Original article:

Design and Manufacturing of Titanium Attachment for Single Implant Retained Mandibular Overdenture: A Review

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Abstract:
People lost their teeth due to numerous reasons. These people have to go for dental treatment and get artificial teeth. But denture treatment is very costly for an average human with limited income. The main factor contributing to the cost of the denture is the number of implants used for the treatment. A single implant costs around Rs. 25000 and generally for better stability, dentists use two or more than two implants for overdenture treatment and the cost may increase. So, the study is done with a specific focus on the design, analysis, and manufacturing of titanium attachment used for a single implant in mandibular overdenture by giving different types of implants to increase the retention and reduce the stresses for better retention.

Materials and Methods: A search with the keywords like Denture, Implant, Overdenture, Single implant overdenture, single implant vs. two implant, Mandibular, Attachment carried out on Science Direct (Elsevier), Saudi dental journal, Journal of dental research and Google Scholar. Open access articles were searched. The referred articles informed studies were also taken or requested.

Results: The search resulted in a total of 30 articles. Among the 21, 9 articles were on mandibular overdenture, 5 articles were related to various types of attachment, 7 articles were on single implant mandibular overdenture and so on.

Conclusions: The review paper concludes that single implant mandibular overdenture can be cost effective for patients because of the reduced number of implants used and surgical intervention. By reducing maximum stresses it gives proper retention in single implant mandibular overdenture and gives proper benefits while eating and speaking.

Keywords: overdentures, implants, attachment, mandibular overdenture, single implant overdentures, single implant vs. two implant.

INTRODUCTION
Dentistry science has worked over the years since the nineteen century it introduced. It provides many solutions for edentulous people, ranging from implants to recently root analogues implants. Edentulism, in which natural teeth are completely lost¹. Statics revealed out of 62% edentulous people 19.2% is suffering from mandibular failure and 12.2% suffering from maxillary failure².

To solve this problem, overdenture were used which gave maximum retention and supported by implant. Implant supported overdentures gave retention, comfort, stability & painless option for edentulous patients. It enhanced the oral health and quality of life. But the problem causes with overdentures was its maximum cost. Many clinicians always received complaint about retention of overdenture particularly the overdenture fixed in mandibular. Number of clinical dentistry trials shows that single implant supported
overdenture offers proper retention and is also a feasible alternative when cost is considered. This study shows that within single implants supported overdentures, implants with various attachment like with ball attachment provide a much satisfactory retentions and stability. But the evaluation of effectiveness of new customized attachment types other than conventional attachment type is still untouched. So aim is to focus on designing of an attachment, which in will increase retention and stability of single implant retained mandibular overdentures and reduces the maximum stresses by increasing forces.

MATERIAL AND METHODS
A methodical review paper on single implant retained mandibular overdenture is conducted by using mandibular prosthesis studies, dental implant studies, case report and clinical randomized trials. The aim is to recognize publications related to single implant retained mandibular overdenture up to 2016. An electronic search with the keywords like denture, overdentures, implant, single implant vs. two implant, single implant overdentures, attachment, mandibular overdenture was carried out on Science Direct (Elsevier), Saudi dental journal, Journal of dental research, international journal of prosthodontic and Google Scholar. Open access literature were search. The referred articles in earlier studies were also requested or obtained.

RESULTS
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<th>Topics</th>
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<td>Single implant Vs two implant</td>
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Table 1: Search Results

SINGLE IMPLANT OVERDENTURE VS TWO IMPLANT OVERDENTURE
Walton JN et al evaluated clinical trial of 86 patients. Two bilateral implants or one midline in mandibular conventional overdentures was provided. The beginning leads to the conclusion that satisfaction of patient in single implant is same as two implant and with lower cost.

Liu J et al studied the biomechanical nature of implants & their influence. He shows that no strain concentration damage occurs in surrounding of single implant retained mandibular overdenture.

Grageda E et al in 2014 submitted a report resulting single implant retained mandibular overdenture is cost effective than two implant supported overdenture.
Bryant SR et al6 newly shows the use of two implant and single implant supported overdentures by taking clinical trials for five years. Satisfaction levels were observed by both type of overdentures, i.e., single and two implant and retention was also equivalent.

**TYPES OF ATTACHMENTS**

Theodoros Trakas7 it shows the comparison between different attachments. It include several factors like implant, marginal bone loss, soft tissue, retention, stress distribution, space requirement, maintenance complication and patient satisfaction. Attachment gave better retention and stability of overdenture. It conclude the attachment mechanism of implant retained overdenture treatment and fulfil the patient need and expectation.

Nabeel Alsabeeha et al8 in 2010 conducted outcome of six different attachment systems in which three are commercially used stud and ball attachment with standard measurements and another two are prototype ball attachment having wide dimensions. Five samples are taken and are connected to three different implants. Result showed the maximum retention was achieved with prototype ball attachment because of its well-built dimensions.

Elie E. Daou9 in 2013 conducted two implant mandibular overdenture available without evidence based support. Midline Research was identified in 2011, but there is a loss of retention related to attachment mainly locator attachment. Attachment are easy to use. The long term outcome of implant overdenture and problems associated with different attachment.

Mohamed I. EI-Anwar10 in 2015 conducted stress generated within implant supported by mandibular retained overdenture by two different attachment like ball and socket and locator attachment. Implant support overdenture increase retention, stability and support with use of different attachment. Attachment are replace when existing some problem with rapid wearing with locator attachment. It directly and quantitatively compare two attachment using FEA. Ball attachment are highly stress than locator. Locator attachment can increased the interval between successive maintenance.

Alan G.T. Payne11 related to mandibular implant support overdenture using more than two implant splinted with multiple round bar. Trail on 59 patient maintenance and complication of 52 mandibular overdenture. Maintenance was greater in first year. More than 70% of retention clip in two implant were single round bar are design whereas 44% of three implant were double round bar and 4 implant were triple round bar are design. In 3 or 4 implant retention clip fracture occurs in 30% and 16% with 2 implant.

**MANDIBULAR OVERDENTURE**

Yuri Omura DDS12 compare outcome between immediately and conventional retained by magnetic attachment loaded mandibular two implant overdenture. In this study 19 patient are assigned either by immediate group or conventional group and 2 implant were received. The result shows higher result in 3 months. There is no far difference between both groups.

R. Timmerman13 shows mandibular overdenture increase satisfaction, retention and quality of life. It increases chewing ability. The report is mainly on 8 year follow up clinical trial. It contain 110 patients with dental problem and receive 3 different treatment. All the participant were satisfied with overdenture. The result shows Longterm satisfaction and retention by two implant.

Jingyin Lui14 shows stress and strain distribution in abutment and denture stability of mandibular overdenture under different number of implant and
different loading condition. The method is studied by locator attachment and three types of load were applied in overdenture. The result shows single implant rotated over the implant and increase strain, two implant shows apparent rotation around the fulcrum and stresses are higher than other and in three implant no stain concentration are found. Single implant overdenture are cost effective.

Maria E. Geertman\textsuperscript{15} shows experience with treatment effect with implant overdenture retained by transmandibular implant .the result shoes significantly more positive for transmandibular implant than endosseousimplant.

Naert\textsuperscript{16} conclude 36 patients divided into 3 groups according to attachment like magnet, ball attachment and straight bar. None of the implant fail during observation. After 5 years, bar group shows higher retention and magnetic group show lower retention.

Douglas Deporter\textsuperscript{17} shows clinical trial of dental implant with mandibular overdenture when trail was gone under 10 year. 52 patients received three free standing implant in mandibular overdenture. It shows that implant fixation are predictable and effective retaintion in mandibular overdenture.

Anita Visser\textsuperscript{18} shows 5 years record of mandibular overdenture supported by 2 and 4 implant. Total 60 patients were with mandibular overdenture. Equally distributed with two and four implant and no difference in satisfaction were observed between both groups.

Matteo Chiapasco\textsuperscript{19} shows success rate of implant in mandible and immediately loadswith implant supported overdenture. 82 patients attending implant support overdenture in mandible. 328screw type implant were placed each patients 4 implant for retaintion. The result shows success rate of immediate loaded implant places in mandible.

Franz SebastianSchwindling\textsuperscript{20} shows patient with mandibular denture provided with mini dental implant to increase retention. The result shows that 99 mini dental implant were placed in 25 patients from this 2 were fractured, 8 implant were failed and then no more implant were lost.

**SINGLE IMPLANT MANDIBULAR OVERDENTURE**

Tao Cheng\textsuperscript{21} this case study were to compare the clinical outcomes of single mandibular implant retained mandibular overdenture that of complete denture. 13 patients were treated with single implant inserted into mandibular midline. The result shows no implant were lost nor denture fracture and objective chewing efficiency of patient significantly improved after implant connection.

SonkeHarder\textsuperscript{22}, The aim of this study is the clinical the oral health related quality of life and the subjective chewing ability of patients with mandibular overdenture retained by a single implant placed in midline. It conclude that single implant support mandibularoverdenture successfully for older patients who showing improvement in chewing ability. NabeelH.M.Alsabeh\textsuperscript{23}, This paper shows single-implant retained mandibular overdentures, opposing maxillary dentures, using a large diameter implant and huge ball attachment system compared with different diameter implants with standard attachment. It conclude that single-implant retained mandibular overdentures are a successful treatment option for elder edentulous adults using implant of different diameter and different attachment system.

GayatriBarai\textsuperscript{24}, This review study is done with a specific focus on design of new attachment in order to increase stability and retention of single implant retained overdenture. The study concludes that single implant supported overdenture can be a cost effective
solution for middle class people with same retention and stability like multiple implant support overdenture.

Nicole Passai\textsuperscript{25}, nine center trial was going on and finally completed in 2016. For complete mandibular overdenture at least two implant were required for better retention. 180 patients were required between 60 to 89 years with sufficient complete denture receive one middle implant in mandible. It has been shown in several clinical trials that one single median implant can retain a mandibular overdenture suitably well up to 5 years without implant failures.

Glen Liddelow\textsuperscript{26} shows whether mandibular overdenture by using single stage surgery and immediate loading of single implant give satisfaction at success rate and functional improvement. 35 patients were treated with mandibular overdenture. Single implant were placed in midline with high stability. Patient satisfaction were high with increase in all comfort. It conclude that after 3 years of observation immediately loaded single implant gave satisfaction to patients.

Alan G. T. Payne\textsuperscript{27} concluded that very limited report on single implant mandibular overdenture. Different loading protocol with different implant and using large attachment system for mandibular overdenture.

DISCUSSION

The proper review of clinical trials, studies dental implants, case report, combined andibular prosthesis, attachment, comparative studies observed that single implant supported mandibular overdenture is cost effective option and financially used for weaker edentulous patients. In edentulous mandibular overdenture the single implant gives excellence, better survival rate and improve quality of oral health life. The single implant survival rate is less in maxilla than mandible. The single implant retained mandibular overdenture is constant and successfully long term solution with stability, comfort and less excruciating surgical intervention and better retention.

CONCLUSION

From the above literature review it shows

1) Single implant inserted in mandibular overdenture works successfully with full satisfaction.
2) Compared with two, three and four implant, single implant is cost effectively by reducing number of implant.
3) Larger dimension attachment provides more retention and give comfort.
4) Using different tressed implant so that it give proper retention.
5) Immediate loading of implant is considerably reliable and securely compared to more than single implant overdentures.

So it can be concluded that single implant supported mandibular overdentures can be cost effective for middle class people with retention and stability and reduces stresses for better retention.

REFERENCES


