

OVER DENTURE ATTACHMENT SYSTEMS- A SYSTEMIC REVIEW AND META ANALYSIS

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ABSTRACT

Introduction: Hence we piloted a systemic review and meta analysis to calculate the rate of survival, response of the tissue, and satisfaction of the patient for the different attachments in the overdentures.

Materials and Methods: We conducted the search for the data from the online sources like the “EMBASE”, “Pubmed”, “Scopus” and other sources. The articles for the past 20 years were searched for the parameters attachment’s of the survival, soft /hard tissues reactions, attachment’s restoration and care, and general performance of the attachments in the overdenture. The data extraction and meta-analysis were based on the PRISMA guidelines. For the assessment of the risk factors and the variables the statistical analysis was done keeping $p < 0.05$ as significant.

Result: There were only 16 articles that fit into the study after the application of the inclusions and the exclusion criteria applied. We observed that most of the studies were with the comparison of the combinations of the attachments like bar and ball attachments and their

subtypes, magnetic and bar attachments, and locator in combination with other attachments. The meta-analysis of pooled 16 studies stated acceptable heterogeneity among 16 studies ($I^2 = 96\%$) and testified to be statistically significant ($P < 0.01$).

Conclusion: We can conclude that the rate of survival in the attachments for a mean follow-up of three years, ranged from 96.2%–100% for ball, 95.8%–97.5% for bar, 90%–92% for magnet and locator attachments were in the range of 97%. Various periodontal issues were reported for all the attachments. However, of all the types of attachments the ball and locator attachments was found to be good at survival rate, tissue response, and patient satisfaction.

Keywords: Overdenture Attachments, Meta Analysis, Ball and Bar Implant-Supported Over-Denture, Locator Attachment, “O” Ring Attachment,

Introduction

The edentulous patients are restored with the complete dentures of which the most recent and advanced are the Implant-supported attachment over-denture that helps in better retention and support than the conventional dentures.[1] The overdentures on the tooth have advantage of the proprioception but the complications of the loss of the periodontal support and the position/condition of the abutment tooth impacting the overdenture. There is the freedom of the selection of the location for the implant overdentures. The bar and ball attachments by Mericske Stern et al. was the first that were successfully used. Later the attachments were classified as 1) frictional, 2) mechanical, 3)frictional-mechanical and 4) magnetic attachments.[2] Various attachments available are bar with coping, bar with clip, studs, bar, , freshly “O” ring attachment, and locator attachment. The survival of the overdenture depends on the attachment that in turn depends on the periodontal support and health. The survival of the attachment is the crucial factor that is considered for the selection by the Prosthodontists. There are various factors that influence the selection of the attachment like the cost, patient related factors like general motivation and expectations, hygiene practices, bone conditions, space available etc. Hence we piloted a systemic review and meta analysis to calculate the rate of survival, response of the tissue, and satisfaction of the patient for the different attachments in the overdentures.

Materials and methods

We conducted the search for the data from the online sources like the “EMBASE”, “Pubmed”, “Scopus” and other sources. The articles for the past 20 years were searched for the parameters attachment’s of the survival, soft /hard tissues reactions, attachment’s restoration and care, and general performance of the attachments in the overdenture. The data extraction and meta-analysis were based on the PRISMA guidelines. The attachments considered were ball, bar, ball-bar, magnetic, locator, ERA, Dalla Bona, conus, and combinations of various attachments. Primary outcome variable was the survival rate of the attachments with various follow-up periods, maintenance visits by the patients, tissue response evaluated both clinically as well as radiographically, patient satisfaction using Visual Analog Scales (VAS). The secondary outcome

variables were Support, Stability, and Retention. Two independent investigators performed the study selection after settling the disagreements. The studies were graphed conferring to the mean difference with the level of significance at $P < 0.01$. In the meta-analysis, heterogeneity was measured as a final calculation of effect size and the confidence interval (CI) around that effect size was calculated by using random-effects in the forest plot. To review and associate studies, the mean values of the outcomes were openly pooled and studied with weighted MDs and 95% CIs. For the dichotomous outcome, the estimations of the effect were stated in risk ratios and 95% CIs. For the assessment of the risk factors and the variables the statistical analysis was done keeping $p < 0.05$ as significant.

Results

A total of 1362 articles were selected of which only 16 were finalized for the meta analysis based on the exclusion and inclusion criterion. [Figure1] Six are prospective case-control or comparative analysis, one is retrospective comparative analysis, and nine are randomized clinical trials. For all the studies the follow-up was done. A total of 920 patients with ~2500 implants were treated in all these. The mean age was 63 ± 2.1 years. The overall survival was 98.21%.

The meta analysis was done by combining all 16 studies by and random effect meta analysis, with an overall acceptable heterogeneity among the studies ($I^2 = 96\%$). The result of various attachments used in implant supported overdenture reported statistically significant heterogeneity ($Q = 374.7403$, $df = 15$, and $P < 0.0001$). The random-effect model reported an MD of -0.1440 (95% CI -0.8126 – 0.5247) [Figures 2-3]. The combined results of 16 studies reported to be statistically significant ($P < 0.01$). The studies related to ball attachments show significant values of retention, survival, and overall performance and the bar attachments produce moderate tissue changes and bone resorption. The locator attachments require constant maintenance and repair. The magnetic attachments reported higher bone resorption under functional force. Summarization of all the studies included is given in Graph 1.

Figure 1. Flow-chart showing the selection of the articles.

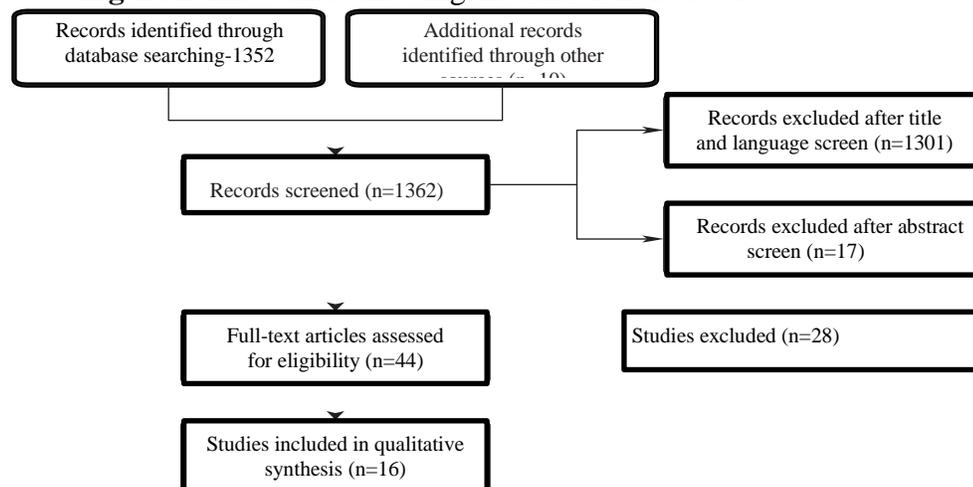
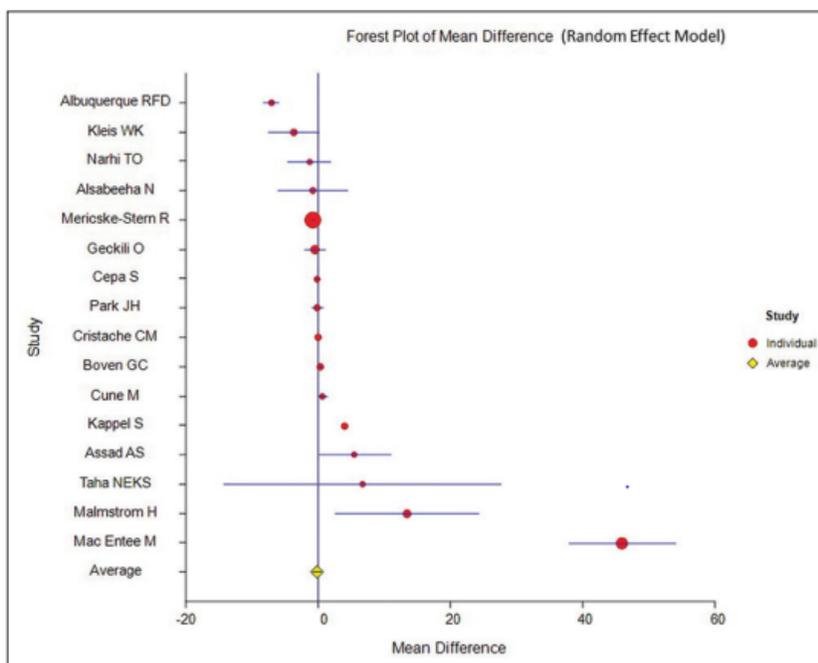


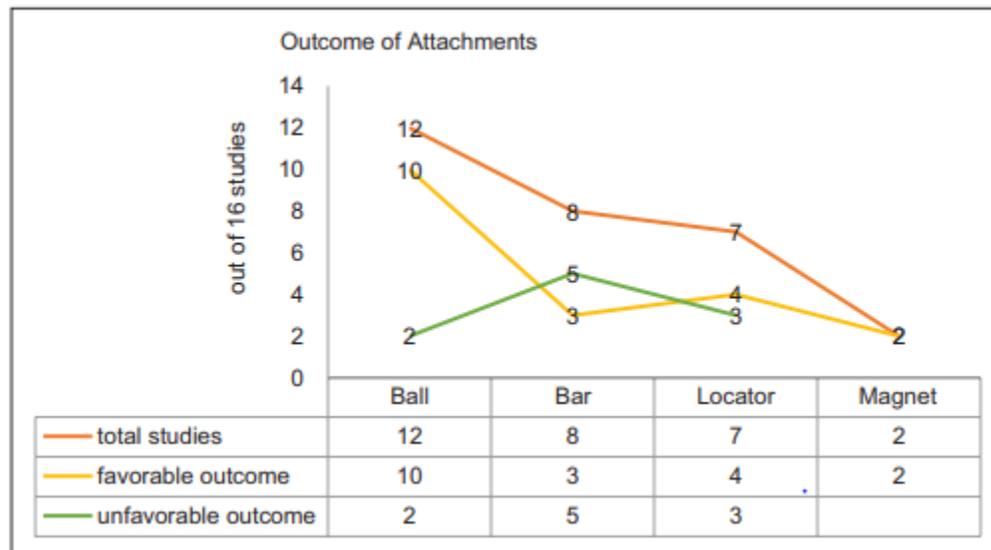
Figure 2: Data for the forest plot of meta-analysis

STUDY	YEAR	MEAN DIFFERENCE	STANDARD ERROR	95.0% LOWER CONFIDENCE LIMIT	95.0% UPPER CONFIDENCE LIMIT	PERCENT RANDOM EFFECTS WEIGHT	PERCENT FIXED EFFECTS WEIGHT
Narhi TO	2001	-1.3	1.5320	-4.5858	1.9858	3.4940	0.0476
Mericske-Stern R	2002	-0.74	0.1030	-0.9425	-0.5374	11.7022	10.5450
Assad AS	2004	5.49	2.3736	0.0163	10.9636	1.7585	0.0198
Mac Entee M	2005	46	4.1350	37.8457	54.1542	0.6436	0.0065
Kleis WK	2009	-3.7	1.926	-7.5623	0.1623	2.4788	0.0301
Cristache CM	2009	0	0.03845	-0.0775	0.0774	11.8107	75.6763
Cune M	2009	0.7	0.3251	-0.0084	1.4084	10.6809	1.0582
Alsabeeha N	2011	-0.8100	2.5815	-6.0564	4.4363	1.5217	0.0167
Malmstrom H	2015	13.38	5.4750	2.4998	24.2602	0.3759	0.0037
Geckili O	2015	-0.4900	0.7734	-2.0230	1.0430	7.3563	0.1870
Kappel S	2015	4	0	4	4	5.8664	0.1118
Cepa S	2016	-0.1	0.1226	-0.3536	0.1536	11.6504	7.4417
Albuquerque RFD	2018	-7.1	0.5515	-8.2437	-5.9562	9.0354	0.3678
Boven GC	2019	0.27	0.1702	-0.0723	0.6123	11.4898	3.8576
Park JH	2019	-0.1000	0.4219	-0.9540	0.7541	10.0165	0.6285
Taha NEKS	2019	6.7	9.8758	-14.2357	27.6357	0.1181	0.0011

Figure 3: Forest plot of mean differences (random-effects model).



Graph 1: Outcome of attachment



Discussion

In the present review the 16 were finalized for the meta analysis based on the exclusion and inclusion criterion. Six are prospective case-control or comparative analysis, one is retrospective comparative analysis, and nine are randomized clinical trials. For all the studies the follow-up was done. A total of 920 patients with ~2500 implants were treated in all these. The mean age was 63 ± 2.1 years. The overall survival was 98.21%. We observed that the ball attachments followed by bar, locator, magnet, conus and equator, and various combinations were the most common sequence of the attachments used for the overdentures. Ball attachment was used in 12 studies that showed a similar bone loss to the magnetic and locator attachment in the first year of placement.[3,4]

The combinations of the attachments were superior in function than alone.[5] Patient satisfaction was 64% for the ball and 100% for the conus-retained implant overdentures.[6,7] The probing depth for ball attachments was lower than that of the bar group and presented excellent peri-implant tissue reaction as reported by a crossover clinical trial.[8]

Regarding the survival of the attachment the five year survival was excellent for the ball-94.2%[9], 89.1% for the bar and 93.5% for locator groups (marginal bone loss: 6 mm)[13], 96.7% in the locator group and 97.9% in the bar group.[14] But there were few complications with the bar attachment like the periodontal issues. [10,11,16]

Among the nine randomized and crossover clinical trials, eight studies associated ball attachments with other attachments such as bar, magnet, locators, conus, and equators and reported that ball attachments require 6.7 repairs in 3 years,[12] has high maintenance cost,[13] show shallower probing depths even after 10 years of use[8] and a modified plaque index of the (0.39 ± 0.39) lowest in 3 years.[7] Thus, the ball attachments fair well with the highest retention values and lowest peri-implant inflammation but high maintenance visits.[15,18,19]

The meta-analysis of the 4 studies stated the survival rate of maxillary implant-supported overdenture.[9,10,14,17] Mericske Stern et al. reported that there is requirement of 4–6 implants to achieve 94.2% of cumulative survival rate with 5-year follow-up time.[9] In regards of maxillary arch, there is a definite prerequisite of 4–6 implants along with bar attachment[10,14,17] in order to distributes the stresses more on multiple attachment, thereby it improves the cross-arch stabilization for maxillary overdenture.[9]

The fixed restorations are more rational than where the use of 4–6 implants for maxillary overdenture,[10] as addition of two or more implant or use of zygomatic implant. The short implant are easy to place and maintain than the conventional implant. The use of short implant reduces the treatment time as grafting procedure of autogenous bone graft needs minimum 6 months to 1-year healing time before the placement of conventional long implant, and there is no contact of removable prosthesis to grafting site during healing time. Hence, it can be concluded that fixed restoration is the logical choice instead of overdenture for the rehabilitation of maxillary arch.

Similarly for the mandibular arch, 2-4 implants with adequate attachment are adequate to give support. Stability, and retention for mandibular denture delivered the support of the residual ridge is sufficient in terms of height and width. In case of the mandibular implant-supported overdenture is more economical than fixed restorations as compared to maxillary overdenture.[14] Further Randomised Controlled trials are required for evaluation of newer attachment systems in terms of retention loss and mucosal changes.

Conclusions

It can be concluded from this review that implant-supported overdenture is more cost-effective than fixed implant prosthodontics with optimal retention and stability than the conventional complete dentures. Our study also assessed the several attachments from the 16 included studies. From our studies ball attachments was superior in performance than other attachments. Maxillary and mandibular attachments varied for the optimal output. In the combination of the attachments Ball and locator attachments showed excellent survival, satisfactory tissue response and effective patient satisfaction for mandibular overdentures. Further studies with other modern techniques along with the combinations are warranted.

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