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Does Implant Fixed Restoration Can Reverse The Physiological Route Of Mandibular Bone Resorption Of The Posterior Edentulous Area For The Completely Edentulous Patients?: Systematic Review.

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ABSTRACT

Introduction: To compare the bone height changes of the posterior mandibular edentulous area of fixed implant prosthesis versus that of removable implant overdentures. **Materials & Methods**: An electronic search was performed using PubMed and Cochrane CENTRAL databases for articles published in English till the end of November 2016. Inclusion criteria were randomized clinical trials (RCTs) and prospective cohort studies (PS) which measured the changes of the height of the posterior edentulous area of the mandible. Two reviewers independently screened titles and abstracts, made data extraction and appraised the quality of included studies. **Results**: From a total of six identified relevant studies, two randomized clinical trials and two prospective cohort studies fulfilled the inclusion criteria. The authors of the included studies concurred to bone resorption as a result of removable prostheses and advocated to fixed prostheses as it allow for preservation of the bone height and even bone apposition. **Conclusion**: the implant fixed prosthesis is superior over the implant removable overdentures regarding the preservation of the posterior edentulous bone height.

Keywords: Edentulous mandible, dental implant, fixed prostheses, overdenture, systematic review.

INTRODUCTION

Rationale: Every patient should be offered sound advice based on the best available evidence. Prosthodontist recommendations about the type of implant superstructure should always include the justification and comparison between the available types of prostheses.

Background

The implant-retained prostheses are treatment option that could improve oral function, chewing force and comfort for edentulous patients and could eliminate a considerable part of the problems that edentulous patients may experience.[1] Although mandibular implant retained and implant supported prostheses as a treatment option have been examined thoroughly by several study groups, most articles have predominantly focused on the bone resorption around the implant, whereas only a few articles have focused on the residual ridge resorption in the posterior mandibular edentulous area.[2-4]

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.[3]

Wright et al.[2] reported low rates of posterior mandibular ridge resorption for patients wearing an implant-retained overdenture and even bone apposition in the same area for patients with a fixed cantilever implant prosthesis.

Statement of the Problem

It is well known that one of the beneficial results of providing implant support for the prosthesis in the anterior region is the preservation of the existing residual bony ridge. While in the posterior region Some authors suggest that over dentures preserve the posterior residual ridge from excessive resorption which may continue throughout life leading to prosthetic problems and sometimes even to pathological fractures,[1,3-6] others suggest that

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overdentures supported by anterior implant concentration may cause accelerated bone loss when compared to conventional dentures and few reports suggest that screw retained restorations with anterior implant concentration and distal cantilevers protect the posterior ridge from resorption and may contribute to posterior bone formation.[7] The data in that field is sparse and inconclusive.

Objective

The aim of this systematic review was to analyze bone height change for implant supported prostheses in edentulous jaws, regarding a potential impact of type of the prosthesis.

A prior protocol was made for this systematic review and registered at the International prospective register of systematic reviews. (PROSPERO2017.55560)https://www.crd.york.ac.uk/prospero/myprospero.php

The first step in the review process was the development of a protocol detailing all methods of the review a priori. The focused (PICO) question for the review was: For completely edentulous patients receiving implant retained restoration, would fixed restorations can preserve the mandibular ridge height in the posterior edentulous area when compared to removable overdenture? Then identifying the PICO items: (P) Patients: they are completely edentulous patients. (I) Intervention: Fixed implant prostheses. (C) Comparator: implant retained overdentures. (O)Type of outcome: bone height changes in the mandibular posterior edentulous area

Methods

A systematic literature search for randomized-clinical trials (RCTs) or prospective cohort studies was conducted within PubMed and Cochrane Library. Quality assessment of the included studies was carried out, and the review was structured according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Statement was used as a reporting template as much as possible. The search strategy was designed to identify evidence of the outcomes of implant restorations in healthy patients with total edentulism treated with fixed prosthodontic implant therapy. Interventions were broadly classified into two groups: fixed prosthsis or implant overdenture the outcome of interest was the bone height change in the posterior mandibular edentulous region. To be included, eligible studies must have had a follow-up period of at least 12 months.

Search strategy

The search strategy [Figure 1] began with an electronic search of publications up to November 2016. This search was performed using the following electronic databases: PubMed and Cochrane. The search included only English language articles published in peer reviewed journals the search was complemented by hand searching through references of relevant review articles and eligible studies for additional useful publications.

Titles and abstracts were initially screened for possible eligibility by two independent reviewers. Any disagreement in the choice of studies of possible relevance was resolved by discussion among the reviewers. if any missing data were detected, the authors of the trials were contacted whenever possible. The keywords used for the search were combinations of the following:

(((((((dental implant) OR implant) OR dental implants) OR implants)) AND (((((Completely edentulous) OR totally edentulous) OR edentulous mandible) OR edentulous ridge) OR edentulous arch)) AND ((((((Telescopic over-denture) OR overly denture) OR overdenture) OR removable prosthesis) OR removable prostheses) OR over-denture)) AND ((((screw retained) OR fixed) OR fixed detachable) OR screw-retained) AND ((((ridge resorption) OR posterior ridge resorption)) OR mandibular resorption).

The obtained results were filtered using the following filters:

Reviews, case reports for exclusion ,clinical trial, randomized controlled trials and prospective trials for eligibility.

Criteria for including studies

To be eligible for inclusion in the review, studies, in English only, had to be randomized controlled trials (RCT) or prospective cohort studies of at least 12 months' follow-up.

Studies were considered for inclusion if they were:

-conducted on patients>18 years;

-fully edentulous;

-with information regarding opposing dentition;

- made on residual ridge without any surgical intervention (e.g. bone augmentation).

- made on edentulism due to teeth loss not as hereditary diseases.

Exclusion criteria for the study

-Short implants or mini implants.

-Zygomatic implants or extra oral implants.

-Previously irradiated patients.

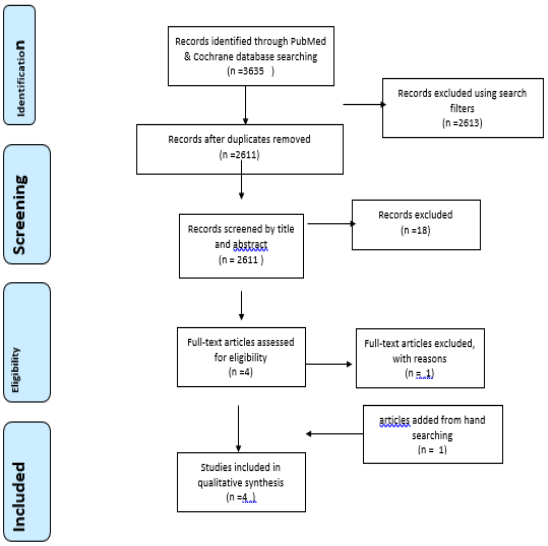
-Overdentures anchored single tooth.

RESULTS

The electronic search yielded 3620 titles from PubMed and 15 titles from Cochrane database. 2628 publications were excluded by custom search filters(case reports, reviews, retrospective studies), the scanned publications were only the randomized clinical trials and prospective studies),1007 publications screened independently .two

publications were added from hand searching. six publications were assessed for eligibility according to the established inclusion and exclusion criteria, Based upon reading the six full text articles, a total of four studies were finally selected.[Figure 1] two publications were excluded with reasons [table 1].

Prisma 2009 Flow Diagram



Authors	Year	Reasons For Exclusiopn
Jacobes R. Et Al.8	1992	Retrospective Study

Data Collection

No meta- analysis was possible because the included studies were of different types(randomized clinical trials and prospective) so data and results were introduced in a descriptive forms [Table 2]

Quality assessment:

Two independent reviewers performed quality assessment process. The validity of the selected studies was checked against biases according to STROBE check list for the prospective cohort studies and CONSORT checklist for the randomized clinical trial.

randomization and allocation concealment in order to avoid selection bias (recorded as adequate, unclear, and not used); blinding assessment in order to avoid performance and detection bias (recorded as not used and single);and completeness of follow-up in order to avoid reporting bias (clear explanation for withdrawals and drop-outs in each treatment group recorded as yes and no, reporting of the possible complications especially in the clinical trial recorded as (no, unclear) [Table 3].

Table 1: excluded study with reason

Table 2: List of included studies

Authors	Year	superstructure	Follow-up duration	Study design	No. of Patients	Implant type
Wright PS et al.2	2002	Overdentures on two implants connected by a bar, Fixed cantilever prostheses on five or six implants	7.5	prospective	44	Brånemark System; Nobel Biocare,
Tymstra N et al.9	2011	Overdenture on two implants Overdenture on four implants Conventional full denture	10	prospective	120	----------
Mosnegutu et al 10	2015	Tissue supported overdenture on two implants(ball attachments) Tissue-implant supported overdenture on two implants with single bar Implant supported overdenture on four implants	10.5	RCT	82	ITI dental implants(Straumann AG Waldenburg CH)
Nakai	2000	Fixed prosthesis Conventional denture Removable prosthesis	from 9 to 66 months	Rct	27	Brånemark System; Nobel Biocare,

Table 3: Risk of bias assessment for the selected articles.

			Selection bias			Blinding	Reporting bias			
study	Study design	Inclusion /exclusion criteria	randomization	Randomization method	Allocation concealment	Blinding	Attrition report	confounding factors	Complication report	Risk of bias
Wright 2002	PS	unclear	Not used	Not used	Unclear	Not used	no	Yes(regression analysis)	no	high
Tymstra 2011	PS	yes	Not used	Not used	unclear	Not used	yes	no	unclear	high
Mosnegutu 2015	RCT	yes	yes	yes	unclear	single	unclear	no	unclear	low
Nakai 2000	RCT	yes	Not used	Not used	unclear	Not used	unclear	no	unclear	high

*PS=prospective study *RCT=randomized clinical trial

The articles were published from 2002 to 2015, The risk of bias in two of the assessed prospective cohort studies (Wright PS et al 2002,Tymstra N et al 2011) was considered substantially high, however the clinical trial (Mosnegutu et al 2015) 10was considered of low risk of bias.[2,9]

one prospective study and one randomized clinical trial reported bone apposition in the mandibular posterior edentulous area patients with a fixed cantilever implant prosthesis and slight bone resorption with the removable overdentures.[2,7]

However for the other studies refuted the hypothesis of bone growth beneath the implant supported prostheses and stated different rates of bone resorption [Table 4].[9,10]

The risk of bias in three of the assessed studies (Wright PS et al 2002, Tymstra N et al 2011, Nakai 2000) was considered substantially high, however the clinical trial (Mosnegutu et al 2015) 10was considered of low risk of bias.[2,9,7]

Table 4: Results

Study	Results
Wright 2002	-0.053±0.07overdentures +0.046±0.061fixed prosthesis Annual rate -0.053%(0.07)overdenture + 0.046%(0.061)fixed
Tymstra 2011	-0.1% (0.07)two implants -0.07% (0.08)four implants -0.08% (0.11)conventional denture
Mosnegutu 2015	-0.51(non-significant difference between the three groups)
Nakai 2000	5 patients increase of more than 3.3% in the height In the other 22 patients, no significant change loss of bone not more than 0.6%

DISCUSSION

In evaluating implant-supported prostheses, survival rate of implant, peri-implant aspect, prosthetic maintenance and complication have been commonly used as conventional criteria11–16.

However, evaluating posterior mandibular bone height change after usage of implant supported prostheses either fixed or removable were little in the literature and lack of consistency which might cause researchers to mislead to analyze data from the different studies.[2,9,10,17–20]

This systematic review was conducted to compare amount of posterior mandibular bone height changes of fixed implant restorations versus implant overdentures. This included only one RCT10 and two prospective cohort studies which are considered of a lower level of evidence than that of RCTs.[2,9]

This review is the first to evaluate the effect of the prostheses type on the course of bone remodeling either by resorption or apposition.

In this systematic review all factors that could affect implant osseointegration, bone height changes and the health of the residual ridge were carefully considered during appraising the inclusion and exclusion criteria of the selected studies. These factors could be biological or mechanical and most probably both together.The biological factors could be related to the systemic diseases, personal habits (e.g. smoking) or abnormal dietary habits .

Patients free from systemic diseases that could affect the metabolic and catabolic process were selected to avoid adverse effect of systemic disorders on healing process, condition of bone and soft tissues that might affect the results of this study.[4,21,22]

On the other hand the mechanical factors are mainly related to the amount of stress transmitted to the supporting structure whether implants or ridges.[23,24]

All patients have been totally edentulous for at least one year before placement of implants to avoid the effect of bone remodeling which follows tooth extraction.[25]

Changes regarding the maxillary arch are not the concern of this review .however; it should be given a great concern as the unfavorable distribution of forces of restoration may contribute in the upper arch changes.[3,9,26]

panoramic radiographs have been reported to be sufficiently reliable to evaluate the available bone height in the area of posterior mandible.[27–29]

In this review measuring of the bone height changes was done using the proportional method introduced by Wilding et al.[30] The author considered the changes of the proportional area measurement could represent the changes of the alveolar ridge height. This method helped in studying the changes in a wide area which is not possible with the other means. This can be considered as indirect way of measurement for that reason some authors preferred the direct vertical measurement on the radioghs.[7,31]

Generally speaking the edentulous alveolar ridge resorption is a continuous process that occurs throughout life so reduction of the alveolar ridge occurred in the two types of restorations was expected. This reduction is most probably due to that the forces transmitted to the ridge exceed the physiological level of tolerance of the alveolar bone. Also wearing of the denture in general changes the ecology of the oral environment which may be responsible for the changes in the supporting soft tissues influencing the state of ridge reduction.[23]

In the included studies the bone changes were not in the same direction. Wright et al.[2] reported an increase in the posterior mandibular residual ridge in patients treated with fixed prostheses on anterior

implants in the mandible. These findings were also described by Davis and Nakai.[7,18]

Wright et al assumed that flexing of the mandible under masticatory load is the stimulus for the bone proliferation, such flexing being encouraged by the application of the entire load anterior to the mental foramina.[2]

Another suggestion was described by Lanyon that dynamic loading of bone can have a profound osteogenic effect, especially when the strains and strain rates are high, and the strain distributions unusual.[14] Wright also suggested that the resilient connection between the overdenture and the bar allows some movement, less bending strain such compressive force from the distal extension saddle may initiate bone resorption.[2]

Mosnegutu et al confirmed this opinion in his study he stated that changes in the stress distribution on the mandible during function depending on the type of the superstructure.[10]

Wright stated that the small amount of resorption that was demonstrated in his study, may be a reflection of the before the start of his study.[2]

Unfortunately most of the studies could be found in the literature were retrospective studies which are of low evidence power.

CONCLUSION

Comparing the bone height changes of the posterior mandibular edentulous area of fixed versus removable implant stabilized prostheses, most of the included studies showed bone resorption in the removable group and bone apposition in the fixed group. However, due to heterogeneity in the prosthodontic designs and attachment systems it is hard to come out with a definitive conclusion.

More over most of the included studies are showing a high risk of bias. Additional RCTs of high quality should be performed with standardization of the method of the evaluation of bone height to perform an accurate data analysis.

Recommendations

For additional conclusions related to the phenomenon of bone apposition in the fixed prostheses group of patients to be confirmed, further investigations into the relationship between stress distribution in the mandible, bone size, density, and the amount and direction of functional force should have extra concern.

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