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Ball versus Locator Attachment Systems: A Systematic Review and Meta Analysis

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ABSTRACT-
Aim -to compare ball versus locator attachment on the basis of retention, patient satisfaction, bone loss, OHRQoL and patient complications in implant supported overdenture patients.
Setting and design- systematic review and meta-analysis
Materials and methods- This systematic review was designed according to the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. The review compared ball versus locator attachment on the basis of retention, patient satisfaction, bone loss, OHRQoL and patient complications in implant supported overdenture patients.
Statistical analysis used- random effect model was used.
Results – the present analysis reviewed for the efficacy of ball and locator attachment.bone loss and OHRQoLwas not significant the different both the groups. Complications were equally distributed in both groups.
Keywords- ball attachment, locator attachment, , patient satisfaction, bone loss, OHRQoL and patient complications.
CONCLUSION
Though a slight inclination was noted for the compromise in patient related factors (ohrqol, complication, bone loss) in ball attachment implants, no significant difference was found in our more analysis. We further recommend more trials with larger samples and longer follow up between these 2 attachments to reinforce this hypothesis.

I. INTRODUCTION

Despite the decline of edentulism, the negative impact on oral health related quality of life remains considerable, especially for the aging population worldwide. This effect is emphasized when function is not re-established with efficient prosthetics. [1-3] Among edentulous patients, in particular, the mandible exhibits severe atrophy of the alveolar ridge, which can result in inadequate denture retention and restricted denture function, and thus in an associated reduction in patient satisfaction.[4] To overcome this problem, dental implants can be inserted to enhance stable seating of the denture. A removable denture can subsequently be attached to the mandible in a comparable minimally invasive way by means of two interforaminal implants. [5,6]

The classical treatment plan for the edentulous patient is the complete removable maxillary and mandibular denture. This treatment is relatively inexpensive in comparison with the implant supported fixed prostheses, but it has several drawbacks. The implant-supported overdentures are recommended to overcome these drawbacks.[7,8] These prostheses have many advantages in comparison with the conventional dentures, including good stability, good retention, improved function and esthetics and reduced residual ridge resorption. It is also possible to incorporate the existing denture into the new prosthesis.[8,9] Another advantage is the reduced number of the implants and easier surgical procedure [7]

Associating dental implants to this therapeutic approach can improve the treatment success rate significantly by increasing denture stability,[10-14] a result that can only be achieved through a mechanism that reliably connects prosthesis and implants: the attachment system. Attachments are, therefore, at the heart of this treatment approach and may draw the line between success and failure. Ideally, the attachment system should allow an easy installation and removal of the prosthesis while firmly holding it in place during function, for the longest time possible.

Attachment systems are manufactured in a large array of materials and shapes, and are generally classified as bar or stud types.[15] The former is composed of a metal bar connecting two or more implants, and metal or plastic retainers commonly called “clips” that clasp the bar. Stud attachments are components installed on individual implants and include clipping-action devices of varied shapes, such as ball and cylinder, and magnets. Ball-shaped stud attachments are

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probably the most popular, and while exhibiting retentive capabilities that may please most patients, they present a hinge resiliency that has a negative effect on perceived chewing ability with complete overdentures.[16] This type of connection also looses retentiveness due to wear, which may vary according to patrices and matrices' material and design.[17,18,19] Another option for retaining an overdenture is the cylindrical abutment, which has a socalled self-aligning property and nylon retentive components with different levels of retention.[20,21] An additional advantage of this attachment is its reduced height, which allows the rehabilitation of small prosthetic spaces.[22] While its cylindrical shape supposedly translates into a resistance factor for implant overdenture rotation and its maintenance might be simpler and less expensive because of the easily replaceable nylon components. [23,24]

Mostly, the attachment system depends on practitioners' events and preferences. from several studies that have been conducted comparing various attachments in ways that are useful for clinical decision making. and also, research on systematic review articles has shown how long the implant lasts,[25] complications in prosthetic[26] and Overdenture patient satisfaction[27] of the mandible without comparison the attachment system. Therefore, a systematic review of the implant overlay system is needed to focus on the published results.

So, the aim of the study was to systematically compare ball and locator attachment systems regarding patient satisfaction, bone loss, complications and retention and OHRQoL in implant supported overdentures.

II. MATERIALS AND METHOD

This systematic review was designed according to the guidelines of the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement.[28,29]

PICO analysis

PICO format (Population, Intervention, Comparison, Results) is used to show clinical questions with obvious inclusion criteria. Questions characteristics and criteria for inclusion Is ball attachment system better than locator attachment system regarding retention, patient satisfaction, bone loss, OHRQoL and patient complications in implant supported overdenture patients?

P: Studies including implant supported prosthesis
I: Ball attachment
C: Locator attachment
O: quantitativeassessment bone loss, patient satisfaction and OHRQoL and qualitatively assessment retention, patient satisfaction

SEARCH STRATEGY

This systematic review search uses an “satisfaction”,” bone loss”,” retention”,” overdenture”, “ball and locator”, “OHRQoL” and” patient complication”. An extensive search of literature was performed on database such as MEDLINE, PubMed and Google Scholar.

ELIGIBILITY CRITERIA

The inclusion and exclusion criteria in this systematic review were the following:
Inclusion Criteria Those articles that have been compared between ball and locator attachment from January 2009 - February 2021
Exclusion criteria were article language other than English, no editorial abstract, only published articles, no dissertation, auditorial or case report. No date limits were applied to guarantee the inclusion of all relevant articles.

Quality assessment

The risk of bias was assessed using the Cochrane Collaboration tool. The selected articles were assessed by the first author, and any variant view of selected articles was further assessed by the second author. The randomized controlled trial studies were evaluated using the following domains: random sequence generation, allocation concealment, blinding of the participant and personal blinding of the outcome assessment, incomplete outcome data, reporting bias, and other bias. The studies were rated further as a risk of bias (low, medium, and high) by the reviewers

Data management

Data extraction was independently done by two reviewers using the specific format. The specific information was as follows: year of publication, study population, various available attachments, and follow-up period.
Tools for measuring outcomes: 1): quantitative asses bone loss, 2) patient satisfaction3) andOHRQoL4) and qualitatively asses retention, 5) patient satisfaction

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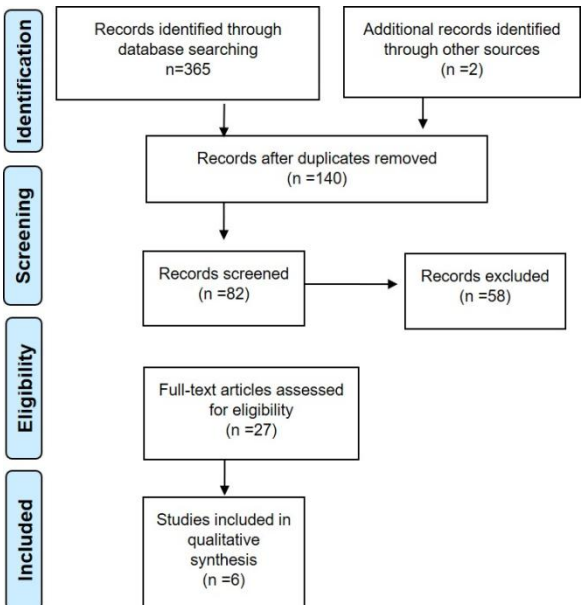

Figure 1. Prisma Flow

III. RESULT

Figure 1 the initial search resulted in 365 articles. After screening the title and reviewing the full-text articles, 58 articles were excluded with the following specification: 140 articles were duplicate, 6 articles were literature review or systematic review and meta-analysis. After screening, reviewing and selecting those articles, only 6 articles met the inclusion criteria

Table 1 showed that there were 6 articles in this systematic review is a randomized clinical trial that concerns oral rehabilitation prosthetic with a supported Overdenture implants using the locator system comparisons ball system. The clinical study published between January 2009 to February 2021 and research follows up around 1 to 5 years.

Table-1

STUDY	Study design	Follow up	Type of attachment	Implant type	Retention performance	Patient satisfaction performance	Bone loss	Oral hygiene related OHRQoL	Complications
Carine Matthys et al	RCT	5 years	Ball and locator attachment	Osseospeed, Dentsply Sirona, Inc, York, Pennsylvania	Retention for balls was better than locators	Similar	Similar	Plaque accumulated more on ball.	
Nabeel H. et al	RCT	1 year	Ball and locator attachment	not mention			Mean marginal bone loss at 1 year was 0.19mm		

							without significant differences observed.		
Silvia Brandt	RCT	3 years	Ball and locator attachment	Straumann (Basel, Switzerland), Astra Tech Dentsply-Sirona; Charlotte, NC, USA)				OHRQoL was significantly higher among patients in locator attachment group than among patients in ball attachment group.	
Sirmahan Cakarer et al	RCT	41.17 months	Ball, bar and locator	Astra Tech, BioHorizons, BioLok, Endopore	Locator	Locator			locator system showed superior clinical results than the ball and the bar attachments.
Wilfried K. Kleis et al	RCT	1 year	Locator and ball	Osseotite TG Standard implant	BALL	Both the attachment showed same patients satisfaction			Within the observation period of this study, the self-aligning attachment system showed a

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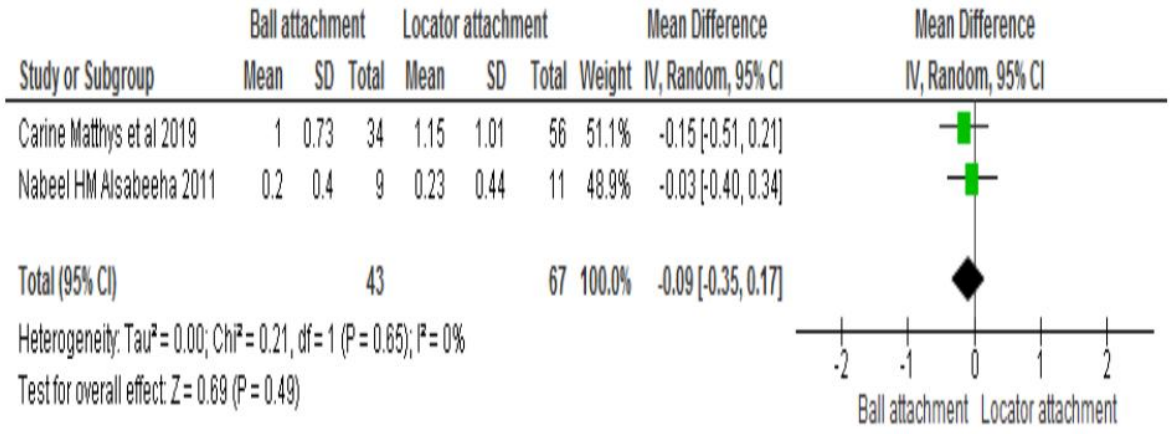
									higher rate of maintenance than the ball attachments
Rubens Ferreira de Albuquerque Jr	RCT	1 year	Locator and ball	Straumann AG (Switzerland), Zest Anchors Inc 123 (Escondido CA USA)	Similar	Similar			

Meta-analysis

Graph 1: Forest plot showing Bone loss comparison between ball and locator attachment



Inference: Two studies were analysed to evaluate bone loss in both groups. 43 implants in ball attachment and 67 locator attachments were assessed. There was no significant difference noted for the measured outcome, with a p value of 0.49. There was no heterogeneity in the study noted with I2 = 0%, suggesting no variation between studies. (Graph 1)

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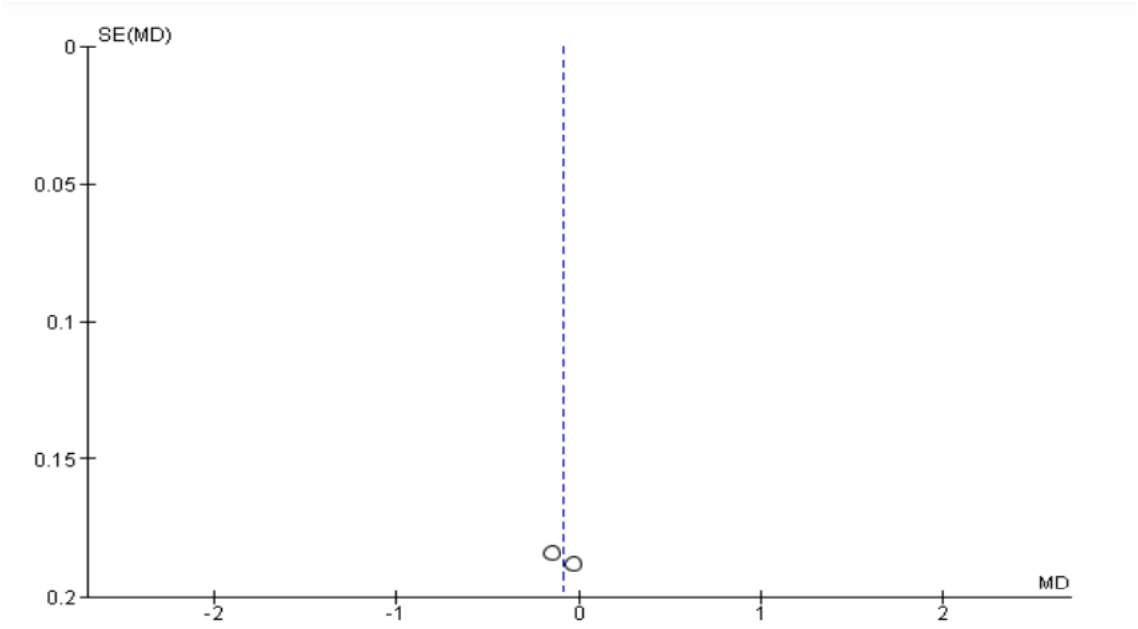
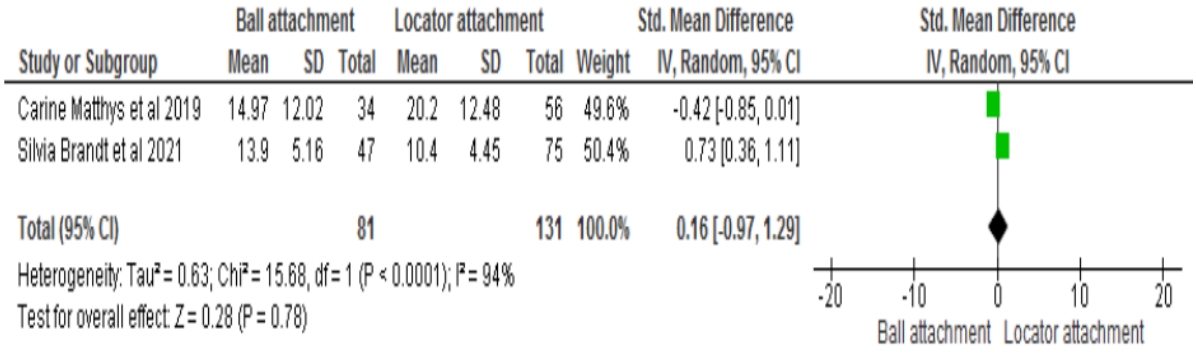
Graph 2: Funnel plot showing Bone loss comparison between ball and locator attachment



Inference: No publication bias noted.

Graph 3: Forest plot showing OHRQoL comparison between ball and locator attachment



Inference: 81 patients and 131 patients in ball attachment group and locator attachment group respectively were assessed for OHRQoL. A mean difference of 0.16 (95% CI – 0.97; 1.29) was noted between the groups, but was non – significant at p = 0.78. Heterogeneity of 94% was observed for the present analysis. Though a heterogeneity value of 94% was noted, the analysis still remains reliable because of random selection of study participants

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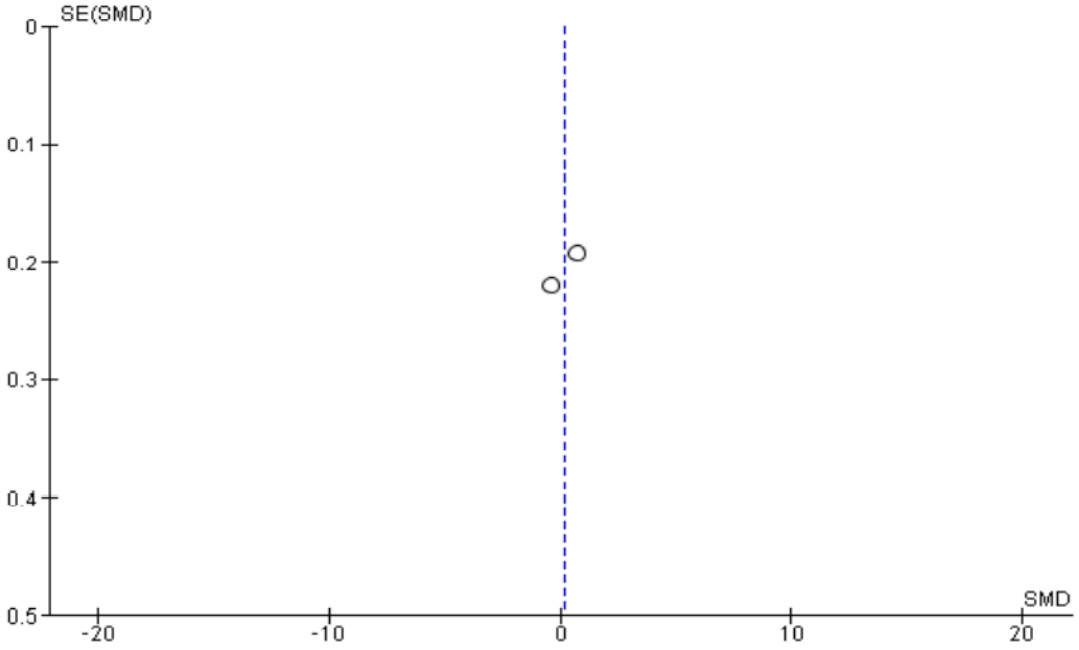
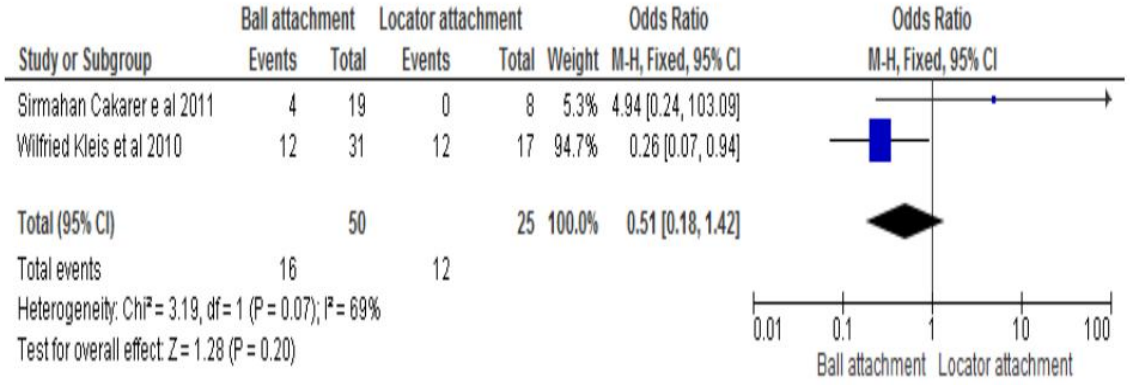
Graph 4: Funnel plot showing OHRQoL comparison between ball and locator attachment



Inference: No publication bias noted.

Graph 5: Forest plot showing complications comparison between ball and locator attachment



Inference: Complications with implant attachment were analysed in 2 studies, with 16 subjects in ball attachment group and 12 in locator attachment group. Complications were equally distributed in both groups which was non – significant at p = 0.20.

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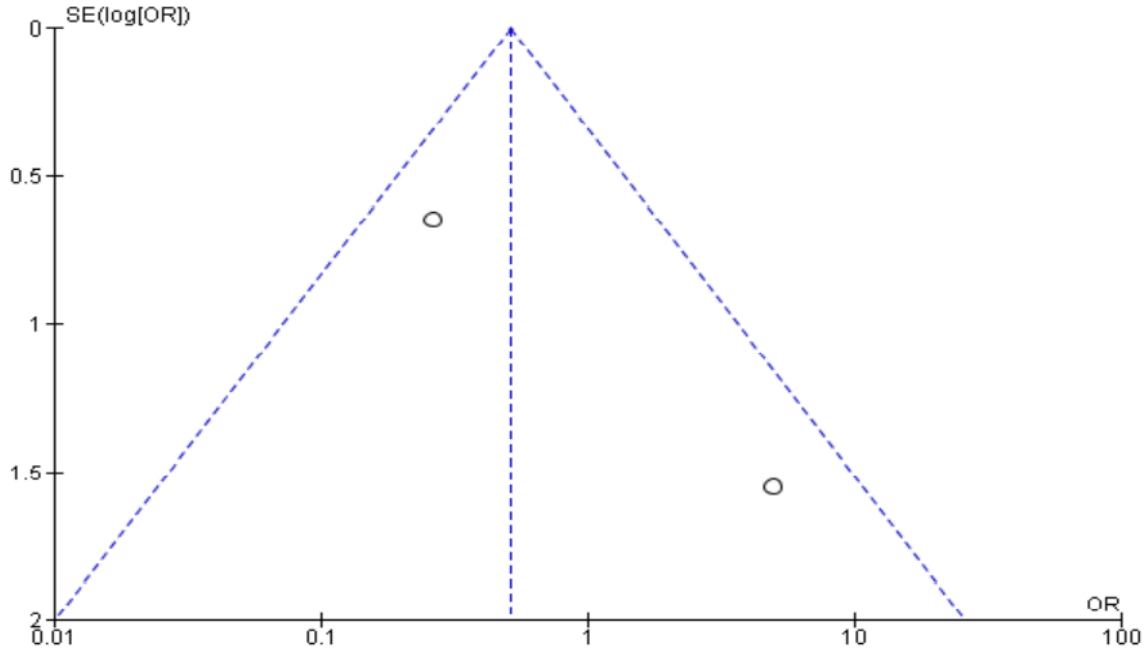
Graph 6: Forest plot showing comparison0f complication between ball and locator attachment



Inference: No publication bias noted.

Data analysis:

Review Manager 5.4 (The Cochrane Collaboration 2020) software was used to run the analysis. Random effect model was chosen assuming the observed estimates of treatment effect may vary across studies due to real differences in treatment effect in each of the study and considering sampling variability by chance. P value lesser than 0.05 was considered to be statistically significant.

Risk of bias (ROBINS-2 tool)

Study	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of personal and participant (performance bias)	Blinding outcome (detection bias)	incomplete outcome data (attrition bias)	Reporting bias (selection bias)	Other bias
Alsabeeha et al	Low	Low	Low	High	Low	Low	Low
Brandt et al	High	High	Unclear	Unclear	Low	Low	Low
Albuquerque et al	Low	Low	High	Low	Low	Low	Low
Matthys et al	High	High	Unclear	Unclear	Unclear	Unclear	Unclear
Kleis et al	Unclear	Unclear	Unclear	Unclear	Low	Low	Low
Cakarer et al	Unclear	Unclear	Unclear	Unclear	Low	Low	Low

IV. DISCUSSION

Several clinical studies evaluating the locator system, other attachments and show that the system locator indicates a higher level of maintenance than the ball attachment[30,31,32]. Thus, the locator found to be more profitable in a clinical viewpoint.[33]

The locator attachment is designed to make insertion and removal easier, has dual retention, and ability to self- align thus increasing its resiliency and tolerance for implant divergency (up to 40°). Due to these design features, the locator rapidly became one of the most popular stud attachments.[34]

Carine reports that important differences that are monitored for the quality of abutment retention. Retention for ball support is better at each implant position proportionally to the locator support.[35]

Loss of bone around the implant support for overdenture assessed in 2 randomized clinical trials showed not significant difference. These results are similar to studies from Carine, who found that implant yield and marginal bone loss were not significantly affected by attachment but there are factors that can cause bone loss around locator attachment.

here are four RCT evaluating patient satisfaction with overdenture locators and ball attachments included in this systematic review. Some of the general aspects analyzed include aesthetic, phonetic results, retention, mastication, ease of use, and cleanliness.

Principal studies indicate no significant differences in patient complaints, based on the attachment system used. Out of three study one study showed patient satisfaction using locator attachment is better than a ball-type attachment.[32,34,36]

2 studies stated patient satisfaction same between overdenture users with locator and ball attachments

In both randomized control trials locator showed better OHRQoL comparing to ball attachments.

Furthermore, Deeb et al. demonstrated that OHRQoL among patients with removable dentures is also affected by socio-economic, demographic, and anamnestic parameters[37].The effect of these parameters was not assessed in the present study, which constitutes a further limitation regarding the assessment of OHRQoL

The simplicity of use and maintenance of ball attachment, its low cost, removal of a superstructure bar, its wide range of movement, and large patient satisfaction are the main advantages of ball attachment. On the other hand, it wears over time, steadily loses retention and the ball attachments must be parallel to each other.

The advantages of the locator attachment are its self-aligning, has double retention, rotational action, built-in guide planes providing precise insertion; it can also be used in nonparallel situations.

V. CONCLUSION

Though a slight inclination was noted for the compromise in patient related factors (ohrqol, complication, bone loss) in ball attachment implants, no significant difference was found in our more analysis. We further recommend more trials with larger samples and longer follow up between these 2 attachments to reinforce this hypothesis.

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