that the incidence decreased in the following year[15]. Evaluations of the prosthetic complications in the first year are important for determining the necessary overall maintenance period.

In the bar-clip group, the number of prosthetic complications in the first year was significantly higher than that in the milled bar with Locator group, which is statistically significant. In the bar-clip group, the rotational bar or prefabricated bar was used. Therefore, the bar-clip group and the Locator group were considered to be a resilient system and milled bar with Locator group were considered to be a rigid system. Several studies have compared the complications of a resilient system and rigid system[1, 16]. Dubic et al(2002) reported that a resilient system required more service in the first 5-year than a rigid attachment[1]. Klennmair et al(2007) reported that the prevention of denture rotation and primary retention of milled bar may contribute to low prosthetic maintenance of a rigid system and prevention of jaw resorption[16].

Fewer studies clinically compared the Locator system with the bar-clip system. Cakarer et al (2011) reported that the complications of attachment fractures and retention clip activation occurred more often in the bar-clip group than in the Locator group[17]. Bihan et al(2011) evaluated the prosthetic maintenance requirements during the first year after the placement of mandibular overdentures supported by Locator, ball, or bar type attachments. They found no statistically significant relationships among the attachment types[18]. In the present study, the Locator attachments exhibited a lower incidence of prosthetic complications than the bar-clip system during the first year. Similarly, Cordaro et al (2013) reported that clinicians found better hygienic conditions and soft tissue health in patients with the Locator attachment than in patients with the bar-clip attachment[19].

The most common complications were retentive component activation and changing of

the Locator male part. Several authors have studied the prosthetic maintenance requirements associated with the retentive component of overdentures[1, 20]. Walton et al(1997) reported that the most common repair was retentive component replacement[20]. Dubic et al(2002) reported that broken, loose, or lost bar clips and female retainers were more frequently observed with resilient devices.1 In the present study, the frequency of Locator male part replacement was higher in the Locator group than in the milled bar with Locator group. The first male part replacement was recorded 12 months after Locator placement in both the groups. The second replacement was found to have been made earlier in the Locator group(23.6 months) than in the milled bar with Locator group(48.3 months). This finding implies that milled bars provide primary retention, thus preventing the loss of retention.

In the bar-clip and Locator groups, the number of adjustments was higher than expected. The most common adjustment was relining, and this result indicated that relining occurred more often with the resilient type of attachment than with the rigid type. Payne et al(2000) found that frequent relining is needed when using overdentures.7 Resilient attachment types allow for rotational movement of the overdenture, which affects residual ridge resorption and denture-bearing tissue, and therefore, relining is critical[21].

In the milled bar with Locator group, repairs occurred more than expected. Fractures of the acrylic resin base were a common problem in the repair category of prosthetic complications. Goodacre et al (2003) reported that the incidence of overdenture prosthesis fracture was 12%[22]. Additionally, research shows that fractures occur as a result of biomechanical stress[23]. Milled bars also require space, given their morphology. The acrylic resin overlying the milled bar is thin and the occlusal force exerted during masticatory functions will flex and twist the prosthesis. Choi et al(2012) reported that denture resin that was less than 2 mm in thickness was weakened, and in this situation, the authors recommend that it be reinforced with metal[24].

Recent studies evaluated the complications associated with the Locator attachment compared to other attachments. Cakarer et al(2011) reported that no complications were noted in patients with the Locator attachment during the observation period[17]. Mackie et al(2011) agreed that a higher success rate was observed with the Locator system over a 3-year period[25]. However, Kleis et al(2010) reported that Locator attachments required a higher rate of maintenance than ball attachments. In addition, the authors noticed that damage to the male parts of the Locator attachment appeared 12 months after delivery, which led to a 75.5% loss of retention and the parts had to be replaced[26]. As mentioned above, the first male part replacement was recorded 12 months after Locator delivery in the present study. Fortunately, replacing the male Locator part is a simple and quick procedure that requires minimal additional work and expenses[26]. According to Payne(2002), predicting the exact frequency of attachment replacement is often difficult, because it depends on whether the

patient or prosthodontist indicates that the part needs to be replaced[27].

This study evaluated various periods and unequal population of the attachment group. A study with a large sample size and longer follow-up periods is recommended for evaluating this type of attachment or a new attachment. Further studies are warranted to assess the effects of opposing dentition and location of implant.

Ⅴ. Conclusions

Within the limitations of this study, the following conclusions were made: (1) compared to the bar-clip attachment, implant overdentures that use milled bars with the Locator attachment have a significantly lower incidence of prosthetic complications for the first year of follow-up after placement and (2) the most common complications of implant overdentures were retentive component activation and replacement of the Locator male part.

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