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Mini dental implant overdenture as an alternative treatment (systematic review)

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Abstract

Background: Patients with narrow alveolar ridges requiring dental implants may be managed by residual ridge augmentation or guided bone regeneration procedures followed by the placement of conventional diameter implants. All these procedures need more time, more cost, and more clinician experience. Mini implants are an alternative option in case of the reduced residual alveolar ridge. Aim: The aim of this study was to evaluate the crestal bone changes, survival rates, and patient satisfaction with mini dental implant. Methodology: An electronic searching was performed in the following databases, Pubmed (1990 to 25 October 2016) and Cochran (1999 to 2016). In addition, hand searching was performed in implant-related journals and through the references of included studies. Result: Four articles resulted after the final filtration, from which three studies were randomized controlled trials and one non-randomized controlled trial. The follow-up period was extended at least 1 year in all studies. The results of the included studies reveal that the marginal bone loss, survival rate, and patient satisfaction of the mini implant were comparable to those resulting from the conventional implants. Conclusion: No significant difference was observed between the mini implant and the conventional implants regarding the marginal bone loss, implant survival rate, and patient satisfaction. However, this review depends on few numbers of studies that accompanied with a high degree of bias, so more evidence to validate this treatment is still necessary. Clinical Significance: The flapless technique of the small implant diameter offers the advantage of less invasion and less trauma to the tissue. Furthermore, the mini implants approach makes promise solution for those patients with medical and/or financial problems to use conventional implants so that they increase the clinical applications of dental implants.

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SYSTEMATIC REVIEW

Mini dental implant overdenture as an alternative treatment (systematic review)

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Keywords
Mandible, marginal bone loss, mini implant, overdenture, survival rate

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Abstract

Background: Patients with narrow alveolar ridges requiring dental implants may be managed by residual ridge augmentation or guided bone regeneration procedures followed by the placement of conventional diameter implants. All these procedures need more time, more cost, and more clinician experience. Mini implants are an alternative option in case of the reduced residual alveolar ridge.

Aim: The aim of this study was to evaluate the crestal bone changes, survival rates, and patient satisfaction with mini dental implant.

Methodology: An electronic searching was performed in the following databases, Pubmed (1990 to 25 October 2016) and Cochran (1999 to 2016). In addition, hand searching was performed in implant-related journals and through the references of included studies.

Result: Four articles resulted after the final filtration, from which three studies were randomized controlled trials and one non-randomized controlled trial. The follow-up period was extended at least 1 year in all studies. The results of the included studies reveal that the marginal bone loss, survival rate, and patient satisfaction of the mini implant were comparable to those resulting from the conventional implants.

Conclusion: No significant difference was observed between the mini implant and the conventional implants regarding the marginal bone loss, implant survival rate, and patient satisfaction. However, this review depends on few numbers of studies that accompanied with a high degree of bias, so more evidence to validate this treatment is still necessary.

Clinical Significance: The flapless technique of the small implant diameter offers the advantage of less invasion and less trauma to the tissue. Furthermore, the mini implants approach makes promise solution for those patients with medical and/or financial problems to use conventional implants so that they increase the clinical applications of dental implants.

Introduction

Usually after teeth loss, alveolar bone continues to resorb that leads to lack of stability and retention, especially of the lower denture, which in turn causes lack of self-confidence and reduction in chewing efficiency.[1-3] Dental rehabilitation of completely edentulous patients with traditional removable prosthesis creates functional and psychological problems for the patients because of the frequent instability of the prosthesis.[4]

Many patients are dissatisfied with their conventional dentures due to functional disability, pain, psychological discomfort, retention, stability, esthetics, and speech discomfort with denture.[5] Patients who received implant-supported overdentures showed increased satisfaction and chewing ability, more self-confidence compared to those with a complete denture. However, dental implants require adequate bone dimensions for their stability. If the available bone is insufficient, further surgical processes such as bone grafting are required.[6]

Patients with narrow alveolar ridges requiring dental implants may be managed by residual ridge augmentation or guided bone regeneration procedures followed by the placement of conventional diameter implants. All these procedures need more time, more cost, and more clinician

experience.[7] Mini implants are an alternative option in case of reduced residual alveolar ridge. Their reduced diameter <3 mm allow for easy and safe insertion in narrow ridges. Moreover, the mini implant technique is simpler and faster, and it is often done with flapless.[7,8]

Mini implant was first introduced in 1994 to support an interim prosthesis, and on implant removal, it was noted that removal of these implants from the bone was difficult because it osseointegrated within the bone.[10-12]

Mini implants loading can delay after 3 months from implant placement, or it can be loaded immediately within the atrophic bone according to the amount of the primary stability, the insertion torque should be at least 30 Ncm.[13] The minimum number of mini implants required for retaining complete removable dentures may be 6 in the maxilla and 4 in the mandible. The implants should be parallel to each other, and the degree of malalignment should not exceed 20° to allow ease denture seating.[13-15]

Some clinical reports have claimed that mini implant used for retaining mandibular dentures are successful.[16,17] Some other studies recorded the survival rate of mini implant-supported mandibular complete dentures is in the range of 81-97.4%.[14,18] However, scientific evidence regarding clinical outcomes of the mini dental implants (MDI) retained overdentures is relatively limited in the literature.[19,20]

The aim of this study was to evaluate the crestal bone changes, survival rates, and patient satisfaction with mini dental implant.

Selection criteria

The literature review and data extraction were performed by the two authors.

The inclusion criteria for the article were selected, and any disagreement between the authors was discussed.

The following inclusion criteria were included in the study:

1. Randomized controlled studied and cohort studies
2. Mini implant in mandible diameter <3.5 mm
3. English-language publication
4. Only mandibular edentulous ridge.

However, the following exclusion criteria were excluded from the study:

1. Case reports, reviews, and non-clinical studies
2. Finite element analysis studies
3. Maxillary mini implant
4. Explanation of technique or manual
5. Animal studies
6. Small-diameter implants that were not meant for permanent use.

The electronic search was done through 3 steps. At step 1, articles titles were screened from the 2 electronic databases, each investigator independently analyzed relevant titles regarding the selected inclusion criteria, and any disagreement was discussed by the 2 authors. At step 2, both authors separately screened the abstracts of all selected titles. Again, any disagreement was discussed by the 2 authors. At step 3, the investigators studied all full-text articles that were included. Selection of the article was based on the inclusion

Methodology

This systematic review was developed according to the PRISMA, and it was formulated using (PICO), participant, intervention, comparison, and outcome (1) Participant: Completely edentulous patient. (2) Intervention: Mini implant-supported mandibular overdenture. (3) Comparison: Other implant alternative treatment. (4) Outcome: Implant survival, peri-implant bone change, and patient satisfaction.

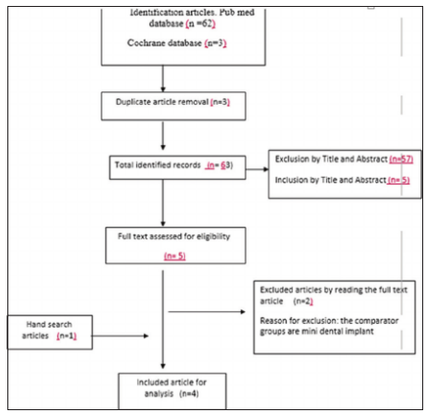
The focused question was "in the completely edentulous patient." Can the mini implants-supported overdenture serve as a good alternative treatment, regarding implant survival, peri-implant bone change, and patient satisfaction?

Electronic searching was performed in the following databases: (1) PubMed (1990 to 25 October 2016) and (2) Cochran (1999 to 2016). The following search terms were in combination, mini implant, mandible, and overdenture.

Hand searching of the years from 1999 to 2016 was done from the following journals: Clinical Implant Dentistry and Related Research, Clinical Oral Implants Research, Implant Dentistry, International Journal of Oral and Maxillofacial Implants, International Journal of Periodontics and Restorative Dentistry, International Journal of Prosthodontics, Journal of Oral Implantology, Journal of Oral Rehabilitation, and Journal of Prosthetic Dentistry. Bibliographies of selected articles were further searched for potentially relevant articles. The study selection procedure was shown in Graph 1.

and exclusion criteria that were applied and the validity of the methodology, and then, the qualitative and quantitative data were extracted.

A data extraction form was developed to collect general information (title, year of publication, and number of implants



Graph 1: Search strategy

used, implant system, implant length and diameter, outcome variable, and follow-up period) [Tables 1-4].

Results

The final electronic search on databases revealed 62 records. After removal of duplicates, 5 articles remained, and the hand searching revealed one additional studies. Two articles were excluded after full-text screening because the comparator groups were mini dental implant. The total number of included article were 4 articles, 3 were a randomized controlled[9,21,22] and one non-randomized controlled.[18] Details about the search strategy are shown in Graphs 2 and 3.

Description of studies

The included studies were four studies. In a non-randomized prospective study,[18] the number of the participants were 22, and they were divided into 2 groups, the study group including 99 implants received 4-5 MDI with diameter 1.8-2.4 mm and length 13-15 mm, the control group were 10 participants including 35 implants received 2-4 conventional dental implants with diameter 3.3-3.7 mm and length: 11-13 mm, the outcome of the study was the assessment of bone density around the implant from computed tomography data, and patients were followed for 2 years. The study out was examined 3, 6, 12, and 24 months after implant placement. This study showed that mini implant survival was 90%.

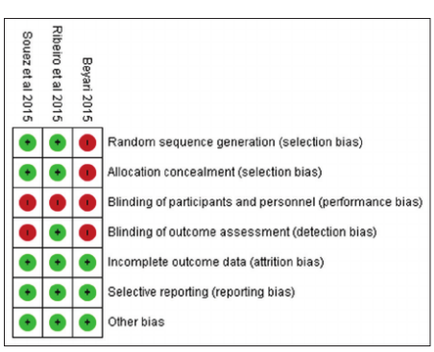
Souza *et al.* (2015)[9] carried out a randomized control study. The randomization (ratio: 1:1:1) was based on computer-generated numbers enclosed in sealed, opaque envelopes. The number of the participants were 120, and they were divided into three groups, compared mandibular overdentures retained by 2 or 4 mini implants with standard implants. The follow-up study was 1 year. Complications such as lost implant were assessed after 3, 6, and 12 months from implant placement. The survival rate of mini implants is not as high as that of standard implants. However, patient satisfaction evaluated by the Oral Health Impact Profile in edentulous adults after 12 months, the result indicating that the 2 or 4 mini implants in the mandibular arch resulted in slightly better oral health-related quality of life. The mean values for most patient satisfaction and masticatory ability in mini implants compared with standard implants items were also higher with 4 mini implants and regarding ease in speaking, comfort, and esthetics; all groups were doing a similar effect.

Ribeiro *et al.* (2015)[21] reported a randomized clinical trial. This study compared post-operative pain and discomfort following the insertion of mini implants and conventional implant for the retention of mandibular overdentures. A total of 120 patients divided into three groups, group 1: Four mini implants in the arch, total of 120 patients were divided into three groups, Group 1: Four mini implants in the arch, total number of implants were 152, Group II: Two mini implant, total number of implants were 84 and a flapless technique whenever possible and if not possible, a small pericrestal incision of approximately 3 mm was performed, and Group III: Two standard implants, total number of implants were 80, osteotomy was done with flap reflection. Seven days after implant insertion, patients answered questions (100 mm visual analog scales) for evaluation the patient satisfaction. It was concluded that that pain was at its highest level in 4 mini implant group, and the pain was moderate in 2 mini implant group, so pain is related to number of surgical sites, and it was reported that the easy of implant insertion and oral hygiene is better in 2 mini implants than the 2 conventional implant group.

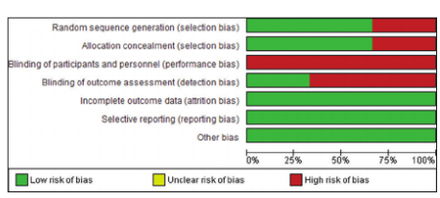
Beyari (2015)[22] compared mini dental implants, ball-type single piece implant, and screw-type tapered root-form implants for supporting complete overdenture. Fourteen completely edentulous patients divided into two groups to evaluate the bone density and bone height changes around the implants at 0, 6, and 12 months after loading. The result proved that there was no significant difference found between the two types of implants.

Data analysis

No statistical analysis of data was performed because of the divergence of the study designs outcomes.



Graph 2: Risk of bias summary: Judgments about each risk of bias item for each included study



Graph 3: Risk of bias graph: Judgments about each risk of bias item presented as percentages across all included studies

Table 1: Temizel *et al.* 2016[18]

Study design	Non-randomized clinical trial
Follow-up	2 year
Age	Not clear
Participant number	Total number=32 Study group=22 Control=99
Implants number	Study group=99 Control=35
Implant company	Mini implant (3M, ESPE), conventional implant (Dentarum implant Gmb)
Implant length×diameter	Study group (length 13/15, diameter 1.8-2.4) Control group (length 11/13, diameter 3.3-3.7)
Surgical technique	Flap
Loading time	Delayed loading
Implant failure	One conventional implant
Successes rate	90%
Bone changes	Study group (1250 HU) control group (1100 HU)
Patient satisfaction	N/A

Table 2: Souez *et al.* 2015[9]

Study design	Randomized clinical trial
Follow-up	1 year
Age	>45 year
Participant number	Total number=120 4 mini implant group=38 2 mini implant=42 2 standard implant=40
Implants number	4 mini implant group=152 2 mini implant=84 2 standard implant=80
Implant company	Mini implant (Mini-Drive Lock MDL; Intra-Lock International Inc.), conventional implant (Morse-Lock Straight 4.0 mm, Intra-Lock International Inc.)
Implant length×diameter	Mini implant group (length 10, diameter 2) Control group (length 10, diameter 4)
Surgical technique	Flap
Loading time	Delayed loading
Implant failure	4 mini implant group=10 and 6 implants lost before loading 2 mini implant group=9 and 6 failed before loading 2 standard implant=1
Successes rate	4 mini implant group=89% 2 mini implant=82% 2 standard implant=99%
Bone changes	N/A

Table 3: Ribeiro *et al.* 2015[21]

Study design	Randomized clinical trial
Follow-up	7 day
Age	59±8.5
Participant number	Total number=120 4 mini implant group=38 2 mini implant=42 2 standard implant=40
Implants number	4 mini implant group=152 2 mini implant=84 2 standard implant=80
Implant company	Mini implant (Mini-Drive Lock MDL; Intra-Lock International Inc), Conventional implant (Morse-Lock Straight 4.0 mm, Intra-Lock International Inc.)
Implant length×diameter	Mini implant group (length 10, diameter 2) Control group (length 10, diameter 4)
Surgical technique	Mini implant group=flapless technique whenever viable and if not possible, a small pericrestal incision of approximately 3 mm was performed Standard group=flap technique
Loading time	Delayed loading
Implant failure	N/A
Successes rate	N/A
Bone changes	N/A

Table 4: Beyari *et al.* 2015[22]

Study design	Randomized clinical trial
Follow-up	12 months
Age	52
Participant number	Total number=14 A group receives two screw type tapered root form implants=7 A group receives two ball single piece mini implants=7
Implants number	N/A
Implant company	Mini implant (Mini Implants, OsteoCare™ Implant System Ltd. Berkshire, UK), Conventional implant (Legacy, Spectra system, Implant Direct, U.S.A.)
Implant length×diameter	Mini implant group (diameter=2.8 mm, length=13) Control group (not mentioned)
Surgical technique	Flapless technique
Loading time	Delayed loading
Bone changes	Bone density percent change for group 1, group 2 was 0.17, 0.56 (P = 0.06) Bone height percent change for group 1, group 2 was − 9.79, −11.99 (P = 0.003) Mean bone height change for group 1, group 2 was 18.77, 18.02 (P = 0.9)

Peri implant bone changes

A randomized clinical trial by Bayen (2015) evaluated all patients radiographically at the time of loading (baseline), 6 months, and 12 months.[22] The result reveled that the bone density percent change for group 1 and group 2 was 0.17 and 0.56 (P = 0.06). Bone height percent change for group 1 and group 2 was −9.79 and −11.99 (P = 0.003). Mean bone height change for group 1 and group 2 was 18.77 and 18.02 (P = 0.9), respectively.

One non-randomized article, Temizel *et al.* (2016)[18] reported the bone density and bone height changes around mini implant in comparison to conventional implant after 2 years. A total number of 99 mini implants used with implant length equal 13-15 mm and implant diameter 1.8-2.4 mm, and a total of 35 conventional implants used with implant length equal 11/13 mm and implant diameter 3.3/3.7 mm. The mean Hounsfield (HU) value in the participants who received MDI was significantly (P = 0.035) higher (1250 HU) than that in the participants who received conventional dental implants (1100 HU). The measured bone height and cortical thickness showed no significant differences (P = 0.930 and P = 0.940, respectively).

Our search results in only one non-randomized clinical trial and 3 randomized clinical trials. There were little studies comparing mini implants with narrow diameter with standard dental implants for complete denture additionally. There were no much studies assess the perimini implant bone changes, and Temizel *et al.* (2016)[18] reported that there is a significant difference to the mini implant group (P = 0.035). The participants who had received MDI had higher HU values than those who received conventional dental implants. The measured bone height and cortical thickness showed no significant differences (P = 0.930 and P = 0.940, respectively).

The method of reporting mini implant follow-up in different studies was variable that did not allow for pooling the data for statistical analysis. Souza *et al.* (2015)[9] study follow-up was 1 year. Ribeiro *et al.* (2015)[21] recorded the patient satisfaction in a questioner after 7 days.

The quality assessment of the included trials was undertaken independently and in duplicate by two review authors as part of the data extraction process. Temizel *et al.* (2016)[18] follow-up was 2 years, the author said that it was non-randomized trial study because it is contraindicated to use standard size implant in a

Implant survival

Temizel *et al.* (2016)[18] reported that only one conventional implant lost after 18 months and no mini implant lost and the survival rates for mini dental implants and conventional dental implants were comparable 90%. While Souza *et al.* (2015)[9] reported that implant survival rate was 89%, 82%, and 99% for 4 mini implants group, 2 mini implants, or 2 standard implants group, respectively.

Patient satisfaction

Patient satisfactions for mini implant comparing with conventional implant were varied between the studies regarding the timing of recordings patient satisfaction and patient satisfaction item, a study record pain, discomfort after 1 year, and the other one record was after 7 days. Souez *et al.* (2015)[9] reported that after 12 months the mean values for most patient satisfaction and masticatory ability in mini implants compared with standard implants items were also higher with 4 mini implant, but they did not evaluate post-operative pain, while Robiero *et al.* (2015)[21] were concluding that that pain was at its highest level in 4 mini implant group 7-day post-operatively.

Discussion

The purpose of this systematic review was to know the available evidence on the mini dental implant, to evaluate the survival rate, crestal bone changes, and patient satisfaction in overdenture support by mini implants. The result of the search strategy from 1990 to 2016 reveals retrospectives studies and one-arm prospective studied which they are of low evidence according to a hierarchy level of evidence.[19]

narrow residual ridge without performing surgical modification. They reported that it was difficult to blind the surgeon, but the statistician was blind to minimize the bias.

According to Cochrane risk of bias assessment for randomization clinical trials, as shown in Graphs 2 and 3, the quality of the evidence was assessed. The randomization and sample size calculation, were adequate and allocation concealment was done in the two randomized control studies.[9,21] to reduce selection bias. Regarding blindness for the 2 included randomization, clinical trials[9,21] were unclear in contrast to the non-randomized study.[18]

Completeness of follow-up and dropout was not reported in Ribeiro *et al.* (2015),[21] but in Souza *et al.* (2015),[9] the number of the dropout and withdrawals in each treatment group was clear and intention-to-treat analysis was done to manage the dropout.

Beyari (2015)[22] is of low evidence due to unclear randomization and allocation concealment method, and he did not explained how he estimate the sample size. The majority of the study was setting an inclusion and exclusion criteria which is important to reduce selection bias. However, all the studies have small sample size which may affect on the final result.

The patient satisfaction result in the included studies could not be combined in one analysis due to variation in the follow-up time, follow-up items, and the surgical technique.

Depending on this systematic review, it is still difficult to draw strong evidence regarding the real effect of mini implant on peri implant bone change, implant survival, and patient satisfaction in comparison to conventional implant due to limited randomized trial and small studies sample size. Consequently, a well-designed randomized controlled trials with long follow-up periods still strongly recommended.

Conclusion

There was no significant difference between the mini implant and the conventional implants regarding the marginal bone loss, implant survival rate, and patient satisfaction. However, this review depends on few number of studies that accompanied with a high degree of bias, so more evidence to validate this treatment is still necessary.

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DENTAL IMPLANT PLACEMENT WITH FLAPLESS AND FLAPPED TECHNIQUE: A SYSTEMATIC REVIEW.

October 2018

Rojin asadollahi · Meysam Mohammadi khah · Niknaz Yahyazadehfar · [...] · zahra tehrani

ABSTRACT Aim: This study was aimed to systematically review and compare implant treatment outcome including success and survival rates, marginal bone loss and post-operative pain between flapped and flapless techniques of implant insertion. Material and Methods: An internet search was performed in PubMed and Cochrane Library in June 2018 using relevant keywords limited to human studies and ... [Show full abstract]

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A randomized controlled study comparing guided bone regeneration with connective tissue graft to re-...

August 2018 · Journal Of Clinical Periodontology

Thomas De Bruyckere · Célien Eeckhout · Aryan Eghbali · [...] · Jan Cosyn

Aim To compare guided bone regeneration (GBR) with connective tissue graft (CTG) to re-establish convexity at the buccal aspect of single implants. Materials and methods Patients with a single tooth gap in the anterior maxilla and horizontal alveolar defect were enrolled in a single-blind RCT. Sites had to demonstrate buccopalatal bone dimension of at least 6mm prior to surgery to ensure ... [Show full abstract]

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Comparison between flapless and open-flap implant placement: a systematic review and meta-analysis

April 2018 · International Journal of Oral and Maxillofacial Surgery

Cleidiel Aparecido Araujo Lemos · Fellippo Verri · Ronaldo Cruz · [...] · Eduardo Piza Pellizzer

No consensus has been reached regarding the influence of the flapless and open-flap surgical techniques on the placement of dental implants. This systematic review compared the effects of flapless implant placement and implant placement with elevation of the mucoperiosteal flap in terms of marginal bone loss, implant survival rate and complications rates. This review followed PRISMA guidelines ... [Show full abstract]

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Effect of guided bone regeneration on bone quality surrounding dental implants

August 2018 · Journal of Biomechanics

Trenton B. Johnson · Ben Siderits · Seth Nye · [...] · Do-Gyoon Kim

Bone quality as well as its quantity at the implant interface is responsible for determining stability of the implant system. The objective of this study is to examine the nanoindentation based elastic modulus (E) at different bone regions adjacent to titanium dental implants with guided bone regeneration (GBR) treated with DBM and BMP-2 during different post-implantation periods. Six adult male ... [Show full abstract]

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