

# Maxillary complete denture outcome with two-implant supported mandibular overdentures. A systematic review

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## SUMMARY

**Objectives.** Research data regarding maxillary complete denture outcome with two-implant supported mandibular overdentures are not consistent. Considering multiple publications on implant supported mandibular overdentures, it was decided to summarize currently present evidence on the maxillary complete dentures opposed by implant-supported mandibular overdentures, and analyze factors that could potentially influence the outcomes.

**Methods.** The articles from 1985 to 2007 related to the topic were identified in the online MEDLINE/ Pubmed and other databases and manually. Primary articles were scanned, and irrelevant studies were excluded from the further review process. Potentially relevant titles and abstracts were provisionally included for consideration on the basis of full text articles. Full text articles were obtained from on-line and printed sources. The data from the studies were extracted and reviewed.

**Results.** The study has failed to identify any prospective satisfying inclusion/exclusion criteria RCT reporting on maxillary bone resorption. The number of maxillary complete denture relining incidences per patient was constantly increasing during the 10-year period. Maxillary complete denture remake incidences comprised 16-33 % of the number of patients followed during the 10-year period. Comparing patient satisfaction with upper dentures at the baseline and after two years, no decrease in satisfaction was noticed.

**Conclusions.** There is no evidence that maxillary ridge resorption is accelerated with certain types of two-implant supported mandibular overdenture attachments. Most common complication for the maxilla – prosthetic maintenance. There is a risk of decreased patient satisfaction with bar-supported mandibular overdenture. Further studies are needed to provide evidence for the maxillary complete denture outcome with two-implant supported mandibular overdentures.

**Key words:** maxilla, complete denture, overdenture, systematic review.

## INTRODUCTION

Research results considering maxillary complete denture outcome with two-implant supported mandibular overdentures are not consistent. Contradic-

tory data is reported regarding maxillary alveolar ridge resorption, complete denture success, and patient satisfaction.

Tooth loss is inevitably associated with alveolar ridge resorption. Major changes of soft and hard tissues take place after tooth extraction during early healing phase: 50% reduction in width, 1-4.5 mm height reduction [1, 2]. However, alveolar ridge resorption is anticipated long after tooth extraction. Continuous alveolar ridge resorption after tooth loss was revealed in classical mixed-longitudinal study of edentulous individuals covering 25 years of complete denture wearing [3]. The reduction of the mandibular ridge was particularly marked – the mean reduction in anterior ridge height being approximately four times as great as that of the maxillary ridge. These statements were supported by the later studies [4]. Alveolar bone loss around mandibular natural teeth

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in patients with partial dentures showed the vertical loss to be only 0.8 mm, compared with a 6.6 mm loss in those wearing complete dentures during a period of 7-year [5]. There are concerns about negative effect on maxillary alveolar bone when maxilla is opposed by remaining mandibular anterior teeth or fixed prosthesis. Loss of bone of the anterior portion of edentulous maxilla is a key element of so called “combination syndrome” [6, 7]. Two-implant supported mandibular overdentures were proved as very efficient in treatment of edentulous mandible [8]. Several studies have reported negative effects of two-implant supported mandibular overdentures on maxillary edentulous ridge [9, 10].

Several studies have reported instability of the maxillary denture with implant-supported overdentures in the mandible [11]. A recent study compared edentulous patient satisfaction with their upper complete dentures who also had two-implant retained mandibular overdentures [12]. Significant difference was revealed between bar, ball and magnet groups: patients in the bar group were less satisfied than patients in the ball and magnet groups. However, other studies have failed to detect any difference of maxillary complete denture stability in mandibular overdenture and mandibular complete denture groups [13].

Similarly, there are some concerns regarding postprosthetic maintenance of maxillary complete denture. Increased demand for relining, rebasing and re-making was reported when implant supported fixed or removable prosthesis was provided for mandible [14]. It is also has been an object of discussions considering which type of occlusal scheme (balanced,

lingualized or canine guided) would most likely ameliorate retention and stability of maxillary complete denture.

It is highly advisable that clinical recommendations should be derived from well designed clinical studies with appropriate randomization, number of subjects and satisfactory follow-up periods.

Considering multiple publications on implant supported mandibular overdentures, it was decided to summarize currently present evidence on the maxillary complete dentures opposed by implant-supported mandibular overdentures, and analyze factors that could potentially influence the outcomes. The purpose of the study was to investigate the influence of mandibular overdentures retained by different attachments on the following treatment outcomes:

1. Maxillary bone resorption;
2. Repair and adjustment of maxillary complete dentures;
3. Patient satisfaction with maxillary complete dentures.

The null hypothesis was: there are no differences in maxillary complete denture outcome with different designs of two-implant supported mandibular overdentures.

**MATERIALS AND METHODS**

Potentially relevant literature was identified via searching for existing reviews and primary studies relevant to a review’s objectives. The search of related to the topic articles published from 1985 to 2007 in English was accomplished in the online databases,

**Table 1.** Characteristics of the included studies (RCT – randomized clinical trial)

Authors, Year	Type of study	Subjects (age)	Inclusion (I)/ Exclusion (E)	Intervention	Maxillary denture outcome	Allocation concealment	Follow-up (years)	Completeness to follow-up
Naert et al, 1997	RCT	36 (36-85 y)	I: ≥10 mm implants, ≥1 y edentulous; E: gagging, class II.	2 mandibular implants	Relining	Unclear	3	94.4 %
Watson et al, 2002	RCT	72 (55-80 y)	I: 12-15 mm implants; E:	2 mandibular implants	Relining, retention, adjustments	Unclear	1	N/a
Meijer et al, 2003	RCT	61 (43-70 y)	I: 8-25 mm mandible height, ≥1 y edentulous; E: preprosthetic surgery	2 mandibular implants	Relining, remaking	Adequate	10	87%
Naert et al, 2004	RCT	36 (36-85 y)	I: ≥10 mm implants, ≥1 y edentulous; E: gagging, class II.	2 mandibular implants	Relining, remaking, retention, fracture, satisfaction	Unclear	1, 5, 10	72%
MacEntee et al, 2005	RCT	100 (mean= 62 y)	I: ≥1 y edentulous; E: ≥8,5 mm implant, preprosthetic surgery, radiotherapy.	2 mandibular implants	Satisfaction	Adequate	2	68%

manually and by other means (search of dissertation thesis, contacting manufacturers etc.). Clinical trials considering treatment of fully edentulous patients by two-implant supported mandibular overdentures and reporting maxillary complete denture outcome were identified. Patients who received two implants in the mandible with minimum of one-year follow-up after prosthesis insertion were considered.

All attempts were made to address the following input variables:

1. Type of the implant system;
2. Number of implants in the mandible;
3. Type of the attachment;
4. Occlusal scheme.

### Search strategy

Free text terms alone or in combination with controlled vocabulary were used to search electronic bibliographic databases: MEDLINE/Pubmed, EMBASE and CCTR (The Cochrane Controlled Trials Register). The Internet search was done by using beta version of meta-search engine – Google Scholar. Last online search was conducted on 15<sup>th</sup> of December 2007. Highly sensitive search strategy instead of specific was used to detect relevant randomized clinical trials (RCTs) and controlled trials (CTs) evaluating maxillary complete denture outcome with different designs of mandibular two-implant supported overdentures.

Manual search was conducted and involved peer-reviewed publications related to the topic, reference lists of relevant primary and review articles and conference proceedings. An attempt has been made into obtaining otherwise unpublished research

in the databases of dissertations and theses. Around 100 implant manufacturers were also contacted (11 of them responded).

### Study selection

Totally 325 primary articles were identified. One reviewer scanned all unmasked articles, and 264 irrelevant studies were excluded from the further review process. Potentially relevant titles and abstracts (n=61) were provisionally included for consideration on the basis of full text articles. Full text articles were obtained from on-line and printed sources.

Following inclusion criteria were applied: edentulous mandible and maxillae, implant supported mandibular overdenture, studies reporting on maxillary complete denture outcome, RCTs and CTs. Exclusion criteria were: clinical trials without control group, 1 or more than 2 mandibular implants, implant supported maxillary prosthesis, no maxillary complete denture outcome reported.

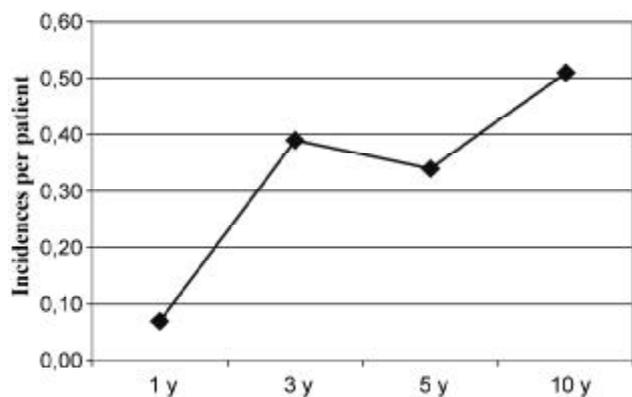
One reviewer applied inclusion and exclusion criteria, and after unmasked assessment of studies, 5 articles remained for further review process. Study selection process was documented giving detailed reasons for inclusion and exclusion.

### Quality assessment

One reviewer performed quality assessment process. The validity of the selected studies was checked against biases according to principles published by “The Cochrane Collaboration”: randomization and allocation concealment in order to avoid selection bias (recorded as adequate, unclear, inadequate and not used); blind outcome assessment in

**Table 2.** Characteristics of the included studies according to the measured outcome (VAS - visual analogue scale)

Authors, Year	Subjects	Implants	Attachments	Occlusion	Relining	Remake	Fracture	Retention	Adjustment	Satisfaction
Naert et al, 1997	34	Branemar k=68	Ball Magnet Bar	Ballanced	Number of incidences (3 y)	-	-	-	-	-
Watson et al, 2002	72	Sterioss=24 ITI=24 Southern=24	Ball	N/a	Number of incidences (1 y)	-	-	Complaints	Phonetic, esthetic complaints	-
Meijer et al, 2003	56	Branemar k=56 IMZ=56	Bar	Ballanced	Number of incidences (5 and 10 y)	Number of incidences (5 and 10 y)	-	-	N/a	-
Naert et al, 2004	26	Branemar k=72	Ball=9 Magnet=10 Bar=7	Ballanced	Number of incidences (10 y)	Number of incidences (10 y)	Number of incidences (10 y)	Questionnaire	-	Fit, discomfort
MacEntee et al, 2005	68	Nobel Biocare=136	Ball=34 Bar=34	Lingualized	-	-	-	-	-	Separate categories, overall VAS



**Fig. 1.** Number of upper complete denture relining incidences per patient during the 10-year period

order to avoid detection bias (recorded as yes, no, unclear and not possible); and completeness of follow-up in order to avoid attrition bias (clear explanation for withdrawals and drop-outs in each treatment group recorded as yes and no) [15]. As a result, 5 articles were selected for data extraction (Table 1). Each article was checked for inclusion/exclusion criteria, type of intervention, allocation concealment, balanced allocation to test and control groups and follow-up.

#### Data extraction process

Variables from the selected studies were recorded to specially designed data extraction forms. The following data were recorded: date of the publication, methods of interventions, number of participants at the baseline and each follow-up period, type of the implants, status of maxillae, allocation concealment and measured parameters of maxilla and maxillary complete denture during the follow-up period. As for the maxillary complete denture outcome, demand for adjustment, relining and remaking, number or denture fractures, retention and patient satisfaction data were extracted. All attempts were made to identify type of occlusal scheme provided. In order to make direct comparisons data from different studies was converted if possible. Some of the study characteristics according to the measured outcomes are presented in Table 2.

#### Description of studies

Comparatively high number of primary studies ( $n=325$ ) were identified due to the fact that maxillary complete denture outcomes are reported as secondary data in studies investigating two-implant supported mandibular overdentures. In order to confirm or reject the study full-text articles ( $n=61$ ) had to be evaluated. However, part of the studies ( $n=264$ ) were rejected based on title and abstract review. The main reasons for rejection were maxillary complete den-

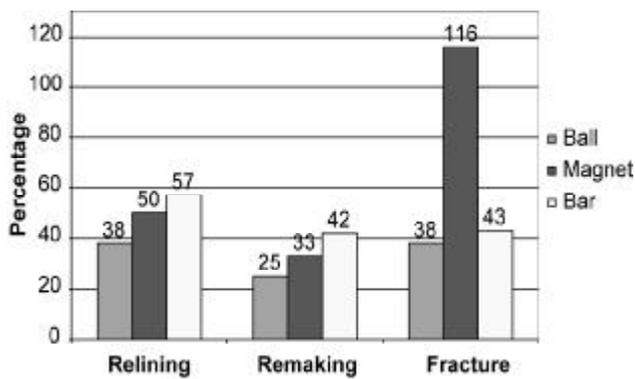
ture outcome not recorded, or only partially presented data in the text or in figures. Careful evaluation of full-texts as well as quality assessment was implemented on studies included in the systematic review ( $n=5$ ). However, in 3 of the selected studies [12, 16, 17] it was not clear either allocation concealment was used. Total patient sample size was comprised of 305 subjects, all of them treated with two-implant supported mandibular overdenture and complete maxillary denture. Follow-up rates varied from 68% to 94.4% and follow-up period – from 1 to 10 years. Three studies compared different types of attachments – balls, magnets and bars and reported maxillary complete denture outcome [12, 16, 18]. Two studies used same type of attachment, but different implant systems [17, 19]. Only one study evaluated number of denture fracture incidences [12]. Due to the different follow-up periods, only few direct comparisons could be made: 1-year data was reported by two studies [12, 17] and another two reported 10-year data [12, 19].

## RESULTS AND DISCUSSION

#### Maxillary bone resorption

The study has failed to identify any prospective satisfying inclusion/exclusion criteria RCT reporting on maxillary bone resorption. Based on the retrospective study, slightly higher resorption in the anterior (5-12%) than in the posterior part (2-7%) of the edentulous maxilla was associated with mandibular ovoid bar retained overdentures [10]. Another retrospective study in 13 patients [20] reported loosening of the maxillary denture, loss of posterior occlusion, increased anterior occlusal pressure, and anterior maxillary bone loss, similar to the effects seen in “combination syndrome”. In contrast, Jacobs et al have found more pronounced annual maxillary bone resorption in complete mandibular denture wearers compared to patients with implant-supported overdentures [14]. Supra-eruption of natural teeth was given as a possible reason for more intense maxillary ridge resorption with natural mandibular teeth rather than with implants. However, a recent review of literature concluded that “the “combination syndrome” does not meet the criteria to be accepted as a medical syndrome” [7].

It could be suggested that mandibular two-implant supported overdentures can pose a certain risk of increased maxillary ridge resorption. During the review process, selected studies have not reported on maxillary ridge resorption, therefore, further studies are needed to ascertain the main factors associated with bone loss in the maxillae.



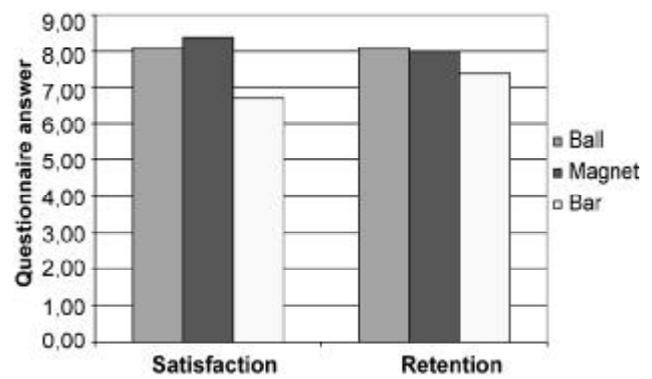
**Fig. 2.** Percentages of main prosthetic complications according to two-implant supported mandibular overdenture attachment type

### Prosthetic maintenance of maxillary complete denture

Need for prosthetic maintenance of maxillary complete denture is associated with increased treatment costs and decreased patient satisfaction. Therefore, it is of crucial importance to estimate it.

Relining is considered as procedure used to resurface the tissue side of a removable dental prosthesis with new base material, thus producing an accurate adaptation to the denture foundation [21]. The need for the denture relining indirectly reflects the changes of the tissues in prosthetic area. As it can be expected, the number of maxillary complete denture relining incidences per patient was constantly increasing during the 10-year period (Figure 1). Watson et al (2002) presented number of relining incidences 1 year, Naert et al (1997) – 3 year, Meijer et al (2003) – 5 year after prosthesis insertion. From 4 studies reporting relining events, results of only two studies [12, 19] could be directly compared, as they both provided data after 10-year of follow-up. Both studies found very similar demands for upper denture relining procedure. According to Naert et al (2004) averagely 0.48 incidences were recorded per patient after 10 years, whereas Meijer et al (2003) reported 0.5 incidences during the same period. Highest increase in the reline incidences could be observed from the 1<sup>st</sup> to the 3<sup>rd</sup> year (Figure 1). However, the way studies determined the need for relining is important. The results could be different depending on either decision to reline was taken on the request of the patient or, on the other hand, it was decision of the dentist. Only one study explained clearly how the need for relining was estimated – it was deemed necessary if wash impression on the fitting surface of the denture using a light-bodied addition silicone material was greater than 1 mm [17].

Remaking incidences of upper complete denture were reported by two studies, both during the 10-year follow-up [12, 19], whereas fracture inci-



**Fig. 3.** General satisfaction and satisfaction with retention of upper denture after 10 years of follow-up (1- very bad, 9- excellent)

dences – only by one study [12]. Meijer et al (2003) reported that maxillary complete denture remake incidences comprised 16 % of the number of patients followed during the 10-year period. However, in Naert et al (2004) study this number was considerably higher – 33%. After 10 years even 66% of subjects had maxillary complete denture fracture complications [12]. This could be explained by comparatively higher forces mandibular overdenture can exert on maxillary complete denture.

It is believed that rate of prosthetic complications with maxillary complete denture could depend on the type of mandibular overdenture attachment. Percentages of main prosthetic complications according to attachment type are presented in Figure 2. The tendency could be observed, that higher demand for relining and remaking was associated with bar-retained mandibular overdenture. However, results of the studies are quite contradictory and significance of this finding is doubted. According to Naert et al (2004), significantly higher number of maxillary denture fracture was observed in the magnet group. This was explained by lower stability of mandibular overdenture with this type of attachment.

### Patient satisfaction and retention

Questionnaire data regarding general satisfaction and patient satisfaction with retention of upper denture after 10 years of follow-up are presented in Figure 3. Different methods were used to assess patient satisfaction with maxillary complete dentures. Naert et al (2004) used VAS (visual analogue scale) and the scale ranging from 1 (very bad) to 9 (excellent), while MacEntee et al (2005) used only VAS. An attempt was made to convert the scale data to VAS, thus both studies could be compared. According to MacEntee et al (2005) average patient satisfaction after 2 years of service was 96% (VAS), which was very similar to the results reported by

Naert et al (2004) – 90% (scale converted to VAS). Comparing patient satisfaction with upper dentures at the baseline and after two years, no decrease in satisfaction was noticed. In contrast, satisfaction rating pain, comfort, mastication with maxillary prosthesis was significantly higher after 2 years [18]. Comparing patients with different types of mandibular overdenture attachments (bars, magnets and balls) all groups were satisfied in terms of general satisfaction, chewing comfort, esthetics etc. However, patients wearing a bar-supported mandibular overdentures were less satisfied with the stability of upper denture [12]. An assumption can be made, that more stable mandibular overdenture can hamper the stability of upper complete denture. This is in accordance with other investigations, which have also found that a direct relationship exists between prosthesis retention, stability and patient satisfaction [22]. Other studies failed to detect any difference in patient satisfaction with bar and ball attachments [18].

## CONCLUSIONS

Due to limited number of studies of acceptable quality the null hypothesis could not be rejected. Considering selected studies in this review, following conclusions might be drawn:

1. There is no evidence that maxillary ridge resorption is accelerated with certain types of two-implant supported mandibular overdenture attachments;
2. Most common complication for the maxilla – prosthetic maintenance. Need for relining might increase after the first years of service;
3. Patient satisfaction with maxillary complete dentures are high, however there is a risk of decreased patient satisfaction with bar-supported mandibular overdenture when rating maxillary denture retention.
4. Further studies are needed to provide evidence for the maxillary complete denture outcome with two-implant supported mandibular overdentures.

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