

SINGLE IMPLANT RETAINED MANDIBULAR OVERDENTURE – A LITERATURE REVIEW

**Jamshid Usman^{1,*}, Shajahan², Rohit Raghavan³, Ranjith Kumar⁴,
Mohammed Ramzi⁵, Sowmya Balakrishnan⁶**

^{1,5,6}Post Graduate Student, ^{2,4}Professor, ³Professor & Head,
Department of Prosthodontics, Royal Dental College, Kerala.

***Corresponding Author:**

E-mail: jamshid.usman@gmail.com

ABSTRACT

Single implants retained over dentures have always been a debatable topic. This is a review article analysing various studies done on the efficacy of single implant retained over dentures. It enumerates research on the topic over a period of 25 years. Single implants retained over dentures have been found to be a cost effective yet efficient treatment option for patients.

INTRODUCTION

Loss of teeth is one of the major handicaps in elderly patients, compromising their chewing efficiency and thus the nutritional status. Due to the early preventive strategies and increasing awareness the prevalence of complete edentulism is declining worldwide especially in the developed countries. But in developing countries like India about 60-69% of population are estimated to be either partially or completely edentulous over their 25th birthday¹. In an epidemiological survey conducted in 2012, it was revealed that a total of 62% of a population was found to be completely edentulous of which, 30% in both arches, 19.2% in mandibular arch and 12.2% in maxillary arch².

Dentures have been a source of compensation for edentulism, since time unknown, but the function and retention of dentures have always been a challenge for the dentist especially in the mandibular arch. To overcome the limitations of the conventional denture, mandibular dentures retained by two or more implants were developed and used. Studies on mandibular dentures showed that dentures retained by two or more implants are more satisfactory than conventional dentures³⁻⁴. A strong consensus that at least two implants are required to retain mandibular complete dentures has been prevalent over the years⁵. International consensus has found that two implants in the inter foramina area should be the first choice for standard care for the edentulous patients⁶.

However, because of the treatment costs of this standard implant therapy⁷, many patients cannot afford treatment with multiple implants or are not willing to accept necessary bone augmentation procedures. Multiple clinical trials have shown that single median implant can retain a mandibular over denture well for up to 5 years⁸⁻¹¹ without the implant failing, when delayed loading was used¹². Furthermore, in a randomized clinical trial, which compared single or two implant retained mandibular

overdentures¹³ shown a satisfactory result when lowered the component cost and treatment time. The basis of this study is to provide an overall outcome of the treatment done in mandibular dentures supported by a single implant over those mandibular dentures supported by multiple implants.

MATERIALS AND METHODS

The literature on single implant retained mandibular over denture was found to be scarce. A search of the Pub Med on 'single implant over dentures' till March 2015 resulted in 205 references. After exclusion of publications lacking an abstract, not covering the topic with single implant retained mandibular over denture, or written in other languages than English, 22 references remained. Our references on single implant supported over denture extended from august 1997 to 6 February 2015. One of the study which was a randomised controlled trial is still ongoing and registered.

Among the 22 references, most references concentrated on a specific topic and their study was limited to that alone. The major topics of discussion and the number of references relating to them were as follows:

Topics	No. of Publications
Conventional denture Vs single implant supported over dentures	5
Single implant supported over denture Vs two implant supported over denture	5
Types of attachment	7
Immediate loading /early loading	3
Primary stability	1
Masticatory performance and crestal bone loss	2
Prosthetic maintenance	2
Study done by randomised controlled trial	4
Biomechanical behaviour	2

RESULTS

Due to the challenges faced in restoring an edentulous patient with conventional mandibular denture, or with expensive multiple implant supported over dentures, the clinical outcome of a single implant supported mandibular over denture has been investigated, discussed and studied for the past few decades in various aspects by various authors.

Atwood et al and Tallgren¹³ mentioned in their study that there is an annual reduction of 0.4mm of alveolar bone in the anterior mandible of edentulous patient due to various physiological changes. This resorption of the mandibular ridge might be the major cause for denture instability and retention problems in patients with conventional dentures. When implants were placed the resorption in the mandible was found to be as low as 0.5mm for over a period of 5 years, and the long term resorption may be 0.1mm annually¹⁴. Von Wowern and Gotfredsen¹⁵ stated that there happens to be a load-related positive bone remodelling in the anterior mandible due to the increase in function with implants and this appeared to be independent of the attachment system. These factors along with increased retention provided by various attachments of the implant might be the cause of success for implant supported over dentures in mandible, but the minimum number of implant required still remained a controversy. Compared to multiple implant supported over denture, the single implant supported are economical, less time consuming and minimally invasive. The results obtained and their reviews are discussed below.

Conventional denture Vs single implant supported over dentures

Cordioli G et al⁸ in 1997, conducted a five-year study which evaluated a treatment option by using a single implants over denture in the midline of the mandible of 21 geriatric patients according to the protocols of standard surgical technique in two stages. Improvement in oral comfort, function and health of the peri-implant soft tissues, and the marginal bone levels interproximally were evaluated for 5 years after over denture delivery. Results showed a remarkable improvement in comfort and function without any failures of the implants placed. In a clinical report by **Krennmair G et al**⁹ in 2001 nine patients with a mean age of 82.2 years underwent placement of a single symphyseal endosseous implant and anchorage of complete denture using ball attachments. Standardized recall examinations were carried out at intervals of 3-6-months for a period of 18 month. The anchorage with single implant led to the improvement of both patients' subjective satisfaction and reduction in reported discomforts.

Wolfart S et al¹⁶ in 2008 reported two clinical cases of a single implant in the middle of the mandible with ball attachment and with a screw activated matrix for the stability and retention of the prosthesis. The result showed improvement in the chewing ability and quality of life in old patients.

Single implant supported over denture Vs two implant supported over denture

Walton JN et al⁵ in 2009 conducted randomized clinical trial of 86 subjects using conventional complete dentures were given either one midline or two bilateral mandibular implants. Patient satisfaction was similar and the single-implant patients had the benefit of significantly lower component costs, reduced time of surgery, postsurgical maintenance and besides in the 2 implant group five implants had failed in four patients.

Liu J et al¹⁷ in 2013 conducted a study on the influence of number of implants on the biomechanical behaviour of mandibular implant-retained over dentures and concluded that, Single implant retained over dentures showed no damaging strain concentration in the bone surrounding the implant.

Grageda E et al¹⁸ in 2014 published a report that single implant retained over denture had an additional advantage which was less expensive and invasive compared to that of the over dentures supported by two implants.

Bryant SR et al¹⁹ in 2015 compared use of single or two implants for implant over dentures in a five year randomized clinical trial. It showed no significant difference in the satisfaction or survival of edentulous subjects.

Types of Attachment

Maeda Y et al²⁰ in 2008 conducted an in-vitro study using a magnetic and ball attachments. They concluded that single-implant over dentures with above mentioned attachments had similar biomechanical behaviour to that of two-implant retained over dentures in terms of the force transmitted to the abutment and the denture base.

Alsabeeha N et al²¹ in 2010 did an in vitro retention force investigation on different designs of attachment systems used for single-implant retained mandibular over dentures. Here, two ball attachments (prototype) of greater dimension and four commercially available attachments (ball and stud) of normal dimension were compared. They found that attachment systems of larger dimensions provided higher retentive forces for mandibular single implant over dentures.

Alsabeeha NH et al⁷ in 2011 submitted the results of a randomised-control trial on attachment systems. They concluded that a mandibular single-implant over denture is a successful treatment option for older edentulous patients.

Alsabeeha NH et al²¹ in 2010 did a study on the clinical performance and material properties of single-implant over denture attachment systems and concluded that large ball attachment systems reflected favourable wear behaviour and clinical performance.

Cheng T et al²² in 2012 conducted a study on patient satisfaction and masticatory efficiency of mandibular over dentures retained with single implant using the attachments(stud and magnets) and found that there were no statistically significant differences in overall patient satisfaction, speech, and retention between the above mentioned attachments.

Kono K et al²³ in 2014 conducted a study on in-vitro assessment of mandibular single/two implant over dentures using stress-breaking ball attachments and conventional ball attachment. Strain surrounding the implant, pressure at 5 different soft tissue areas, and displacement of the denture base were measured and found that the pressure at each region of the stress breaker ball attachment was less than that compared with the conventional ball and it also provided optimal stress distribution.

Nascimento JF et al²⁴ in 2015 conducted a study on the photo elastic stress distribution produced by different retention systems for a single-implant mandibular over denture in photo elastic model of a resilient edentulous ridge. They concluded that the load transmitted to the implant was equally distributed over the implant with low stress concentration.

Immediate loading /early loading

Liddelow GJ et al²⁵ in 2007 in his 36 month prospective study reported that immediately loaded single implant using an oxidized-surface modified implant and the existing denture can provide a better treatment which is less expensive.

Alsabeeha NH et al⁷ in 2011 submitted results of their study concluding that an immediate loading found to be successful treatment option for single implant over denture.

Primary Stability

Alsabeeha NH et al⁷ in 2011 concluded that the primary stability of the implants had no influence in the host site variables (age, gender, quality and quantity of bone).

Masticatory performance and crestal bone loss

Cordioli G et al⁸, in 1997 in his five-year prospective study on single implant mandibular over dentures showed that there is a mean marginal bone loss of 1.42 +/- 0.56 at 60 months period.

Grover M et al²⁶ in 2014 conducted a study related to the quality of life, masticatory performance and crestal bone loss with single implant, mandibular over dentures retained using magnet with

conventional and shortened dental arch shows least bone loss with the latter but more patient satisfaction was seen in former.

Prosthetic maintenance

Passia N et al³⁷ in 2014 conducted a six-year clinical outcome of mandibular over denture retained with single implant stated a limitation during treatment period was the loss of retention of the matrix followed by exchange of female component.

Bryant SR et al¹⁹, in his 5-year study to compare one or two implants for implant over dentures stated that most participants required a maintenance or occasional denture replacement during the study period, and there were no significant differences between the groups.

Randomised clinical trials

Walton JN et al⁵ in 2009 conducted a clinical trial and concluded that lower component cost and treatment times, with comparable satisfaction and maintenance time over the first year, indicating that a over denture in the mandibular arch retained by a single midline implant was an alternative to the customary two-implant over denture for maladaptive denture patients.

Alsabeeha NH et al⁷ submitted preliminary results of a randomised-control trial on early loading with different implant diameters and attachment systems on mandibular single implant over dentures in thirty six edentulous participants. Their study concluded that a mandibular single implant overdenture is the best treatment criteria for older edentulous adults.

Passia N et al¹¹ in their ongoing randomized controlled trial in 180 patients about a mandibular single dental implant retained dentures and its influence of the loading protocol aims to give information on the ability of a single median implant to retain a complete mandibular denture when immediately loaded. This treatment option will strongly improve everyday dental practice, if viable.

Bryant SR et al¹⁹ in their 5-year randomized trial to compared one or two implants for implant over dentures and found no differences in survival or satisfaction between these mandibular over dentures .

Biomechanical behaviour

Liu J et al¹⁷ conducted a three-dimensional finite element analysis on the influence of number of implant on the biomechanical behaviour of peri-implant bone, implants, abutments and over dentures and were recorded. They concluded that single implant retained mandibular over dentures do not show damaging strain concentration in the bone around the only implant and that it was a cost-effective treatment option for edentulous patients. The placement of a third implant between the original

two in patients rehabilitated by two-implant over dentures showed improvement in the constant and obvious denture rotation around the fulcrum line showed.

Maeda Y et al²⁰ conducted an in-vitro study and came to a conclusion that over dentures using single implant with dome-type magnet or ball attachments had biomechanical effects similar to the two-implant over dentures in terms of lateral forces transmitted to the abutment and denture base movements under molar functional loads.

DISCUSSION

When implants were placed the resorption in the mandible was found to be as low as 0.5mm for over a period of 5 years, and the long term resorption was 0.1mm annually. Various studies have found that single implant retained mandibular over dentures do not show damaging strain concentration in the bone around the only implant. The load transmitted to the implant gets equally distributed over the implant with low stress concentration. The main advantages are lower component cost and treatment times, with comparable satisfaction and maintenance time over the first year. In an ongoing randomized controlled trial on 180 patients, about mandibular single dental implant retained dentures and its influence of the loading protocol, Passia N et al aim to provide information on the ability of a single median implant to retain a complete mandibular denture when immediately loaded. This treatment option will strongly improve everyday dental practice, if viable.

CONCLUSION

1. Within the limitations of this study, it may be concluded that,
2. Single implant retained over denture is an economical and therapeutic alternative to a conventional mandibular complete denture showing remarkable improvement in oral comfort, function, health of the peri-implant soft tissues, Periotest values, oral health quality of life and also in the preservation of mandibular alveolar bone for up to 5 years after delivery of the over dentures.
3. Under favourable conditions, immediate prosthetic loading of a single implant is considered reliable and safe compared to multiple implant supported over denture.
4. There was no significant difference in the survival rates of mandibular over dentures attached to 1 or 2 implants.
5. Compared to two implant retained dentures, single implant over dentures were more cost effective, fewer surgery appointments, less invasive, post surgical denture maintenance and denture relines.

6. Single implant over dentures with dome type magnet or ball attachments had biomechanical effects similar to two-implant over dentures. Attachment systems of larger dimensions provided higher retentive forces and that stress breaker ball attachment provided optimal stress distribution.
7. One of the limitations encountered during treatment period was the loss of retention of the matrix followed by exchange of female component.

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