

**Patient satisfaction, maintenance & complication with bar-clip, ball and socket and magnet attachments in mandibular implant overdenture treatment: A systematic review**

<sup>1</sup>Dr. Kushal Maheshkumar Patel , Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

<sup>2</sup>Dr. Vilas Valjibhai Patel, MDS , Professor and Head, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

<sup>3</sup>Dr. Sareen Subhash Duseja, MDS, Professor, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

<sup>4</sup>Dr. Avani Dhaval Patel, MDS, Reader, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

<sup>5</sup>Dr. Bhakti Arvindbhai Patel, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

<sup>6</sup>Dr. Satish Ratilal Makwana, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

**Corresponding Author:** Dr. Kushal Maheshkumar Patel, Post Graduate student, Department of Prosthodontics and Crown & Bridge, Narsinhbhai Patel Dental College and Hospital, Visnagar, Gujarat, India.

**How to citation this article:** Dr. Kushal Maheshkumar Patel, Dr. Vilas Valjibhai Patel, Dr. Sareen Subhash Duseja, Dr. Avani Dhaval Patel, Dr. Bhakti Arvindbhai Patel, Dr. Satish Ratilal Makwana, “Patient satisfaction, maintenance & complication with bar-clip, ball and socket and magnet attachments in mandibular implant overdenture treatment: A systematic review”, IJMACR- May – June - 2021, Vol – 4, Issue -3, P. No. 13 – 21.

**Copyright:** © 2021, Dr. Kushal Maheshkumar Patel, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License 4.0. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract**

Mandibular implant overdentures provide improved treatment outcome than conventional denture therapy, but there is controversy as to which overdenture attachment is the best choice. Although all attachment systems are useful. The aim of this systemic review was to evaluate and compare the patient satisfaction in implant supported mandibular overdenture with three different attachment

systems. A search of *in vivo* studies that investigated the patient satisfaction with bar-clip, ball & socket and magnet attachments in mandibular implant overdenture treatment. In this systematic review, PubMed/Medline, EBSCO, Google scholar and Web of Science databases were explored until February 2020 with no year limit. Data regarding the effectiveness of bar-clip, ball & socket and magnet attachments were collected. After duplicates'

removal, 1100 studies were identified, 42 were selected for full-text analysis, and 16 remaining papers met the inclusion criteria and were included in this systematic review. Hence, within the limitations of this systematic review, following may be concluded, there is greater variability in patient satisfaction with ball attachments in short clinical trials(1 -9 months) and bar attachments with long clinical trials(3-8 years).

**Keywords:** Ball attachments, Bar attachments, magnet attachments, implant supported overdentures, patients satisfaction.

### **Introduction**

In geriatric patients the occurrence of edentulism is common condition. According to the United Nations Population Division (UN 2011), the share of India's edentulous population aged 60 and above is projected to climb from 8% in 2010 to 19% in 2050. One therapeutic approach directed at improving oral function in the elderly is the use of implant-supported over denture (ISOD).<sup>[1]</sup>

In the rehabilitation of the edentulous mandible, implant-retained overdentures represent a viable and cost-effective treatment. A stabilization by implants can increase the satisfaction of the patients and can help to sustain the bone.<sup>[2]</sup>

The conventional dentures have been the treatment of choice for the edentulous patients for a long time. However, the patients usually have complaints of mandibular denture with problems such as lack of stability and retention because edentulous mandible loses four times more bone volume than the edentulous maxilla. An average of 0.4 mm of mandibular anterior vertical resorption occurs each year. These factors cause problems such as patients experiencing pain while eating and chewing, also arouses concerns about the denture loosen

while eating, speaking, or laughing and report fears about the negative effect of dentures on social situations.<sup>[3]</sup>

The benefits of implant-retained/ supported mandibular implant overdenture (IOD) treatment relative to conventional mandibular denture treatment have been well documented. Half of all conventional mandibular dentures demonstrate problems with prosthesis stability and retention, with retention being the single most important deficiency reported.

As increasing numbers of implants are used, it is possible they will assume a greater role with treatment outcome, particularly involving prosthesis support. However, more implants may not translate to improved prosthesis retention and/or stability, and subsequent treatment outcome may be relatively unaltered, other than a slight increased risk from additional treatment and added expense.<sup>[4]</sup>

In completely edentulous patient, implants which are used in conjunction with attachments to enhance the retention and stability of overdenture are considered as pillars of ISOD. It is very important for the clinician to have a good knowledge about different attachment systems, their advantages and disadvantages, indications, and contraindications for achieving long-lasting stable results because different clinical situations demand different types of attachment systems to serve better. To select a proper attachment, one should first understand the mechanical properties and the load distribution characteristics of different attachment systems.

For successful ISOD treatment, the evaluation of prosthetic space analysis is critical. For bar-supported overdenture, at least 13–14-mm interocclusal space is required considering teeth size, denture base thickness, bar thickness for the rigidity, the space from the mucosa to the bar for hygiene, and the soft-tissue thickness. Minimum

space requirement for ball attachment is 10–12 mm and for locators is 8.5 mm. Inadequate space for prosthetic components can result in an over-contoured prosthesis, excessive occlusal vertical dimension, fractured teeth adjacent to the attachments, attachments separating from the denture, fracture of the prosthesis, and overall patient dissatisfaction.<sup>[5]</sup>

This study was, therefore, undertaken to evaluate and to compare the patient satisfaction in implant-supported mandibular overdenture and their satisfaction level with three different attachment systems, i.e. ball-socket, bar-clip, and magnet attachments.

## **Materials and method**

### **Eligibility criteria**

#### **Inclusion criteria:**

- RCT and clinical trial studies on mandibular implant overdentures (MIO) until August, 2020
- Comparative studies between attachments on MIO with same number of implants Root form endosseous standard implants
- Upper complete denture
- Conventional loading
- Published in English

#### **Exclusion criteria**

- Case reports or technical reports without statistical comparison
- Study duration less than 1 year of function
- Rigid type of application with milled bar and telescopic abutments
- Combination or Cantilevered application of attachments
- Paper without abstract

The PICO format (Population, Intervention, Comparisons, Outcomes) was used to define a clinical question with clear inclusion criteria. The specific question and

inclusion criteria were clinical studies involving completely edentulous participants (P) requiring mandibular implant overdentures opposing conventional maxillary complete dentures (I). The chosen studies were then further divided according to overdenture attachment systems (primarily bar, ball, or magnet attachments) that were used (C). Survival rate of implants, prosthetic maintenance and complications, and patient's satisfaction were the outcomes (O) evaluated.

### **Search strategy**

A systematic literature search was conducted using the combined MeSH terms "mandibular prosthesis" or "Denture, Overlay" and "dental implants" or "dental prosthesis, implant supported" and "clinical study" or "comparative study" or "outcome assessment" or "epidemiologic studies" or "intervention studies" or "patient satisfaction" and limited by "Human" and "English" in the data base, Medical Literature Analysis and Retrieval System Online (MEDLINE).

The electronic search was further augmented by hand search through the following journals: Clinical Implant Dentistry and Related Research, Clinical Oral Implants Research, Implant Dentistry, International Journal of Oral and Maxillo-facial Implants, International Journal of Oral and Maxillo-facial Surgery, International Journal of Periodontics & Restorative Dentistry, International Journal of Prosthetics, Journal of Clinical Periodontology, Journal of Dental Research, Journal of Oral Implantology, Journal of Oral and Maxillo-facial Surgery, Journal of Oral Rehabilitation, Journal of Periodontology, Journal of Prosthetics, Journal of Prosthetic Dentistry.

### **Study selection, data extraction & data analysis**

At the outset, two independent reviewers evaluated the selection of the articles according to the inclusion and exclusion criteria. Extracted data were the sample size,

patient age, observation period, type of implant, number of implant, type of attachment, treatment outcomes and the outcome of statistical analysis comparing any of the following quantifiable factors: 1) implant survival rate, 2) prosthetic maintenance and complications, 3) patient satisfaction.

The implant survival rate denoted the raw percentage of implants still present at follow-up after initial placement of implants. Prosthetic maintenance and complications denoted mechanical damage of the implant superstructures. Patient satisfaction concerning chewing ability, phonetics, and social function were evaluated by questionnaire, visual analogue scale (VAS), or in some cases by patient preference. Data was insufficient to conduct a statistical meta-analysis on those factors, so data were descriptively analyzed.

## Results

Among 1100 potentially relevant records, 92 records were selected for abstract review. Amongst them 42 were selected for the full text analysis and 16 were selected in the systematic review. (Fig. 1). All the 16 eligible studies were in vitro studies which had compared patient satisfaction, maintenance & complication between bar, ball and magnet attachments. The extracted data from included studies are presented in table 1.

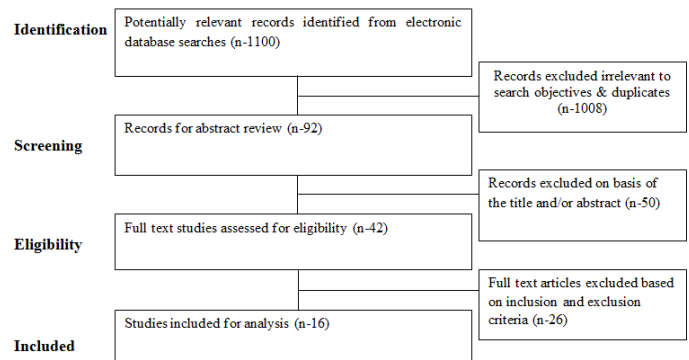


Fig.1: Flowchart of the systematic review according to PRISMA Statement

Table 1: summary of all included studies

Sr No.	Author	Year	No. Of Patients/ Implants	Follow-Up (Year Or Months)	Implant Type	Implant Survival Rate (Percentage)	Type Of Attachment	Prosthetic Maintenance & Complications	Patient's Satisfaction
1.	Varshney et al <sup>[5]</sup>	2019	15/30	6 Months	ADIN	NS	Bar ,Ball & Locator	Locator > Bar and Ball	Locator Is Better Than Ball. & Ball Is Better Than Bar
2.	Viswambaran et al <sup>[6]</sup>	2015	30/60	9 Months	EZ Hitec Implants	93.3	Bar & Ball	NR	NS
3.	Burns et al <sup>[7]</sup>	2011	30/120	1 Year	Nobel Biocare	NR	Bar & Ball	NS	Ball Is Better Than Bar
4.	Stoker et al <sup>[8]</sup>	2011	110/294	8 Year	Straumann	NR	Bar & Ball	Ball>Bar	NR
5.	Cune et al <sup>[9]</sup>	2010	18/36	10 Year	Friadent	NR	Bar, Ball, Magnet	NR	NS
6.	Kleis et al <sup>[10]</sup>	2009	60/120	1 Year	BIOMET	93.3	Ball,	Locator > Ball	NS

					3i		Locator		
7.	Macentee et al <sup>[11]</sup>	2005	68/136	3 Year	Nobel Biocare	NR	Bar, Ball	Ball > Bar	Bar Is Better Than Ball
8.	Naert et al <sup>[12]</sup>	2004	36/72	10 Year	Nobel Biocare	NR	Bar, Ball, Magnet	Magnet>Bar > Ball	Bar & Ball Are Better Than Magnet
9.	Timmerman et al <sup>[13]</sup>	2004	111/294	8 Year	Straumann	NR	Single Bar, Triple Bar, Ball	NR	Bar Is Better Than Ball
10	Karabuda et al <sup>[14]</sup>	2002	36/96	2 Year	NI	NR	Bar & Ball	NS	NS
11	Payne et al <sup>[15]</sup>	2000	59/104	3 Year	Nobel Biocare	NR	Bar & Ball	NS	NS
12	Davis et al <sup>[16]</sup>	1999	37/74	5 Year	Astra	Bar:95.8 Ball:100 Magnet:91.7	Bar, Ball, Magnet	Ball, Magnet > Bar	NS Page 8
13	Naert et al <sup>[17]</sup>	1999	36/72	5 Year	Nobel Biocare	98.7	Bar, Ball, Magnet	NR	NR
14	Weismejer et al <sup>[18]</sup>	1997	110/283	1.3 Year	Straumann	NR	Bar, Ball	Bar > Ball (1 Yr), No Difference (2-5 Yr)	NS
15	Gotfredsen et al <sup>[19]</sup>	1997	32/69	4.5 Year	Astra	98.5	Ball, Magnet	NR	NS
16	Naert et al <sup>[20]</sup>	1994	36/72	3 Year	Nobel Biocare	95	Bar, Ball, Magnet	Ball, Magnet > Bar	NS

\*NR – Not Recoded

†NS – Not Significant

## Discussion

The conventional complete mandibular denture often exhibits poor retention, stability, and support in the patients with severely resorbed ridges. This result in marked difficulty in patients carrying out basic functions such as eating, speaking and leads to deterioration in satisfaction levels, and overall quality of life. Osseointegrated dental implants offer the possibility of stabilizing the complete denture prosthesis in such cases, thereby overcoming some of the limitations of

conventional complete dentures. Today, a multitude of implant and attachment systems are available for the fabrication of ISOD.

This systematic review addressed implant survival rate, prosthetic maintenance and complications, and patient satisfaction of mandibular implant supported overdentures according to different attachment systems for edentulous patients.

### Patient's satisfaction

**MacEntee et al**<sup>[11]</sup> stated that bar attachments have better retention & patient's satisfaction than ball attachment. **Naert et al**<sup>[12]</sup> compared the prosthetic aspects and patient satisfaction with prosthetic care in two-implant-retained mandibular overdentures, whether implants were splinted with a bar or left with magnets or ball attachments. He concluded that the ball attachments scored best in relation to retention of the overdenture, soft tissue complications, and patient satisfaction at year 10. The bar group scored lower for comfort and stability of the maxillary denture. Magnets offered patients the least comfort. AlNiCo alloys, which have been used in dentistry for many years as a magnet material, were especially easily corroded in saliva rapidly weakening their attractive force.<sup>[8]</sup> However, recently rare-earth alloys, such as neodymium (NdFeB) and new laser-welding technique make it possible to produce a stronger and potentially more durable magnetic force.<sup>[13-14]</sup> overall patients satisfaction was similar for the three attachment types, patients in the magnet group were less satisfied with denture stability and chewing ability. **Timmerman et al**<sup>[13]</sup> evaluated An Eight-year Follow-up to a Randomized Clinical Trial of Participant Satisfaction with Three Types of Mandibular Implant-retained Overdentures. He said that general satisfaction with mandibular implant-retained overdentures and their opinion about phonetics, aesthetics, and social functioning over time are high and not dependent on treatment strategy. Only the score on the item 'retention and stability of the overdenture', for the participants with overdentures on 2 implants with ball attachments, decreased over time. He also suggest that a mandibular overdenture retained by 2 implants interconnected by a bar attachments might be the best treatment strategy with proven stability in the long term. This study shows that having more than 2

implants does not lead to a more satisfied individual in terms of denture and social function. Results of this study suggest that retention and stability of the mandibular overdenture, rather than the degree of retention by implants, drive participant satisfaction. In contrast to above results some authors<sup>[6,9,10,14-16,18-20]</sup> stated that there is no significant difference in patients satisfaction in bar, ball and locator attachment systems.

**Burns et al**<sup>[7]</sup> evaluated 3 different mandibular implant overdenture treatments with respect to prosthesis retention and stability, tissue response, patient satisfaction and preference, and complications to determine treatment outcomes. He also noticed that the bar treatment provided greater prosthesis retention than the other treatment type. The 4-implant bar treatment provided greater prosthesis retention than the other treatment types(2 implant bar) in this study, but after experience with all systems, subjects were more satisfied with and preferred the independent implant treatment. The 2 abutments easier to clean than those with a bar. Since the weak link in conventional mandibular denture treatment is inadequate prosthesis retention and stability.

### Prosthetic complications

Some studies<sup>[7,14,15]</sup> concluded that there is no statistical difference in prosthetic complication in any attachment systems. In contrast to above results, **Weismejer et al**<sup>[18]</sup> concluded that bar attachment had higher complications than the ball attachment. Most common requirements were related to clip loosening in bar attachments and matrix loosening in ball attachments. While Some studies<sup>[8,11,16,20]</sup> concluded that ball attachment has higher prosthetic complication compared to other attachment systems. **Naert et al**<sup>[12]</sup> concluded that magnet attachments have higher prosthetic complications than bar and ball



attachments. Common complications were wear and corrosion of magnet attachments.

Varshney *et al*<sup>[5]</sup> and Kleis *et al*<sup>[10]</sup> stated that locator attachments shows higher complication than ball & bar attachments. Most common maintenance needed in locator attachment was replacement of female part.

### Implant failures

Based on the articles in which an observation period ranged from 6 months to 10 years, the survival rates of the implants which supported the overdentures in the mandible, ranged from 91.7% to 100%, and the mean implant survival rate was over 98%, both of which supports the presumption that this treatment has a good prognosis in a long-term perspective. This high implant survival rate was coincident with the result of previous reports which showed an implant survival rate of more than 97.2% for mandibular fixed prosthesis. Six studies<sup>[6,10,16,17,19,20]</sup> presenting data on implant survival according to attachment systems, did not specify censored data for a cumulative survival rate making it impossible to calculate an implant survival rate according to different attachment systems through meta-analysis.

It has previously been reported that most prosthetic maintenance and complications occur during the first year of loading. In the present review pooled evidence was inconclusive in this regard. Magnet attachments showed the most common prosthetic maintenance and complications due to wear and corrosion. Corrosion of magnetic attachments occurs by breakdown of the encapsulating material and diffusion of moisture and ions through the seal.

### Conclusion

Within the limitations of this systematic review, following may be concluded,

1. Regarding prosthetic maintenance and complications, locator need less service, ball and bar attachment fragments required more service.
2. Although bar attachments provide more retention than ball attachments, still ball attachments are more preferred by patients because of less maintenance, ease of cleaning and less interference with tongue.
3. Regarding prosthetic maintenance and complications, ball attachments required less service in short clinical trials(1 to 9 months) while bar attachments required less service in long clinical trials(3-8 years).

### References

1. Mahajan N, Thakkur RK. *et al.*, Overdenture locator attachments for atrophic mandible. *Contemp. Clin. Dent.* 2013 Oct;4(4):509.
2. Shor A, Goto Y, Shor K. *et al.*, Mandibular two-implant-retained overdenture: prosthetic design and fabrication protocol. *Compend Contin Educ Dent.* 2007 Feb 1;28(2):80.
3. Hyland R, Ellis J, Thomason M, El-Feky A, Moynihan P. *et al.*, A qualitative study on patient perspectives of how conventional and implant-supported dentures affect eating. *J Dent.* 2009 Sep 1;37(9):718-23.
4. Redford M, Drury TF, Kingman A, Brown LJ. *et al.*, Denture use and the technical quality of dental prostheses among persons 18–74 years of age: United States, 1988–1991. *J. Dent. Res.* 1996 Feb;75(2\_suppl):714-25.
5. Varshney N, Aggarwal S, Kumar S, Singh SP. *et al.*, Retention and patient satisfaction with bar-clip, ball and socket and kerator attachments in mandibular implant overdenture treatment: An in vivo study. *The Journal of the Indian Prosthodontic Society.* 2019 Jan;19(1):49.

6. Viswambaran M, Arora V, Gupta SH, Dhiman RK, Thiruvalluvan N. *et al.*, A clinico radiographic study of immediate loading implants in rehabilitation of mandibular ridges. *Med J. Armed Fprces India.* 2015 Dec 1;71:S346-54.
7. Burns DR, Unger JW, Coffey JP, Waldrop TC, Elswick Jr RK. *et al.*, Randomized, prospective, clinical evaluation of prosthodontic modalities for mandibular implant overdenture treatment. *J Prosthet Dent.* 2011 Jul 1;106(1):12-22.
8. Stoker G, van Waas R, Wismeijer D. *et al.*, Long-term outcomes of three types of implant-supported mandibular overdentures in smokers. *Clin Oral Implants Res.* 2012 Aug;23(8):925-9.
9. Cune M, Burgers M, van Kampen F, de Putter C, van der Bilt A. *et al.*, Mandibular overdentures retained by two implants: 10-year results from a crossover clinical trial comparing ball-socket and bar-clip attachments. *Inte J Prosthodont.* 2010 Jul 1;23(4).
10. Kleis WK, Kämmerer PW, Hartmann S, Al-Nawas B, Wagner W. *et al.*, A comparison of three different attachment systems for mandibular two-implant overdentures: one-year report. *Clin Implant Dent R.* 2010 Sep;12(3):209-18.
11. MacEntee MI, Walton JN, Glick N. *et al.*, A clinical trial of patient satisfaction and prosthodontic needs with ball and bar attachments for implant-retained complete overdentures: three-year results. *J Prosthet Dent.* 2005 Jan 1;93(1):28-37.
12. Naert I, Alsaadi G, Quirynen M. *et al.*, Prosthetic aspects and patient satisfaction with two-implant-retained mandibular overdentures: a 10-year randomized clinical study. *Int J Prosthodont.* 2004 Jul 1;17(4).
13. Timmerman R, Stoker GT, Wismeijer D, Oosterveld P, Vermeeren JI, Van Waas MA. *et al.*, An eight-year follow-up to a randomized clinical trial of participant satisfaction with three types of mandibular implant-retained overdentures. *J. Dent. Res.* 2004 Aug;83(8):630-3.
14. Karabuda C, Tosun T, Ermis E, Ozdemir T. *et al.*, Comparison of 2 retentive systems for implant-supported overdentures: soft tissue management and evaluation of patient satisfaction. *J. Periodontol.* 2002 Sep;73(9):1067-70.
15. Payne AG, Solomons YF. *et al.*, Mandibular implant-supported overdentures: a prospective evaluation of the burden of prosthodontic maintenance with 3 different attachment systems. *Int J Prosthodont.* 2000 May 1;13(3).
16. Davis DM, Packer ME. *et al.*, Mandibular overdentures stabilized by Astra Tech implants with either ball attachments or magnets: 5-year results. *Int J Prosthodont.* 1999 May 1;12(3).
17. Naert I, Gizani S, Vuylsteke M, Van Steenberghe D. *et al.*, A 5-year prospective randomized clinical trial on the influence of splinted and unsplinted oral implants retaining a mandibular overdenture: prosthetic aspects and patient satisfaction. *J. Oral Rehabil.* 1999 Mar;26(3):195-202.
18. Saaby M, Karring E, Schou S, Isidor F. *et al.*, Factors influencing severity of peri-implantitis. *Clin Oral Implants res.* 2016 Jan;27(1):7-12.
19. Gotfredsen K. Implant supported overdentures—the Copenhagen experience. *J Dent.* 1997 Jan 1;25:S39-42..
20. Naert I, Quirynen M, Hooghe M, van Steenberghe D. *et al.*, A comparative prospective study of splinted and unsplinted Brånemark implants in mandibular



- overdenture therapy: A preliminary report. *J Prosthet Dent.* 1994 May 1;71(5):486-92.
21. Saygili G, Sahmali S. *et al.*, Retentive forces of two magnetic systems compared with two precision attachments. *J.Oral Sci.* 1998;40(2):61-4.
22. Riley MA, Walmsley AD, Harris IR. *et al.*, Magnets in prosthetic dentistry. *J Prosthet Dent.* 2001 Aug 1;86(2):137-42.
23. Ceruti P, Bryant SR, Lee JH, MacEntee MI. *et al.*, Magnet-retained implant-supported overdentures: review and 1-year clinical report. *J Can Dent Assoc.* 2010 Sep 16;76(52):1-6.
24. Awad MA, Lund JP, Dufresne E, Feine JS. *et al.*, Comparing the efficacy of mandibular implant-retained overdentures and conventional dentures among middle-aged edentulous patients: satisfaction and functional assessment. *Int J Prosthodont.* 2003 Mar 1;16(2).
25. Thomason JM, Lund JP, Chehade A, Feine JS. *et al.*, Patient satisfaction with mandibular implant overdentures and conventional dentures 6 months after delivery. *Int J Prosthodont.* 2003 Sep 1;16(5).