Journal of Chemical Health Risks

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JCHR (2025) 15(3), 696-712 | ISSN:2251-6727

Clinical Efficacy and Patient Outcomes of Mini Dental Implant-Retained Overdenture Prostheses in Edentulous Patients: A Systematic Review

Roshni J Taori[1], Jaykumar Gade[2], Shyam A Chandak[3], Sharwari P Bhatkar[4], Vaishnavi J Mohite[5], Shruti Matale[6]

[1] Post graduate student, department of Prosthodontics & Crown &Bridge, Swargiya Dadasaheb Kalmegh Smruti Dental College and Hospital, Nagpur

(Received: 16 March 2025 Revised: 20 April 2025 Accepted: 01 May2025)

KEYWORDS

Mini-implant,

Overdenture,

Mini-implant supported overdenture,

Narrow diameter implant

ABSTRACT:

Objective: The goal of this systematic review was to assess the use of mini-implants in retention of complete overdentures in order to assess survival rates, marginal bone loss prosthetic satisfaction and quality of life.

Data: This Systematic Review is registered on PROSPERO (Registration no- CRD42024555076), following the PRISMA statement and PICOS question.

Source: An electronic literature search was carried through PubMed, Web of Science, Research Gate and Google Scholar databases from year 2015 to 2024. The focused question was: 'Is the use of mini-implants feasible for prosthetic rehabilitation with overdenture prosthesis?'

Results: In 14 studies selected for this systematic review, total 1431 mini-implants were placed in 630 patients. There was a higher survival rate of mini-implants. More frequent failures for maxillary compared with mandibular arches. The majority of studies revealed marginal bone loss values similar to those of standard implants. All studies verified an increase in satisfaction and quality of life after rehabilitation with mini dental implant retained overdenture prostheses.

Conclusion: The present systematic review suggests that within the scope of this study, mini-implants for retaining overdenture prostheses can be considered a viable alternative treatment. This conclusion is based on the high survival rates of the mini-implants, acceptable levels of marginal bone loss, and notable improvements in patient satisfaction and quality of life.

1. Introduction

The improved quality of life and declining mortality rates worldwide have contributed to a significant increase in the elderly population. With, global decrease in the rate of edentulism, the sheer number of people reaching advanced age means that there are still a considerable number of individuals who are edentulous.(1) This demographic shift necessitates ongoing attention to dental health and care for the elderly population to ensure their quality of life.

Edentulous patients frequently have problems completing daily activities such as chewing food and creating phonemes. Tooth loss eventually results in atrophy of dental supporting structures including loss of muscle tone, and unfavourable facial aesthetics.(1) Usually these patients are offered traditional dentures.(1,2) The purpose is rehabilitating the stomatognathic system with masticatory efficacy, speech and cosmetic appearance.

Nevertheless, certain prostheses, particularly the mandibular denture, are known to have specific issues, such as inadequate stability and retention due to alterations in the size and form of ridge. (3) After extraction and years of wearing removable denture, atrophy of remnant alveolar ridges proceeds. With insufficient stability this happens quicker

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and extensively.[4] These generate difficulties like pain while eating, chewing, frequent worries regarding denture movement and anxiety about the detrimental effect at social occasions.[3] Patients also indicate that, due to problems with eating items that are difficult to bite or chew they have to alter what they eat. In some occasions, people shun social interactions completely.[3] Nowadays patients have exceptionally high standards for oral care; delivering a standard denture which eventually turns into a poorly fitting prosthesis fails to achieve these goals. One solution to these difficulties is implant supported denture.

Mishellany-Dutour et al. claimed that tooth loss and ageing affect mastication that cannot be compensated simply wearing a complete denture.[5] In this situation, implants can be offered as an alternate treatment for stabilizing the mandibular denture. Implant-supported overdentures give greater stability as well as retention with better chewing performance. Patients also express higher pleasure with aesthetics since the denture is not shifting. Implants decrease future bone resorption along with the long-term success rate in the lower jaw being at least 95% and there are minimal significant problems.[3] Long-term advantages of using two or more than two standard-sized implants (SSIs; diameter ≥ 3.75 mm, length ≥ 10 mm) for retention and support of mandibular overdentures have been well-documented. Therefore two, implant-retained overdentures have currently been considered as the primary choice of therapy.

However, some patients cannot get standard size implants due to low alveolar ridge volume.[6] This therapeutic option is limited in certain groups because of medical, anatomical or/and economic reasons. [7] Moreover, aged and, in particular, physically impaired patients are often not willing to endure long-lasting and invasive procedures including bone augmentation to be able to obtain SSIs. Adjusting implant dimensions facilitates simpler surgical operations and hence more implant patients.

The mini-implant overdenture is a relatively recent treatment option for complete edentulism.[8] In the last few years mini-implants became widely employed as an orthodontic anchorage, single and multiple tooth fixed replacement, bridge repair and removable prosthesis retention, becoming crucial for many scenarios. Further, the advancement of the dental implantology science provides technological improvements in the tiny implant design. This progress involves refinement of the implant shape, thread patterns and its surface treatments, improving primary stability and contributing to faster osseointegration. Mini dental implants is a solid one-piece implants with a diameter ranging from 1.8- 2.4 mm implanted by single-stage flapless technique. These are biocompatible titanium screws conceived and designed by Victor I. Sendax. When first introduced, they were viewed as just a transitional device providing stabilization for provisional prostheses during implant healing, but currently they are employed as an alternative to traditional implants for long-term prosthesis function. [9] Mini-implants (MDIs; ≤2.9 mm broad, ≥10 mm long) aims for retention of entire mandibular ODs. They can be promptly loaded when good primary stability is established. Usually, four MDIs are put in the interforaminal region for mandibular overdenture retention.

In comparison with traditional implants, MDIs are cost-effective[6,9], have less difficulties during flapless implant placement and without necessity of bone grafting treatments. Therefore, MDIs are important notably in elderly individuals with chronic illnesses.[10] The one stage flapless surgery provides numerous advantages such as improved healing along with minimal postoperative discomfort, and immediate restoration in mastication and esthetics during the healing.[11] It has been shown that mandibular overdenture assisted by four mini dental implants contribute to a long-lasting treatment-inducing enhancement of oral health-related quality of life.[12,13]

2. Materials and Methodology

REGISTRATION PROTOCOL

This Systematic Review is registered on PROSPERO (Registration no- CRD42024555076), following the PRISMA (The Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

ELIGIBILITY CRITERIA

Eligibility criteria included clinical human studies, randomized controlled trials (RCTs) or prospective

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studies evaluating the use of mini-implants for rehabilitation with overdenture prosthesis and studies published in English.

The search strategy was based on the following **PICOS** questions:

POPULATION-

Edentulous patients rehabilitated with overdenture.

INTERVENTION-

Mini implant retained overdentures

CONTROL-

Standard implant retained overdentures

OUTCOME-

Primary outcome- survival rates of mini dental implants is effective when used for retention of overdentures prosthesis.

Secondary outcomes- marginal bone loss, quality of life and prostheses complications in mini dental implants retaining overdenture prosthesis.

STUDY DESIGN-

Clinical human studies, randomized control trials and Prospective studies.

INFORMATION SOURCES

An electronic literature search was carried through PubMed, Web of Science, Research Gate and Google Scholar databases from year 2015 to 2024, for the studies regarding mini-implant retained overdenture. The search was restricted to the studies published in English language and answering the PICOS questions.

SEARCH STRATEGY

The studies to be included in present systematic review were searched and combinations of title, abstract, Medical Subject Heading Terms (MeSH) and keywords were used. The terms used were mini-implant overdenture OR narrow diameter dental implant OR mini-implants in prosthodontics in combination with Boolean operators. The search terms were connected with Boolean operator "OR". Both the comparator and the outcome were included in the primary search so as not to miss any relevant publication.

Subsequently, manual search was conducted based on the reference list of selected studies and relevant reviews to identify studies that were not indexed in the above databases.

International *Journal of Prosthodontics* and Restorative Dentistry, Journal of Prosthetic Dentistry, The International *Journal of Prosthodontics*, The Journal of Indian Prosthodontic Society, Journal of Dentistry, Journal of Dental Research, Clinical Implant Dentistry and Related Research, International Journal of Oral and Maxillofacial Implants, International Journal of Oral and Maxillofacial Surgery- Identified related articles by searching for existing reviews and study designs.

STUDY SELECTION

The focused question formulated based on PICOS criteria was: 'Is the use of mini-implants feasible for prosthetic rehabilitation with overdenture prosthesis?'

STUDIES TO BE INCLUDED AS PER FORMAL SCREENING

1. Studies conducted from year 2015 till 2024.
2. Studies with-

a) Flap/flapless placement of implants
b) Mini-implants retained overdenture in maxilla
c) Mini-implants retained overdenture in mandible
d) Mini-implants retained overdenture in both maxilla and mandible
e) Clinical human studies, RCTs or prospective studies

3. Studies published in English language.

STUDIES TO BE EXCLUDED AS PER FORMAL SCREENING

1. Unpublished studies, in vitro studies, animal studies, retrospective studies, biomechanical studies, case reports, case series, abstracts, textbooks, narrative reviews and expert opinions.
2. Studies in language other than English.
3. Studies with adjunct surgical procedures with implant placement e.g. bone grafting
4. Studies with overdenture retained via other means.
5. Studies with fixed partial dentures.
6. Studies with conventional dentures.
7. Studies not meeting the inclusion criteria.

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ELIGIBILITY

The full texts of selected studies were acquired and the reference lists of all the primary articles were screened for any additional relevant studies. All the full text articles were analyzed for final eligibility in the systematic review.

DATA EXTRACTION /DATA COLLECTION PROCESS

Two review authors (RT, JG) independently read and judge all titles and abstracts. In case of discrepancy third author (SC) was consulted.

For studies meeting the inclusion criteria, full text articles were obtained and further evaluated.

The search also involved exploring other sources of evidence such as unpublished studies, PG/PhD theses and dissertations from gray literature. In order to be able to perform the systematic review, all reported study results were transformed in standardized extraction form.

Key data was extracted and compiled in tables, and the quality of the selected articles was assessed, according to predetermined criteria for methodology and performance. The criteria of the Cochrane handbook for interventions were used, and the risk of bias was graded as low, some concerns, or high. Quality of evidence were graded according to the GRADE (Grading of Recommendations Assessment, Development and Evaluation) system.

3. Results

Literature Search

A comprehensive search from multiple databases resulted in 511 articles. Articles of relevance were identified and duplicates were removed. 127 articles were selected after screening the title and abstracts. 23 articles were excluded due to absence of text in English language.

83 articles were then excluded after thorough reading. 7 articles were excluded due to lack of adequate data. **14** publications fulfilled the criteria of the present Systematic Review.

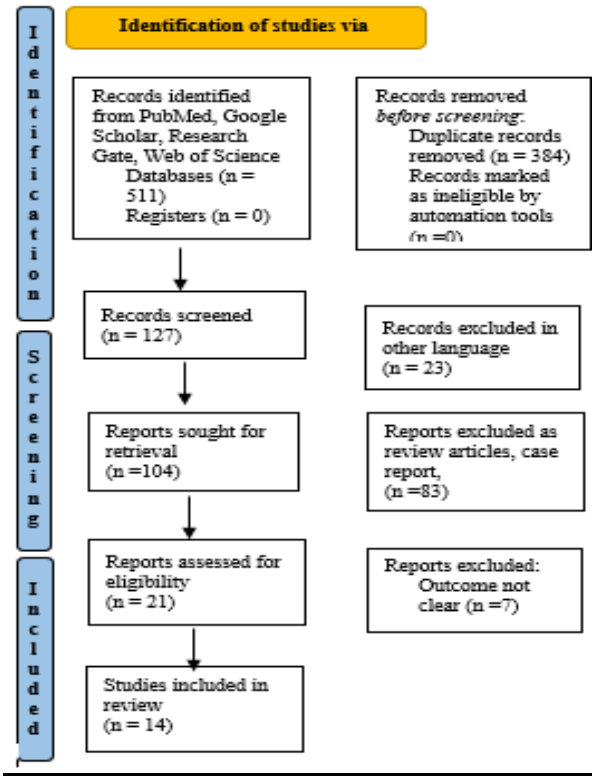

Figure1: Prisma Flow Chart for Study Selection Process[43]

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Description of the studies

The characteristics of the 14 included studies[12,14-26] in this systematic review are given in the results of the individual studies and described in **Table 1, Table 2**. The participants included were completely edentulous with implant supported overdenture in maxillary and or mandibular arches. All the 14 included trials, were RCTs, clinical human studies and prospective studies. Total 1431 mini-implants were placed in 630 patients.

Table No 1- Characteristics of Included Studies

Sr no	Author /Year	Study Design	Patients n	Mini implant n	Mean age, years	Diameter/ length	Arch (maxilla/ mandible)	Range of follow up	Groups evaluated
1	F G Mangano et al (2015)	Prospective study	62	231 MI	71.1	≥2.7×10mm	Mandible	1-4 years	G-3-4 MI
2.	A Catalan et al (2015)	Prospective study	7	14 MI	62-74 years	1.8×13-15mm	Mandible	7 years	G- 2 MI
3.	W Aunmeungtong et al (2016)	Randomized control trial	60	120 MI		G1- 3×12mm G2- 3×12mm G3- 3.75×10mm	Mandible	1 year	G1- 4 MI G2- 2 MI G3- 2 SI
4.	Hasan et al (2016)	Prospective study	26	70 MI	68±11	MI- 1.8-2.4 mm× 13-15 mmSI- 3.3-3.7 mm× 11-13 mm	Mandible	12 months	G1- 2-4 SI G2-4-5 MI
5.	S Persic et al	Prospective study	122	200 MI	63.62±9.6 years	MI- SI- 3.75/4.5mm diameter	Mandible	3 years	G1- 200MI G2- 112 SI G2-32 SI
6.	S temizel et al (2016)	Prospective study	32	99 MI		MI- diameter: 1.8-2.4 mm; length: 13-15 mm SI- diameter:	Mandible	2 years	G1- 4-5 G2- 2-4 SI

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						3.3-3.7 mm; length: 11-13 mm			
7.	K Zygogiannis (2016)	RCT	10	40MI	Not mentioned	1.8mm× 10mm	Mandible	18 months	
8.	S Jawad et al (2017)	RCT	46	.40 MI	Not mentioned	2.1 mm diameter 10 mm length	Mandible	6 months	G1- 2 G2-2
9.	I Kovacic et al (2019)	RCT	63	28	Not mentioned	MI- 6 or 8 mm long, 2 or 2.5 mm wide SI- 10–14 mm long, 2 or 2.5 mm wide	Mandible	1 year	G1- G2
10.	AJ Schuster et al (2021)	RCT	21	42 MI	67.7 years	2.9×10 mm	Mandible	6 months	G-2
11.	O A Gaballa et al (2021)	RCT	36	36 MI	Not mentioned	2.5mm diameter and 10 mm length	Mandible	12 months	G1- 2 G2- 2
12.	D El Azab et al (2021)	RCT	14	28 MI	50-65 years	2.5mm diameter and 10 mm length	Mandible	12 months	G1-2 G2-2
13.	A Celebic et al (2023)	RCT	83	291 MI		2.0 or 2.5 mm wide and 10–14 mm long	Mandible	5 years	G1-4 MI G2-3 MI
14.	A Scarano et al (2024)	Prospective stydy	48	192 MI	No mentioned	2.7× 10-13mm	Mandible	12-16 years	G-4 MI

Table No 2- Qualitative Characteristics of Included Studies

Sr no	**Author /Year /State / Country**	**Retention System**	**Surgical Technique**	**Complications**	**Survival rates of mini-implants n**	**Over Denture Fracture**	**Parameters evaluated**	**Outcomes**

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1	F G Mangano et al (2015)	Ball	Full thickness lap	Hyperplastic mucositis Peri-implant infection Teeth fracture Replacement caps, Relining prostheses	MI- 1 failed (98.2 %)	2 failed	Implant failure, peri implant marginal bone loss, complication	After 4 years of loading, six implants failed, giving an overall cumulative survival rate of 96.9%. The mean distance between the implant shoulder and the first visible bone-to-implant contact was 0.38 – 0.25 and 0.62 – 0.20 mm at the 1- and 4-year follow-up examinations, respectively. An incidence of 6.0% of biologic complications was reported; prosthetic complications were more frequent (12.9%).
2.	A Catalan et al (2015)	Ball	Flapless	NR	0 failed (100 %)	0 failed	Patient satisfaction Retention Peri-implant mucosa	Patient satisfaction was significantly improved, and reported improvements in chewing, aesthetics, ability to socialize, and comfort levels. Retention without MI: (mean: 0.49 N) Retention with MI after 7 years: (mean: 6.21 N) Mucosa and peri-implant bone showed no pathological changes.
3.	W Aunmeungtong et al (2016)	Equator cap attachment, o-ring ball	Experimental-Flapless, control-full thickness flap	Attachment loosening, denture fracture	0 fracture	Fracture- 6 in Group 1 and 2, 13 in group 3	Success rate and clinical implant performance scale.marginal bone level	verall patient satisfaction with the overdenture was high, (score > 60). The average patient satisfaction in Groups 1, 2, and 3 were 67.83 6 5.26, 70.88 6 4.12, and 60.85 6 8.54, respectively. There were no significant differences in patient satisfaction between Groups 1 and 2. However, patient satisfaction in these two groups was statistically higher than Group 3 ($p < 0.05$).
4.	Hasan et al (2016)	Ball/ rubber ring attachments	Randomized control trial	NR	NR	NR	Maximum bite force	Biting forces improved with overdenture supported by conventional or mini-implants MI: 81 N–138 N/SI: 167 N–235 N No significant difference was obtained between the MI and SI.

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5.	S Persic et al	Ball, Locator and bar	NR	NR	NR	NR	Oral hearth related quality of life	The MI used to retain overdenture showed better OHRQoL than bar and locator with standard implants.
6.	S temizel et al (2016)	Ball	Full thickness flap	No surgical or prosthodontic complications	MI; 0 failed (100 %). SI- 1 failed (97.1 %)	0 failed	Bone density, Probing depth, Implant stability	MI had clinical outcomes similar SI to support overdenture prostheses. MI: 1250 HU/SI: 1100 HU ($p = 0.035$) MI: 1.2 mm/SI: 1.8 mm ($p < 0.001$) MI: ——— 0.3 and ——— 1.4/SI: ——— 4.0 and ——— 4.9 ($p < 0.001$)
7.	K Zygogiannis (2016)	Ball	Full thickness flap	NR	0 failed (100 %)	NR	Marginal bone loss. OHIP-20 Visual analogue scale	1.04 mm (Mesial/Distal) The patients expressed a high level of satisfaction and oral health–related quality of life with this treatment modality
8.	S Jawad et al (2017)	Ball	Flapless	CI- pain, infection	0 fracture	0 fracture	OHIP-20, VAS,	t he pilot study successfully recruited, randomized, and retained edentulous elderly patients for an implant trial, meeting targets with acceptable retention rates. Although the numerous questionnaires were burdensome, they provided useful feedback for future trials. The chewing test was inconsistent and time-consuming. The implant failure rate was low (1/46). Repeated data collection on indirect costs was deemed unnecessary due to minimal changes between visits. 4o
9.	I Kovacic et al (2019)	Lingual bar, o-ring	Flapless	NR	NR	NR	Modified plaque index, Modified bleeding index,	The Short MDI group had mean marginal bone loss (MBL) of 0.26 ± 0.35 mm, 6.4% of failure, and 92.6% of, both, success and survival rates. The Standard-MDI

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							Marginal bone loss	group had mean MBL of 0.34 ± 0.40 mm, 5% of failure, 95% of survival, and 94.3% success. There were no significant differences in MBL (p = .420), survival (p = .414), and success (p = .571) between the groups. The Short MDI group had significantly less plaque (p = .001) and bleeding on probing (p < .001)
10.	AJ Schuster et al (2021)	Stud and locator	Full thickness flap	NR	0 fracture	0 fracture	Implant stability quotient, Probing depth,	The study evaluated the effects of ridge regularization on dental implant outcomes, finding that it significantly enhanced implant stability (with higher ISQ values on Days 7 and 15, but lower on Day 180), reduced probing depth on Days 60 and 180, and decreased inflammatory markers (TNF-a and IL-1b) at specific intervals. Notably, ISQ and probing depth changes were associated with TNF-a and IL-1b levels, and clinical outcomes correlated with bone type, duration of edentulism, and mandibular bone atrophy. The implant survival rate was markedly higher in the ridge regularization group (100%) compared to the nonridge group (67%). Overall, ridge regularization improved implant stability, reduced inflammation, and led to better clinical outcomes.
11.	O A Gaballa et al (2021)	Ball	Full thickness flap	NR	0 fracture	0 fracture	Visual analogue scale, Changes in bone height	The mean ± SD of overall satisfaction was higher in the treatment than the control group with statistically significant difference [t (18) = 6.2, p = 0.00] at baseline, 6 [t(18) = 5.2, p = 0.00] and 12

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								months [t(18) = 4.04, p = 0.00] follow-up.
12.	D El Azab et al (2021)	Bar	Full thickness flap	NR	NR	NR	Bone level in different occlusion	In case of splinted mini-implants retaining mandibular overdenture, type of occlusion has no effect on the supporting structures.
13.	A Celebic et al (2023)	Ball	Flapless/ open flap	loosening	0fracture (100 %)	0 fracture	Marginal bone level, Success and survival rates	Repeated measures showed that the mean peri-implant bone loss increased progressively at a small amount over five years in both groups (four-MDI group = −0.36 ± 0.74; three-MDI group = −0.33 ± 0.27 mm; p < 0.05). However, an ANCOVA revealed no significant effects of the group (no significant difference between the threeand the four-MDI groups; F = 0.085; p = 0.771), gender (F = 0.023; p = 0.88), or covariate age (F = 1.95; p = 0.167) on the dependent variable: the 5-year MBL change. The success rate (together with successful survival) was 93.8% in the four-MDI group and 91.7% in the three-MDI group. The log-rank (Mantel–Cox) test revealed no significant differences between them (X 2 = 0.373; p = 0.541).
14.	A Scarano et al (2024)	O ring	Flapless	Denture fracture, Implant fracture, mobility	5 fractures	12 fractures	Patient satisfaction,	The most remarkable improvements in patient-reported satisfaction were seen in retention, which increased from 2.23 ± 0.42 preoperatively to 8.60 ± 0.49 postoperatively, chewing ability, which increased from 2.79 ± 0.54 preoperatively to 9.00 ± 0.58 postoperatively. comfortability and speaking ability improved from 3.25 ±

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								0.64 and 3.50 ± 1.01 to 9.29 ± 0.46 and 8.00 ± 0.41, respectively

Risks of bias within the studies

Quality assessment was performed including the following aspects: Randomization process, allocation concealment, blinding of participants and personnel, blinding of outcome, incomplete outcome data, selective reporting and other bias. If all criteria met, the study was considered as low risk of bias. If 2 or more criteria were not met the study was classified as high risk of bias.

The assessment of each table was summarised in **Figure 2.** Risk of bias for individual studies is described in **Table 3**. Among the 14 studies judged 2 studies[17,20] showed some concerns . 7 studies[12,14,16,18,22,24,26] were at low risk and 5 studies[15,19,21,23,25] are considered at high risk of bias

Figure 2: Traffic Light Plot for Determining Risk of Bias

+/green color: low risk of bias; ?/yellow color: some concerns;

−/red color: high risk of bias

Table No 3: Risk Of Bias for Individual Studies

Sr No.	Author / year	Potential risk of bias
1.	F G Mangano et al 2015	**Low**
2.	A Catalan et al 2015	**Some concerns**

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3.	W Aunmeungtong et al 2016	**High**
4.	I.Hasan 2016	**High**
5.	S Persic et al 2016	**Low**
6.	S Temizel et al 2016	**Some concerns**
7.	K Zygogiannis et al 2016	**Low**
8.	S Jawad et al 2017	**High**
9.	I Kovacic et al 2019	**Low**
10.	A J Schuster et al 2021	**Low**
11.	O A Gaballa et al 2021	**Low**
12.	D Azab et al 2021	**High**
13.	A Celebic et al 2023	**Low**
14.	A Scarano et al 2024	**High**

Quality Assessment of the Studies

Study quality varied considerably, and out of a total possible QATSDD score of 42, scores for the individual studies ranged from 19 to 40. The average score was 26.5 (4.8). **Table 4** shows the mean score for each of the 14 criteria of the quality assessment. A mean score of 0 indicates none of the papers met any of the components of the criteria, with a total possible score of 3 indicating all the papers fully met the criteria.

Table No 8: Quality Assessment of the Studies

Quality Criteria	Mean Score (SD, Range)
Evidence of user involvement in design	0.8 (0.2, 0-2)
Explicit theoretical framework	0.8 (0.2, 0-2)
Evidence of sample size considered in terms of analysis	2.1 (1.4, 0-3)
Statistical assessment of reliability and validity of measurement tools	1.8 (0.9, 1-3)
Strength and limitations critically discussed	1.3 (0.8, 0-3)
Good justification for method of analysis	2.3 (1.4, 0-3)
Clear description of research setting	2.0 (1.7, 1-3)
Description of procedure for data collection	1.9 (1.3, 1-3)
Statement of aims/objectives in body of report	2.2 (1.4, 1-3)
Detailed recruitment data	2.3 (1.6, 1-3)
Representative sample of reasonable size	2.1 (0.9, 1-3)
Rationale for choice of data collection tool	2.0 (1.1, 1-3)
Fit between research question and method of analyis	2.5 (1.2, 1-3)
Fit between research question and method of data analysis	2.3 (1.2, 1-3)

Some quality criteria were well addressed by the included studies, in particular the fit between the research question and method of data collection and analysis. None of the included papers had, however, evidence of user involvement in the design, and there was a lack of explicit theoretical framework underpinning the majority of the studies. Two other areas less well addressed were

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the approaches taken to estimate the sample size and assessment of reliability and validity of the measurement tools used. For the quality assessment, there was overall agreement between independent reviewers of 247 of 280 (88.2 %) of quality criteria scores. Because quality assessment was, however, an ordered variable, a weighted kappa was also carried out to establish relative concordance between reviewers. It was assumed that the differences between individual quality scores were equal. The inter-rater agreement (kappa with linear weighting) was 0.78 (95% CI, 0.65–0.93) indicating good agreement.

4. Discussion

Edentulous individuals with compromised alveolar ridges commonly experience challenges with denture retention and stability. Therefore, employing an implant-retained overdenture is recognized as a viable and effective treatment approach particularly in the mandibular ridge. [18]

Consequently, implants enhance stability, retention, chewing efficiency, and overall patient satisfaction. Several factors, including bone width, quality, the patient's systemic health, and their acceptance of surgery, influence the choice of implant type. For example, conventional implants provide significant retention and stability but require adequate bone width and may not be suitable for thin alveolar ridges without ridge management.[22]

Alternatively, mini-implants offer the advantage of immediate placement using a flapless approach, eliminating the need for ridge management.[22]

The initial hypothesis has been confirmed with high reported survival rates (92.32%) for mini implants, which are comparable to those observed with conventional implants for retaining overdenture.[24]

However, overdentures in the maxilla exhibited higher failure rates (31.71%) compared to the mandible (4.89%), highlighting the importance of considering these differences during treatment planning. The maxillary arch typically presents lower bone density and thicker masticatory mucosa often necessitating longer implant abutments which increases the lever arm length and can affect implant stability, leading to an increased risk of failures. [27,28]

The type of overdenture prosthesis also influences the survival rates of mini-implants, as full palatal coverage demonstrated lower failure rates (21.6%) compared to partial palatal coverage [29] (46.2%). Additional support provided by palatal coverage, distributes stress more effectively between the implants and the adjacent soft tissue support areas [31].

Mini-implants typically require a minimum length of 11.5 mm for successful placement. Due to their small diameter, it is advisable to place the longest feasible implant to maximize the bone surface area and minimize the force per square millimetre exerted on the bone under load. According to Tomasi et al. [31], MDIs with shorter lengths (7–10 mm) have shown a higher failure rate compared to longer MDIs (14 mm).

Although overall survival rates for implants are generally favourable, two studies [13, 38] specifically compared mini-implants with standard implants. Temizel et al. [36] found no failures with mini-implants, whereas one standard implant failed. In contrast, Souza et al. [13] reported lower survival rates for mini-implants (85.5%) compared to conventional implants (99%). This discrepancy may be influenced by biomechanical factors, particularly implant length. [29] In Souza et al.'s study, the mini-implants length was 10 mm, whereas others have utilized mini-implants ranging from 12 to 18 mm in length.

Causes of MDI failure includes inadequate bone density, torque exceeding 60 N cm (which can result in pressure necrosis or implant failure), insufficient implants, and non-parallel placement exceeding 20 degrees. The majority of failures typically occur within first six months post-implantation.[10] Most studies reviewed utilized four MDIs for retaining mandibular overdentures, with two studies using two MDIs and one study employing both two and four MDIs. A comparative assessment within the same study [43] indicated higher rates of prosthetic complications with two MDIs (n = 64) compared to four MDIs (n = 52). Therefore, the use of four MDIs is recommended for retaining mandibular overdentures.

Hasan et al. evaluated changes in biting forces among edentulous patients wearing complete dentures before and after receiving implant-supported overdentures. The study also compared differences in biting force changes between conventional implants and mini-implants. The

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results indicated that both conventional and mini implant-supported overdentures led to significant improvements in biting forces for the participants.[15]

Celebic et al, evaluated the success of three MDIs compared to four MDIs for retaining mandibular overdentures. The 5-year findings revealed minimal rates of peri-implant bone loss in both groups, with no significant difference observed. Success and survival rates did not differ and were deemed satisfactory in both cohorts, confirming the study hypothesis. In contrast, a shorter-term study indicated that both two and four MDIs resulted in improved oral health-related quality of life (OHRQoL) compared to two standard implants. However, the costs were lowest for the options involving two MDIs.[44]

Younger patients typically exert higher occlusal forces and chew more vigorously. Implants, lack proprioception and may not fully accommodate these forces, explaining a slightly negative correlation (though not statistically significant) between age and marginal bone loss. In terms of maintenance for patients with three or four MDIs, no denture base fractures were recorded during the 5-year follow-up due to reinforcement with a Co-Cr metal framework in all dentures. Most "O"-ring replacements were necessitated by calculus formation or wear, with only a few becoming dislodged from metal housings. Despite the manufacturer's recommendation for annual replacement, only a small number of "O"-rings required changing after one year. Notably, a slightly higher number of "O"-rings needed replacement in the three-MDI group. All "O"-rings were eventually replaced after five years, aligning with similar studies.[44]

Significant improvements in quality of life and patient satisfaction have been consistently reported, contributing significantly to enhanced social well-being. Mini implants have been associated with either superior or comparable Oral Health-Related Quality of Life (OHRQoL) scores compared to standard implants. This difference may be attributed to differences in retention systems, as nylon matrices used with standard implants are more prone to wear than the O-rings used with mini-implants.[26]

The limitation of present systematic review is that despite the significant increase in the number of studies assessing the behaviour of mini-implants for retaining overdentures there is a fewer number of RCTs. Additionally, the difficulty of blinding of participants, personnel and outcome assessors can be considered as bias. Thus, these results should be interpreted with caution due to reduced number of RCTs, and further RCTs should be performed to better answer in terms of rehabilitation with overdentures supported by mini-implants. Even so, the use of MDIs to retain overdenture demonstrates viability, adequate survival rates, reduced marginal bone loss and good patient satisfaction; it may therefore be representing a viable clinical indication for appropriate cases, especially in situations where it is not possible to rehabilitate the patient with standard implants.

5. Conclusion

The present systematic review suggests that within the scope of this study, mini-implants for retaining overdenture prostheses can be considered a viable alternative treatment. This conclusion is based on the high survival rates of the mini-implants, acceptable levels of marginal bone loss, and notable improvements in patient satisfaction and quality of life. However, these conclusions were based on weak evidence due to the limited number of Randomized controlled trail studies.

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