



A CLINICAL COMPARISON OF PROSTHETIC COMPLICATIONS OF IMPLANT-SUPPORTED OVERDENTURES WITH DIFFERENT ATTACHMENT SYSTEMS: A SYSTEMATIC REVIEW

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ABSTRACT

Aim: To systematically evaluate and compare prosthetic complications associated with different attachment systems used in implant-supported overdentures. **Materials and Methods:** This systematic review was conducted according to PRISMA guidelines and registered in the PROSPERO database (CRD4202421975). Electronic searches were performed in PubMed, Cochrane Central, and ScienceDirect databases from May 2005 to October 2023, supplemented by manual searches. Clinical studies evaluating prosthetic complications of implant-supported overdentures were included. Data extraction and risk-of-bias assessment were performed independently by two reviewers. **Results:** Nine clinical studies involving 387 patients were included. Attachment systems evaluated included bar, ball, Locator, O-ring, resilient liner, and OT Equator attachments. Bar and ball attachments demonstrated higher prosthetic maintenance requirements, while Locator and resilient liner systems showed fewer mechanical complications and better peri-implant tissue outcomes. Implant survival rates were high across all attachment systems. **Conclusion:** Locator attachments and resilient liner bar systems demonstrated more favorable prosthetic and biological outcomes compared to bar, ball, and O-ring attachments. Selection of attachment systems should be individualized based on patient needs, hygiene capability, and long-term maintenance considerations.

KEYWORDS : Implant-supported Overdenture, Prosthetic Complications, Attachment Systems, Bar Attachment, Locator Attachment

INTRODUCTION

Edentulism remains a significant public health concern affecting mastication, esthetics, phonetics, and quality of life. Conventional complete dentures often present limitations related to retention and stability, particularly in the mandible. Implant-supported overdentures (IODs) have emerged as a reliable treatment option, improving prosthetic function, patient comfort, and implant survival rates.

Various attachment systems such as bar, ball, Locator, O-ring, resilient liner, and equator attachments have been introduced to retain overdentures. Although these systems enhance denture retention and stability, they differ in terms of maintenance requirements, biological response, and prosthetic complications. Despite their widespread use, no universal consensus exists regarding the optimal attachment system.

Clinical guidelines, including the McGill and York consensus statements, recommend at least two implants to retain a mandibular overdenture, with additional implants suggested in specific cases such as a dentate maxilla, short implants (<8 mm), or patients with high retention needs⁹. Various attachment systems are available for IODs, including bar and stud (ball and locator) a While these attachments improve function and stability no universal consensus exists on the optimal system. The choice of attachment must consider factors such as cost, jaw morphology, implant system long-term maintenance requirements.

This systematic review aims to evaluate and compare prosthetic complications associated with different attachment systems used in implant-supported overdentures to assist clinicians in evidence-based decision-making.

MATERIALS AND METHODS

Protocol Registration

This registration was done to avoid duplication of system. The study protocol was registered on PROSPERO database. The PROSPERO registration number for protocol for this study is CDR4202421975. This registration was done to avoid duplication of systematic review.

Review Question

What prosthetic complications are associated with implant-supported overdentures using different attachment systems?

PICO Framework

- Population:** Patients with implant-supported overdentures
- Intervention:** Different attachment systems
- Comparison:** Comparison between attachment systems
- Outcome:** Prosthetic complications and their management

Search Strategy

Electronic searches were conducted in PubMed, Cochrane Central, and Science Direct databases. Manual searches of relevant prosthodontic journals were also performed. Articles published in English between 2005 and 2023 were considered.

Inclusion Criteria

- Clinical studies, randomized controlled trials, cohort studies, case series (>5 patients)
- Studies evaluating prosthetic complications of implant-supported overdentures

Exclusion Criteria

- In vitro studies
- Studies not reporting prosthetic outcomes
- Patient-centered outcome studies without prosthetic data

Study Selection

A total of 369 articles were identified. After duplicate removal and screening, nine studies met the inclusion criteria and were included in the qualitative synthesis.

Data Extraction

Data extracted included study design, sample size, attachment system, implant location, follow-up period, prosthetic complications, biological outcomes, and overdenture survival rate.

Risk of Bias Assessment

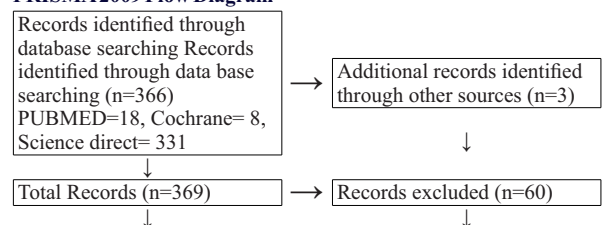
The Cochrane Risk of Bias Tool (RoB 2) was used to assess methodological quality across five Bias

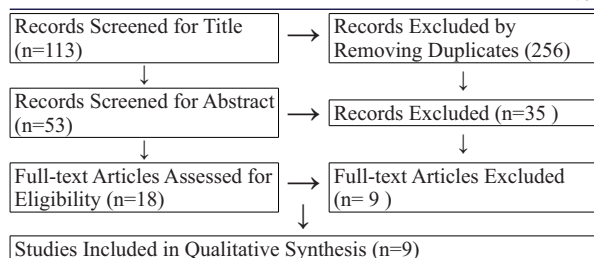
RESULTS

Records identified through database searching (n = 366) PubMed (n = 27) Cochrane Central (n = 8) ScienceDirect (n = 331)

Additional records identified through other sources (manual search) (n=3)

PRISMA 2009 Flow Diagram





Screening
Records after duplicates removed (n = 113)
Records screened (n = 113) Records excluded (n = 60)

Eligibility

Full-text articles assessed for eligibility (n = 18) Full-text articles excluded (n = 9) Reasons for exclusion: Patient-centered outcomes only (n = 4) Attachment systems not relevant to review (n = 3) Inadequate or unclear reporting of results (n = 2)

Included

Studies included in qualitative synthesis (systematic review) (n = 9).

The included studies comprised 9 clinical investigations published between 2009 and 2023, involving a total of 387 patients. Of these, 5 were randomized controlled clinical trials, 1 cohort study, 1 prospective study, and 2 clinical studies. Mandibular overdentures were evaluated in 72 patients, maxillary overdentures in 83 patients, and both arches in 232 patients. Attachment systems assessed included bar, ball, Locator, O-ring, resilient liner, and OT Equator attachments.

Prosthetic Complications

Across all studies, the most frequently reported prosthetic complications included attachment wear, loss of retention, need for clip or O-ring replacement, screw loosening or fracture, denture base fracture, and need for relining. Bar attachments were associated with higher plaque accumulation, mucosal hyperplasia, and clip wear. Ball attachments showed frequent O-ring replacement and increased maintenance. Locator and resilient liner attachments demonstrated fewer mechanical complications and improved peri-implant tissue health.

Table 1. Prosthetic Complications Associated with Different Attachment Systems

Attachment system	Common prosthetic complications	Relative complication rate
Bar	Clip wear, screw loosening, denture fracture, hygiene issues	High
Ball	O-ring wear, retention loss, frequent maintenance	Moderate–High
Locator	Loss of retention, replacement of male component	Low–Moderate
O-ring	Wear and loss of elasticity	Moderate
Resilient liner	Liner separation or wear	Low
OT Equator	Minor detachment, screw loosening	Low

Implant and Overdenture Survival

Implant survival rates across the included studies ranged from 89% to 100%. Overdenture survival rates were similarly high, with no statistically significant differences between attachment systems. Locator and resilient liner systems showed slightly higher overdenture success rates with reduced maintenance requirements compared with bar and ball attachments

Author (Year)ObjectiveKey ResultsConclusionCiftci et al. (2023)To evaluate prosthetic complications and survival of mandibular bar-retained overdentures with cement-retained versus screw-retained bars.Polymer attachment wear was the most frequent complication (72.6%). Cement-retained bars showed longer service life but more fractures. Overdenture survival rate was 91.9%.Both bar designs demonstrated high survival rates; screw-retained bars exhibited fewer prosthetic complications.Red et al. (2022)To assess implant survival and prosthetic complications of OT Equator-retained maxillary overdentures.Implant survival rate was 92.9%. Anterior detachment was the most common complication. Mechanical complications were minor.OT Equator-retained overdentures are a predictable, stable, and economical treatment option for edentulous maxillae.Park et al.

(2019)To compare bar and ball attachments in maxillary four-implant retained overdentures.Bar attachments improved stress distribution but showed poorer peri-implant tissue health. Ball/O-ring attachments required more prosthetic maintenance and O-ring replacements.Bar attachments were more vulnerable regarding peri-implant tissue maintenance, while ball attachments required greater maintenance.Elsyad et al. (2017)To compare long-term clinical and prosthetic outcomes of clip and resilient liner attachments in bar-retained mandibular overdentures.Clip group showed significantly higher plaque index, gingival index, probing depth, and bone loss. Survival rates were 96.6% (clip) and 100% (resilient liner). Resilient liner attachments produced superior peri-implant tissue health and fewer prosthetic complications over 7 years. Kappel et al. (2013)To compare immediate loading of mandibular overdentures retained by Locator attachments or Dolder bars. Survival rates were 93.5% for Locator and 89.1% for bar attachments. Both systems demonstrated minimal prosthetic complications. Immediate loading with Locator or bar attachments showed comparable success; ease of maintenance may favor Locator attachments. Akca et al. (2013)To compare biological and prosthetic outcomes of ball versus Locator attachments in early-loaded mandibular overdentures. Bone loss and prosthetic complications were greater with ball attachments. Implant survival rates were similar. Locator attachments resulted in fewer prosthetic complications, although biological outcomes were generally comparable. Cakar et al. (2011)To evaluate complications associated with ball, bar, and Locator attachment systems. Fourteen complications occurred with ball attachments, seven with bar attachments, and none with Locator attachments. Locator attachments demonstrated the best clinical performance with the lowest complication rate and superior maintenance of oral function. Kleis et al. (2009)To compare prosthetic maintenance and biological outcomes of Locator, bar, and TG-O-ring attachments. Locator attachments showed the highest maintenance requirements (34 complications), mainly due to loss of retention. O-ring attachments had 14 complications and bar attachments had the fewest. Biological outcomes were similar among groups. All systems exhibited comparable biological outcomes; Locator attachments required more prosthodontic maintenance because of retention loss. Cehreli et al. (2009)To evaluate marginal bone loss and prosthetic maintenance in mandibular overdentures supported by two implants with ball attachments. No implant failures occurred. Prosthetic outcomes were comparable between implant systems. Greater marginal bone loss was observed around Brånemark implants. Both implant systems demonstrated similar prosthetic success and peri-implant tissue outcomes, although marginal bone loss differed slightly.

Table2: Comparative Summary of Included Studies

Author (Year)	Objective	Key Results	Conclusion
Ciftci et al. (2023)	To evaluate prosthetic complications and survival of mandibular bar-retained overdentures with cement-retained versus screw-retained bars.	Polymer attachment wear was the most frequent complication (72.6%). Cement-retained bars showed longer service life but more fractures. Overdenture survival rate was 91.9%.	Both bar designs demonstrated high survival rates; screw-retained bars exhibited fewer prosthetic complications.
Reda et al. (2022)	To assess implant survival and prosthetic complications of OT Equator-retained maxillary overdentures.	Implant survival rate was 92.9%. Anterior detachment was the most common complication. Mechanical complications were minor.	OT Equator-retained overdentures are a predictable, stable, and economical treatment option for edentulous maxillae.
Park et al. (2019)	To compare bar and ball attachments in maxillary four-implant retained overdentures.	Bar attachments improved stress distribution but showed poorer peri-implant tissue health. Ball/O-ring attachments required more prosthetic maintenance and O-ring replacements.	Bar attachments were more vulnerable regarding peri-implant tissue maintenance, while ball attachments required greater maintenance.

Elsyad et al. (2017)	To compare long-term clinical and prosthetic outcomes of clip and resilient liner attachments in bar-retained mandibular overdentures.	Clip group showed significantly higher plaque index, gingival index, probing depth, and bone loss. Survival rates were 96.6% (clip) and 100% (resilient liner).	Resilient liner attachments produced superior peri-implant tissue health and fewer prosthetic complications over 7 years.
Kappel et al. (2013)	To compare immediate loading of mandibular overdentures retained by Locator attachments or Dolder bars.	Survival rates were 93.5% for Locator and 89.1% for bar attachments. Both systems demonstrated minimal prosthetic complications.	Immediate loading with Locator or bar attachments showed comparable success; ease of maintenance may favor Locator attachments.
Akca et al. (2013)	To compare biological and prosthetic outcomes of ball versus Locator attachments in early-loaded mandibular overdentures.	Bone loss and prosthetic complications were greater with ball attachments. Implant survival rates were similar.	Locator attachments resulted in fewer prosthetic complications, although biological outcomes were generally comparable.
Cakarer et al. (2011)	To evaluate complications associated with ball, bar, and Locator attachment systems.	Fourteen complications occurred with ball attachments, seven with bar attachments, and none with Locator attachments.	Locator attachments demonstrated the best clinical performance with the lowest complication rate and superior maintenance of oral function.
Kleis et al. (2009)	To compare prosthetic maintenance and biological outcomes of Locator, bar, and TG-O-ring attachments.	Locator attachments showed the highest maintenance requirements (34 complications), mainly due to loss of retention. O-ring attachments had 14 complications and bar attachments had the fewest. Biological outcomes were similar among groups.	All systems exhibited comparable biological outcomes; Locator attachments required more prosthodontic maintenance because of retention loss.
Cehreli et al. (2009)	To evaluate failures occurred. Prosthetic outcomes were comparable between implant systems. Greater marginal bone loss was observed around Brånemark implants.	No implant failures occurred. Prosthetic outcomes were comparable between implant systems. Greater marginal bone loss was observed around Brånemark implants.	Both implant systems demonstrated similar prosthetic success and peri-implant tissue outcomes, although marginal bone loss differed slightly.

DISCUSSION

The findings indicate that while all attachment systems provide acceptable implant survival, their prosthetic maintenance requirements differ significantly. Bar and ball attachments were associated with higher complication rates, particularly related to retention loss and hygiene challenges. Locator attachments, due to their self-aligning and resilient design, demonstrated reduced maintenance and improved patient comfort.

Resilient liner systems showed favorable biological outcomes by distributing occlusal forces and minimizing peri-implant inflammation. These results emphasize the importance of selecting

attachment systems based on patient dexterity, hygiene capability, and long-term maintenance considerations.

Elsyad et al. (2017) compares resilient and clip Bar. The aim of this trial was to evaluate clinical and prosthetic outcomes of resilient liner and clip attachments for bar/implant-retained mandibular overdenture after 7 years. significantly higher number of mechanical complications in the clip group compared to the resilient liner group .

Clip group had significantly higher PI, GI, probing depth (PD), and bone loss than the resilient liner group over the 7-year period. survival rates after 7 years to be 96.6% for clip attachments and 100% for resilient liner attachments. Within the limitations of this study, resilient liner attachments are recommended for bar/implant retained mandibular overdentures than clip attachments in terms of peri-implant tissue health and prosthetic complications after 7-years.

Kappel et al. (2013) compares new concept of Immediate Loading of Two Dental Implants, in Edentulous Mandibles, with Locator Attachments and Dolder Bars, minimal prosthetic complications in both groups, with no major superstructure failures. However, minor repairs like clip replacement were necessary. Higher modified plaque index (mPI) and modified gingiva index (mGI) for bar attachments than Locator attachments. Implant survival rates of 93.5% for Locator attachments and 89.1% for bar attachments after 1 year. Immediate loading protocols with either system appear viable, when initial implant stability is achieved.

Akca[2013] compares the biological and prosthetic complications of early loaded one stage implant overdenture with 2 different attachments, ball and locator attachments. Bone loss was greater in ball attachment group as compared to locator Prosthetic complications with ball attachments was higher.

Survival rates was comparable Biological outcomes were comparable with early loaded both attachments were comparable, More prosthetic complications with ball attachments as compared to locator attachments.

Cakarer(2011) compares 3 attachments Ball, Bar and locator attachments, Prosthetic complications including, fractured over dentures, replacements of O- ring attachment and retention clips, implant failures, hygiene problems, mucosal enlargements, attachment fractures, retention loss and dislodgement of the attachments were recorded.

Locator system showed superior clinical results than the ball and the bar attachments, with regard to the rate of prosthodontic complications and the maintenance of the oral function.

Wilfried K. Kleis[2009] Compare of Three Different Attachment Systems for Mandibular Two-Implant Overdentures [Ball, Bar and O-Ring] Locator system brought up 34 prosthetic complications, especially the need for change of the male parts or activation because of loss of retention.

TG-O-Ring patients showed 14 complications, most of them the change of the O- Rings. Dal-Ro abutment had seven minor complications in 12 months of clinical use, Biologic complications and patients' oral health-related life quality showed no significant difference among the three experimental groups.

Murat Cavit Cehreli[2009] compares Marginal Bone Level Changes and Prosthetic Maintenance of Mandibular Overdentures Supported by 2 Implants with unsplinted Straumann implants with O- rings and unsplinted Ball attachment Mandibular overdentures supported by unsplinted early-loaded Straumann and Brånemark implants lead to similar peri-implant soft tissue and prosthetic outcomes Higher marginal bone loss could be observed around Brånemark implants after 5 years. Broken/loose/lost retainers, occlusal adjustment, and retightening of the retainer were more experienced in the Straumann group.

CONCLUSION

Ball attachments had more prosthetic complications and bone loss compared to Locator attachments, with the Locator system generally performing better across multiple studies, showing fewer prosthetic issues and better maintenance of oral function.

Overall, Locator attachments and resilient liner bars appear to provide more favorable prosthetic and biological outcomes compared to bar,

ball, and O-ring systems, particularly in minimizing mechanical complications and maintaining peri-implant soft tissue health. Selection of attachment type should be tailored to individual patient needs, balancing ease of maintenance, biological health, and functional demands.

REFERENCES

- 1]. Ciftci G, Somay SD, Ozcan I, Ozcelik TB, Yilmaz B. Prosthetic complications with mandibular bar-retained implant overdentures having distal attachments and metal frameworks: A 2- to 12-year retrospective analysis. *J Prosthet Dent.* [2023] Volume 130 Issue 4
- 2]. Reda R, Zanza A, Testarelli L, Di Nardo D, Bellanova V, Xhajanka E. Implant survival rate and prosthetic complications of OT Equator retained maxillary overdenture: a cohort study. *J Clin Med.* [2022];[3]:[730–738].
- 3]. Moustafa Abdou Elsyad Long term clinical and prosthetic outcomes of soft liner and clip attachments for bar/implant overdentures: A randomized controlled clinical trial. *J Prosthet Dent.* 2018 Aug;45(8):647-656. doi:10.1111/joor.12500..
- 4]. Park JH, Shin SW, Le JY. Bar versus ball attachments for maxillary four-implant retained overdentures: a randomized controlled trial. *J Prosthet Dent.* [2019];[1-9.].
- 5]. Kappel S, Eberhard L, Giannakopoulos NN, Rammelsberg P, Eiffler C. Immediate loading of two dental implants in edentulous mandibles with Locator® attachments or Dolder® bars: first results from a prospective randomized clinical study. *Clin Oral Implants Res.* [2013];[.].
- 6]. Akça K. Early-loaded one-stage implants retaining mandibular overdentures by two different mechanisms. *J Prosthet Dent.* [2013];[Page numbers].
- 7]. Cakarar S, Can T, Yaltirik M, Keskin C. Complications associated with the ball, bar, and Locator attachments for implant-supported overdentures. *Med Oral Patol Oral Cir Bucal.* [2011];. doi:10.4317/medoral.17312.
- 8]. Cehreli MC, Uysal S, Akça K. Marginal bone level changes and prosthetic maintenance of mandibular overdentures supported by 2 implants: a 5-year randomized clinical trial. *J Prosthet Dent.* [2009];[Page numbers].
- 9]. Kleis WK, Kämmerer PW, Hartmann S, Al-Nawas B, Wagner W. A comparison of three different attachment systems for mandibular two-implant overdentures: one- year report. *J Prosthet Dent.* [2009];[Page numbers].
- 10]. Tallarico M, Khanari E, Caneva M, Meloni SM. Multicenter retrospective analysis of implant overdentures delivered with different design and attachment systems: Results between one and 17 years of follow-up. *Dent J (Basel).* 2018;6(4):71.
- 11]. Khan F, Baig M, Alzahrani AH. Implant-supported overdenture: A review. *J Pharm Biomed Sci.* 2017;07(05). doi:10.20936/jpbms/170705
- 12]. Gonçalves TM, Campos CH, Garcia RC. Splinted and unsplinted overdenture attachment systems: A systematic review and meta-analysis. *J Oral Rehabil.* 2018 Aug;45(8):647-656
- 13]. Alsabeeha NHM, Payne AGT, Swain MV. A systematic review and meta-analysis of the attachments used in implant-supported overdentures. *Int J Prosthodont.* 2009 May-Jun;22(3):221-227.
- 14]. Popoff DA, Rocha EP, Santiago JF Jr, Pellizzer EP, de Carvalho PSP. Quantitative and qualitative assessment of the wear pattern of two attachment systems of dissimilar materials for mandibular implant-retained overdentures: An in-vitro study. *BMC Oral Health.* 2023;23(1):693.
- 15]. Altintas NY, Gokcen-Rohlig B, Senel FC, Ozan O, Akova T. Prosthetic failures in dental implant therapy. *Implant Dent.* 2012 Apr;21(2):186-193.
- 16]. Alhajj MN, Reissmann DR. Biomechanical aspects of various attachments for implant overdentures: A review. *Polymers (Basel).* 2021 Oct;13(19):32
- 17]. Brandt S, Tropitzsch A, Röhling S, Rammelsberg P, Zenthöfer A. Implant- supported overdentures: Current status and preclinical testing of a novel attachment system. *Int J Environ Res Public Health.* 2023;20(3):2051.
- 18]. Alhajj MN, Reissmann DR. Biomechanical aspects of various attachments for implant overdentures: A review. *Polymers (Basel).* 2021 Oct;13(19):3248.