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Effect of Implant-Supported Fixed Prosthesiswith or Without Cantilever Extensions on Marginal Bone Loss with Regarding to Technical Complications. Systematic Review and Meta-Analysis

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Abstract

Purpose: *The aim of this study was to test the significant differences of the Marginal Bone Loss (MBL) between implant supported fixed prosthesis with or without cantilever extensions, and to assess whether or not reconstructions with cantilever extensions increase the incidence of technical complications*

Materials and Methods: *A comprehensive electronic searching in PubMed and Cochrane databases up to July 2017 with language restriction to English only. Weinclude any RCT, controlled clinical trials and cohort studies reporting data with regard to the outcome of treatment with implant-supported FPDs with cantilever extensions after a mean function time of at least 3 years. In addition, a manual searchingwas performed for related journals from January 2011 to July 2017. A meta-analysis was performed on all included studies by using a random effect model (mean, 95%confidence intervals [CI]) to pool the effect size.*

Result: *Initial screening and manual searching result in 115 articles from which only 5 articles compatible with our inclusion criteria. No statistical significance was foundbetween implant supported fixed prosthesis with or without cantilever extensions (confidence interval CI = 95 and P = 0.31).*

Conclusion: *No strong evidence to support the difference between implant supported fixed prosthesis with or without cantilever extensionsin the amount of MBL.*

Keywords: *Dental prosthesis, implant supported, fixed partial denture, cantilever*

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I. Introduction

Dental implant technology has developed rapidly in recent years. In the treatment of multiple tooth gaps in partially dentate patients implant borne reconstructions are normally designed in such a way that abutments are located at both ends of the fixed dental prosthesis (FDP). One possible option to this concept is the incorporation of cantilever FDPs borne on implants(Hälg et al 2008). The selection of prosthetic options to replace missing teeth should be based on scientific evidence, in situations where local conditions of the residual edentulous ridge or the presence of anatomical structures (i.e. maxillary sinus, mental foramen) in areas where implants have to be ideally (prosthetically) placed, a number of surgical procedures, such as guided bone regeneration and sinus floor elevation, have been developed , increasing cost and morbidity of complex dental treatment using such approaches, together with a number of related complications, may limit the choice of complex treatment in daily practice(Aglietta et al., 2009).The incorporation of cantilever extensions into implant-borne reconstructions may be considered as an option(Zurdo, Romão, & Wennström, 2009)

For implant-supported FPDs, several papers evaluated the success and survival rates of implant-prosthetic rehabilitations with cantilever extensions, mainly showing an implant behavior similar to that of fixed partial dentures without extensions. However, some papers identified a higher percentage of technical and biological complications for follow-up times of more than 5 years (Zurdo et al., 2009).In implant-supported FDPswith cantilever extensions (ICFDPs) the distribution of masticatory forces appeared not to be uniformly distributed. Higher strain concentrations at the implant sites, especially at the level of the implant–bone interface adjacent to the extension, were noted. Consequently, a higher incidence of complications was expected for implant-supported cantilever FDPs. Moreover, it has been postulated that the presence of excessive force concentrationsmay also lead to bone loss around implants(Kim et al 2014).

Clinical studies reported conflicting results for medium- and long-term outcomes of implant-supported FDPs with cantilever extensions (ICFDPs). Comparing ICFDPs with implant-supported FDPs without cantilever extensions (IFDPs)(Romeo et al., 2003)reported an overall implant survival rate of 97% and a prosthesis success rate of 98% during a follow-up period of 1–7 years. The survival rates were similar for both treatments and, hence, it was concluded that ICFDPs represented a predictable therapy. On the other hand, (Nedir et al 2005)reported a higher number of complications for ICFDPs compared with those encountered for IFDPs (29.4% vs. 7.9%).

At this moment, the influence of cantilever extensions upon MBL and prosthetic/biologic complications remains unclear. This might be attributed to many confounding factors that are known to influence the MBL of implant-supported cantilevered fixed dental prostheses but have not been properly accounted for(Torrecillas-Martínez et al., 2014).The predictability of reconstructions on implants applying cantilevers remains unclear. To date, however, evidence of the effects of various prosthetic designs (e.g. distal or mesial cantilever extension), number of implants supporting ICFDPs and occlusalconcepts on the incidence of complications in ICFDPs is still sparse.

The purpose of the present systematic review was to analyze whether a cantilever extension on a fixed partial denture supported by implants increased the amount of peri-implant bone loss. Another purpose was to assess whether or not reconstructions with cantilever extensions increase the incidence of technical complications.

II. Materials And Methods

A formulated focused problem, intervention, comparator, outcome (PICO) question of this systematic review was: Inpatients needing dental implant rehabilitation could the implant-supported FDPs with cantilever extensions ICFDPs result in equivalent occurrences of Marginal Bone Loss (MBL) when compared to implant-supported FDPs without cantilever extensionsIFDPs?

Search strategy

This systematic review was conducted in accordance with the PRISMA (preferred reporting items for systematic reviews and meta-analyses statement)(Liberati et al., 2009). A systematic review of the English literature was conducted for selected articles published up to July 2017. Searching was performed using an electronic database (Medline, PubMed) and (Cochranelibrary). The combination of the following terms which represent P, I, C AND O elements of PICO format was performed:

(Fixed bridge) OR Fixed bridges) OR Bridge, Fixed) OR Bridges, Fixed) OR Fixed partial denture) OR Fixed partial dentures)OR Denture, Fixed partial) OR Dentures, Fixed partial)OR Partial denture, Fixed) OR Partial dentures, fixed)) AND (Cantilever bridge) OR Cantilever bridges) OR Cantilever fixed bridge) OR Cantilever fixed bridges)) AND (Dental prosthesis, Implant supported) OR Implant-supported dental prosthesis) OR Dental prostheses, implant-supported) OR Implant supported dental prosthesis) OR Implant-supported dental prostheses)OR Prostheses, implant-supported dental) OR Prosthesis, Implant-supported dental) OR Prosthesis dental, implant-supported) OR Dental, implant-supported prosthesis) OR Dental, implant-supported prosthesis) OR Implant-supported prosthesis dental) OR Implant supported prosthesis dental)OR Prosthesis dental, Implant supported) OR Prosthesis dental, Implant-supported) OR Denture, implant-supported) OR Denture implant-supported) OR Implant-supported denture) OR Dentures, Implant-supported) AND (Complications).

Moreover, hand-searching of the following journals was undertaken from January 2011to July 2017: Clinical Implant Dentistry & Related Research ClinicalOral Implants Research, International Journal of Oral & Maxillofacial Implants, International Journal of Periodontics & Restorative Dentistry, Journal of Clinical Periodontology and Journal of Periodontology.Titles and abstracts were initially screened by two independent reviewers (M.A. and M.M.) for possible inclusion criteria's:

1- In vivo studies from 2000 to 2017

2-RCT, controlled clinical trials and cohort studies reporting data with regard to the outcome of treatment with implant-supported FPDPs with cantilever extensions after a mean function time of at least 3 years were accepted for inclusion.

3- Articles in English

4-Patients rehabilitated with partial prostheses with or without cantilevers and sufficient amount of bone to place implants.

While the Exclusion criteria's:

1- Papers with a less than 3-year follow-up were excluded

2- Letters, in vitro studies, systematic reviews and narrative reviews.

3-Studies on overdentures and complete rehabilitations were also excluded.

4-Studies from which data on selected outcome variables could not be retrieved or calculated were not considered.

Studies selection

The 115 abstracts retrieved from the electronic search for possible inclusion in the review. In addition, hand searches were performed on bibliographies of the selected articles. One further article was identified for inclusion after the hand search.The full-text analysis of studies of relevance was conducted independently by the reviewers and disagreement was resolved by discussion.The two reviewers independently assessed the 14full-text articles to determine whether they fulfilled the defined criteria for final inclusion. Any disagreement was resolved by discussion.Five studies were found to qualify for inclusion in the review, while nine studies had to be excluded **Figure (1)**.

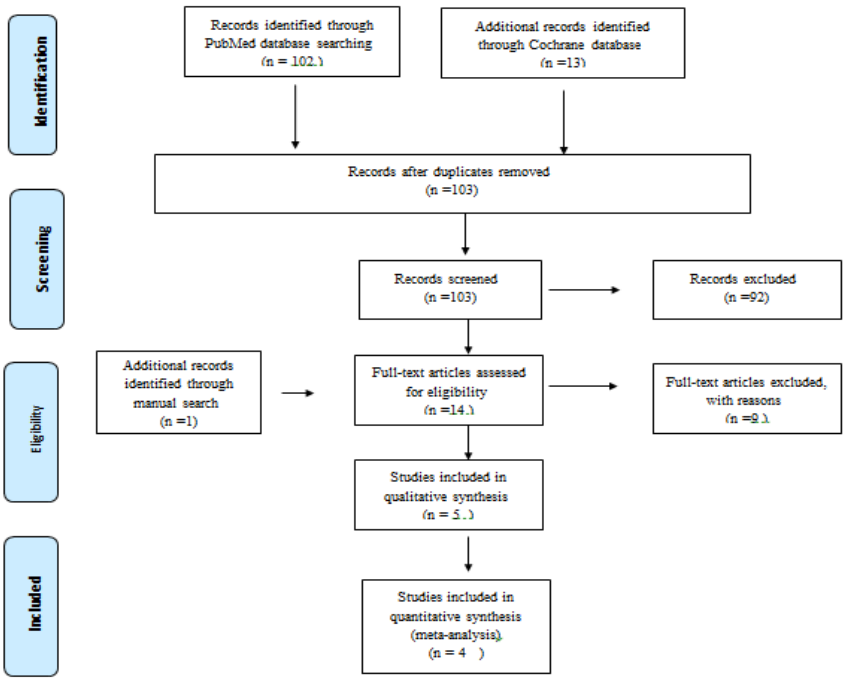


Figure (1): Screening process used to identify eligible studies

Excluded studies

Out of the nine studies that were excluded following full-text analysis, two had reporting data from the same cohort more than once, including five studies no specific data on ICFDPs, and in further two studies selected outcomes from either one groupICFDPs or IFDPs**Table (1).**

Table (1): Excluded studies with reasons of exclusion

Excluded studies	Cause of exclusion
(Brägger et al., 2011),(Brägger et al., 2005)	Reporting data from the same cohort more than once
(Kreissl et al 2007),(Wittneben et al., 2013),(Nedir et al., 2005),(Rammelsberg et al., 2013)(Romeo et al., 2003)	No specific data on ICFDPs**,** selected outcomes not retrievable
(Vanl □og et al., 2013)	No cantilever group
(WU Min-jie et al., 2013)	Only cantilever group

Data extraction

Data were extracted independently by the two reviewers using a data extraction form previously agreed upon. Disagreement regarding data extraction was resolved by discussion and consensus. Studies in which data on a certain variable were lacking or could not be calculated were scored as 'not reported' for the variable in question**Table (2)**.

Quantitative data synthesis Table (3)

Data for the meta-analysis were extracted by two independent reviewers and compared.

Reference	Type of study	Number of patients	Implant system	Follow-up period	Number of reconstructions	number of implants (mean)	Cantilever extension	Type of antagonists	Location of recons-tructions
(Hälg et al 2008)	Case–control studies	54	ITI	5.3 years	Cant: 27 Non-C: 27	Cant: 1.7 Non-C: 1.2	1 crown unit mesial: 12 distal:15	Teeth or FPDPs on teeth	Maxilla : cant 22, non-cant 9 Mandible: cant 24, non-cant 23
(Wennström et al 2004)	Case–control studies	50	Astra Tech	5 years	Cant: 24 Non-C: 26	Cant: 2.6 Non-C: 2.8	Mean 9mm distal	Teeth or FPDPs on teeth except 1 (implant supported FPDP)	Maxilla : cant 12, non-cant 16 Mandible: cant 14, non-cant 8
(Romeo et al 2009)	Prospective cohort	45	Straumann	8.2	59	116	NR Mesial: 32 distal: 27	Natural teeth or fixed partial dentures (n:45) implant-supported FPPs:14	Maxilla:33 Mandible:26
(Palmer et al 2012)	prospective Cohort	28	MT Osseo Speed	3	Cant: 24 Non-C:4	28	6-12 mm	Natural teeth or fixed/removable prosthesis	Maxilla: 20 Mandible: 8
(Kim et al 2014)	A retrospective cohort	206	Neoss3i , Nobel Biocare	4.25	Cant : 128 Non-cant: 144	Cant :132 Non cant : 203	NR mesial: 71 distal:61	NR	Maxilla:cant 80,non-cant 150Mandible: cant39,non-cant:45mandib

Table (2): Characteristics of the included studies

Reference	Lost prostheses	Lost implants	Complications – supraconstruction	Marginal bone loss (mean mm)Implant level	Survival rate
(Hälg et al 2008)	Cant: 3 Non-C: 1	Cant: 2 Non-C: 1	Cant: 6 Non-C: 0	Cant: 0.23(SD±0.71) Non-C: 0.09(SD ±0.45)	Implants Cant : 95.7% for Non- cant : 96.9% Prosthesis Cant: 88.9% Non- cant: 96.3%
(Wennström et al 2004)	Cant: 2 Non-C: 1	Cant: 2 Non-C: 1	Cant: 3 Non-C: 3	Cant: 0.39(SD±0.89) Non-C: 0.23 (SD±0.65)	Cant: 2 (8.3%) Non-C: 1 (3.8%)
(Romeo et al 2009)	No loss	No loss	FPDs superstructure :11	1.1(0.35)	Implants - 90.5-100% Prosthesis 57.7-100%
(Palmer et al 2012)	NR	NR	porcelain fracture: 11 screwloose:8	Cant: 0.50(SD±0.1) Non-Cant:0.40(SD±0.8)	NR
(Kim et al 2014)	Cant: 1 Non-C: 0	Cant: 4 Non-C:1	Cant: 16 Non-C: 7	Cant:0.58(SD± 1.16) Non-Cant: 0.55(SD ±1.030	Implants Cant: 96.7% Non -cant : 99.5% Prosthesis Cant: 92.2% Non -cant : 97.2%

Table (3): Quantitative data of the included studies

The primary outcome was the amount of radiographic bone loss around dental implants. The pooled weighted mean (WM) and the 95% confidence interval (CI) of each variable were estimated and the weighted mean difference (WMD) was also calculated and analyzed with (Review Manager 5.3, The Cochrane Collaboration).

Results

The literature search confirmed the inexistence of publications on RCT comparing the outcomes of implant-supported FPDswith and without cantilever extensions

Characteristics of the included studies (Table 2)

In this review, four of included studies performed a direct comparison between implant-supported fixed prosthesis with or without cantilever extensions with respect to peri-implant Marginal Bone Loss (MBL). All included studies reported a well-defined period of follow-up (3-8.2 years)

The total number of prostheses included in the five studies was 463 (203 with and 260 without cantilever extensions)among the studies. The number of implants supporting the prostheses (197 for cantilever FPDPs and 215 for non-cantilever FPDPs).

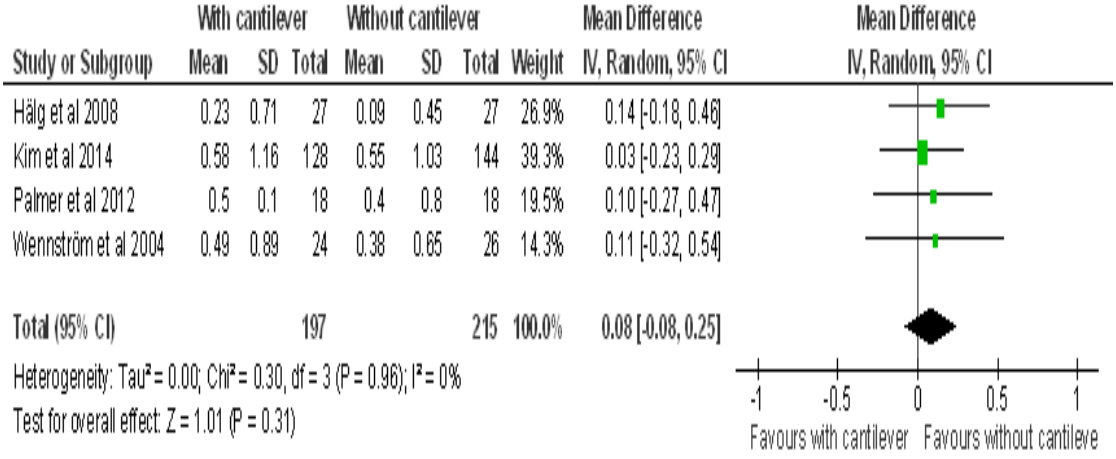
III. Meta-analysis

Results of the Effect of Cantilever Presence on Radiographic Marginal Bone Loss(MBL)

The meta-analysis for the four included studies was performed to assess the same comparisons and outcomes. We use the mean difference for the continuous outcome (MBL) in a software program (RevMan 5.3, 2014).All 4 included studies results were pooled using the randomeffectmodel as statistical heterogeneity among studies where (chi^2 = 0.30P =0.96).

The mean difference of MBL which used in this meta-analysis as an outcome measure for marginal bone loss between implant-supported FPDPswith and without cantilever extensions for all pooled results were 0.08 (−0.08-0.25) with 95% confidence interval. This overall estimate is statistically non-significant with P = 0.31**Figure (2)**.

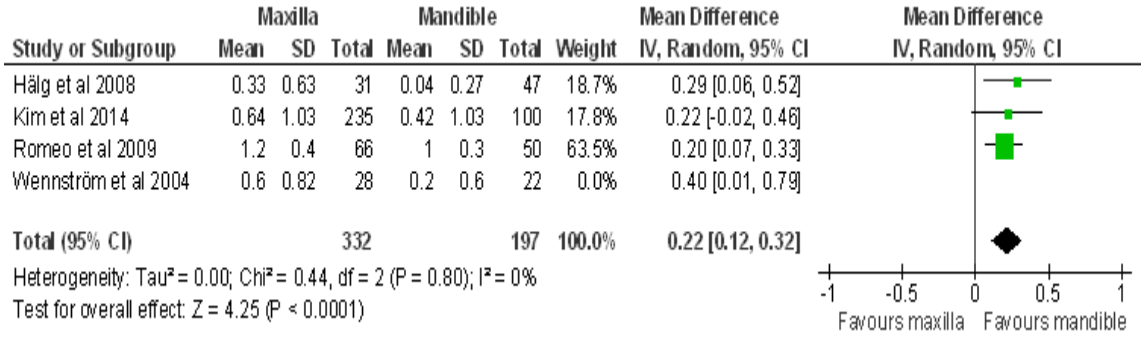
Figure (2): Forest plot of comparisonimplant-supported FPDPswith cantilever extensionsversus implant-supported FPDPswithout cantilever extensions, outcome: 1.1 marginal bone loss (mm)



Results of the Effect of Cantilever location on Radiographic Marginal Bone Loss(MBL)

In this systematic review, the authors use a meta-analysis to compare the effect of the location of cantilever fixed prosthesis either on maxilla or mandible on amount of marginal bone loss, The mean difference of MBL which used in this meta-analysiswere 0.22 (0.12-0.32) with 95% confidence interval. This overall estimate is statistically significant with P <0.00001. The meta-analysis was made with random effect model for the continuous outcome(MBL) as seen in**Figure (3).**

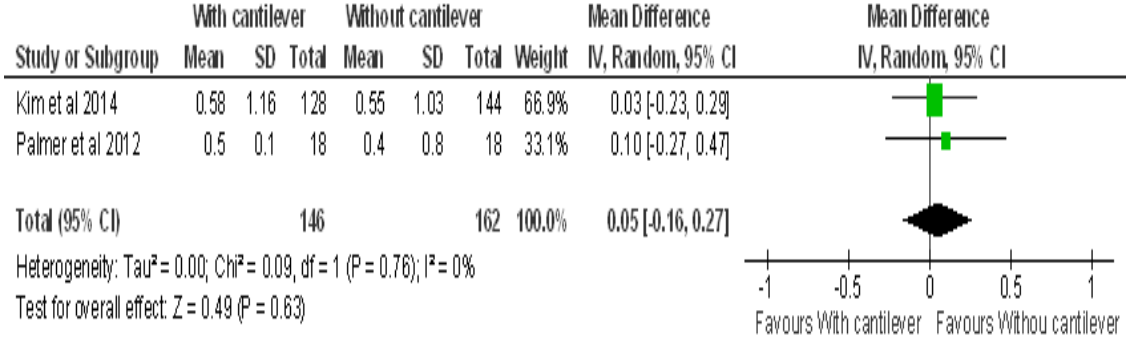
Figure (3): Forest plot of comparison implant-supported FPDPswith cantilever extensions in maxillaversus mandible , outcome: 1.1 marginal bone loss (mm)



Marginal bone loss with single implant supported prosthesis with or without cantilever extensions

Bone loss was reported in two studies (Kim et al., 2014)and (Palmer et al., 2012),The mean difference of MBL which used in this meta-analysiswere 0.05 (-0.16-0.27) with 95% confidence interval. This overall estimate is statistically insignificant with *P* =0.63. The meta-analysis was made with random effect model for the continuous outcome (MBL) as seen in**Figure (4)**

Figure (4): Forest plot of comparisonsingle implant supported prosthesis with or without cantilever extensions outcome: 1.1 marginal bone loss (mm)



Loss of implants and prostheses

Only data relative to post-loading implant survival rates (e.g. failures that occurred after loading, without accounting for implants lost during the initial healing period) were available **Table 3**. Overall, from the 528implants available for analysis, eleven losses were registered, eight implants support cantilever fixed prosthesis and three implants support fixed prosthesis without cantilever extensions (Hälg et al., 2008)(Wennström et al., 2004)(Kim et al., 2014).Regarding loss of prosthesis from the 463 restorations available for analysis, eight losses were registered, six implants support cantilever fixed prosthesis and two implants support fixed prosthesis without cantilever extensions(Hälg et al., 2008)(Wennström et al., 2004)(Kim et al 2014), while (Romeo et al 2009)reported no loss in either implants or prosthesis and (Palmer et al 2012)not reporting any information regarding implants or prosthesis loss.The survival rate of implants were reported in two studies(Hälg et al., 2008) and (Palmer et al., 2012) range from 95.7-96.7% respectively for implants in fixed prosthesis with cantilever extensions ,while survival rate of prosthesis were reported in (Hälg et al., 2008), (Romeo et al 2009) and (Kim et al 2014) range from 88.9- 96.7% for fixed prosthesis with cantilever extension and from 96.3- 99.5% for fixed prosthesis without cantilever extension.

Technical complications – supra-constructions

Technical complications related to the supra-constructions in the three included studies were reported to occur. The most common complications were minor porcelain fractures and bridge-screw loosening.(Wennström et al., 2004) reported a total of six incidences (three bridge-screw loosening and three minor porcelain fractures), equally distributed between the cantilever and the non-cantilever FDP groups. (Hälg et al., 2008)also reported six events, but all occurring in the cantilever-FDP group (one supra- structure fracture, four minor porcelain fracture, and one re-cementation).(Romeo et al 2009)reported three prosthesis decementations were observed, 17 esthetic veneer fractures. (Palmer et al 2012)reported minor complications such as 11 porcelain veneer fracture and 8 abutment screw loosening , finally (Kim et al 2014)reported16 incidences of technical complications were recorded in fixed bridges with cantilever extension (1 prosthesis fracture, nine occasions of abutment screw loosening, five abutment screw fractures and 1 implant

fracture)while fixed bridges without cantilever extension shows Seven instances of complications were recorded, which included four cases of abutment screw loosening and three abutment screw fractures.

IV. Discussion

In the present systematic review, a large number of longitudinal cohort studies were analyzed with respect to complications in implant therapy. On the other hand, randomization of differently supported FDPs (exclusively conventional or cantilever implants) is difficult to perform because the decision on these different treatment options is based on surgical limitations, cost, and patient preferences. Regarding implant-supported prostheses, in vitro studies have reported that those implants supporting the cantilever receive non axial occlusal forces, resulting in a higher stress transmission at the neck of the implant, which might trigger peri-implant bone resorption(Sertgöz& Güvener, 1996).The concept of implants supporting a cantilever extension is considered in the discussion by (Aglietta et al., 2009), particularly for cases where there is insufficient space for two implants or a second implant may jeopardize the aesthetics or periodontal health of adjacent teeth. However, they concluded that scientific evidence for this concept is lacking.

There are two categories of complication that occur in implant therapy: biological and technical (mechanical). 'Biological complications' refer to disturbances in the function the implant characterized by biological processes that affect the tissues supporting the implant. It includes reactions in the peri-implant hard and soft tissues, and the detection of such complications requires adequate clinical and radiographic examination methods. Technical complications' serve as a collective term for mechanical damage of the implant/implant components and supra structures (Berglundh & Persson, 2002).The stability of the bone around the implant is the key to success. The amount of resorption is an important indicator to assess implant success ,marginal bone resorption (MBL) has been studied and used as a reference parameter to define therapeutic success(Romeo et al., 2003), radiographic bone-level changes around implants supporting prostheses with cantilever extensions were compared with implant-supported FDPs without cantilever extensions (IFDPs).It is generally acknowledged that longitudinal studies with a time span of at least 3 years are required to properly evaluate the outcome of implant treatment as the observation period of 3 years or more seemed sufficient enough for such complications to appear clinically and/or in the radiographs(Torrecillas-Martínez et al., 2014).

The results of the present meta-analysis showed that there was no overall statistical difference in marginal bone loss between ICFDPsand IFDPs without cantilever extensions, despite the relatively stronger statistical power of the present study in comparison to previously published similar works. This result was the same also for single implant- supported FDPs. Systematic reviews have all concurred with these findings at both prosthesis and implant level (Aglietta et al., 2009)(Zurdo et al., 2009).There was a tendency for more bone loss in the implants supporting maxillary prostheses compared with slight bone gains in those supporting mandibular prostheses. These differences were approaching significance. This difference between the maxilla and the mandible is in agreement with findings of previous clinical studies (J. Wennström et al., 2004)and (Palmer et al., 2012)there was a suggestion that changes in the lower jaw were less, possibly due to the presence of a higher level of compact marginal bone in the mandible compared with the maxilla.

Two studies compared the 5-year outcomes of ICFDPs and implant-supported FDPs without cantilever extensions (IFDPs) (J. Wennström et al., 2004); (Hälg et al., 2008). Ha¨lg et al reported a difference in the survival rate of ICFDPs and IFDPs (89.9% vs. 96.3%, Po0.05), as well as a higher number of technical complications in ICFDPs compared with IFDPs. On the other hand, no difference was reported between the two groups with respect to implant failures and radiographic bone-level changes. Similarly, Wennstro¨m et al. (2004) reported comparable changes in radiographic bone levels around implants supporting ICFDPs with IFDPs. Based on the two studies included in the current review, the calculated overall prosthesis survival rate was 90.55% for ICFDPs, compared with 96.75% for implant-supported FDPs without cantilever extensions. Although these figures may indicate a somewhat inferior performance for the cantilever prostheses, the results should be interpreted with caution because the sample size is small.With respect to studies involving technical complications, higher complication rate appears to occur in ICFDPs(Nedir et al., 2005); (Kreissl et al., 2007); (Romeo et al., 2009); (Brägger et al., 2011); (Palmer et al., 2012)), although few authors have shown higher success rate for ICFDPs ((Romeo et al., 2003); (Becker & Kaiser, 2000); (Eliasson, Eriksson, Johansson, & Wennerberg, 2006)). A systematic review concluded that much of this increased technical failure is related to minor screw loosening, screw fracture and veneer fracture ((Zurdo et al., 2009).

However, when analyzing within the group of implants that presented with technical complications irrespective of the presence of cantilever, there was a significant association between biological and technical complications(Kim et al., 2014)

The fact that the four implants that fractured in the cantilever groups of the two case–control studies included in the current systematic review had a narrow diameter (3.3–3.5mm) suggests that the implants diameter should be considered when evaluating the mechanical risks of a specific prosthetic design.As a consequence, it has to be advocated to avoid the use of diameter-reduced implants in the proximity of cantilever extensions in ICFDPs. While (Kim et al., 2014) reported that four implants were lost one of them due implant fracture and the other three implants the author didn't report the cause of failure.

The length, height, and position of the cantilever (mesial or distal) could not be analyzed in the present study. (Romeo et al., 2009) showed that it does not matter, in terms of peri-implant bone resorption, where the cantilever is located. Another confounding factor that might be considered when assessing peri- implant bone loss is the crown-implant ratio. (Blanes et al 2007) and, more recently, (Garaicoa-Pazmiño et al., 2014) have demonstrated that prosthesis height does not influence the crestal stress concentration, as displayed by no significantly higher MBL.

Further biases that may cause misleading results are that MBL could be influenced by many factors and that it is not limited only to the presence/absence of a cantilever extension. For example, the implant connection has been demonstrated to be a critical factor in the initial MBL and its progression(Peñarrocha-Diago et al., 2013)these data were not sufficiently clear in some of the included studies.Peri-implantitis is an important biological complication resulting in bone loss but was not considered as an outcome in the current review because of the lack of a plausible biological relationship with the presence/absence of cantilever extension.A retrospective study by (Wennerberg & Jemt, 1999)of implant treatment in the partially edentulous patient concluded that there appeared to be a greater risk of mechanical implant overload when implants were placed in the maxilla to support a unilateral free-end restoration. Loosened screws were found more frequently in implants supported the prosthesis.

On the contrary, there are no available studies on the behavior of mesial cantilever prostheses as compared with distal cantileverprostheses. It can be argued that biomechanical loads applied to the cantilever will be more intensive whether this is mesial or distal(Romeo et al., 2009).In other side,(Kim et al., 2014) illustrated that the higher the technical complications were associated with increase cantilever arm , as a lengthier cantilever might for example be related to design features that compromise access to oral hygiene.The variety of results between the different publications selected for the present systematic review may be explained from different aspects. The number of implant-supporting ICFDPs could have an effect on the survival and success of the prostheses. In the papers selected for the present systematic review, the number of implants per prosthesis varied between one and three.he data, however, might point out to the fact that implant complications are complex and multifactorial in nature and it is likely that the factors which cause an abutment screw loosening can initiate a chain of events leading to or including plaque-induced peri-implant tissue inflammation and marginal bone loss(Kim et al., 2014)Accordingly, authors do not recommend the use of cantilever extensions as the treatment of choice. Case selection remains the key determinant when selecting the type of prosthesis

V. Conclusions

1- The incorporation of cantilevers into implant-borne prostheses did not have any significant effect on the amount of peri-implant marginal bone loss.
2-The position of the cantilever FPDPs in either maxilla or mandible did influence the bone loss at the follow-up examination
3- The survival rate was high for both cantilever and non-cantilever FPDPs.
4- The most common reason for loss of FPDPs with cantilever extensions were implant fracture.

Clinical implications

This is in agreement with a recent consensus statement by the European Association for Osseointegration, which indicated that "an implant-supported fixed partial dental prosthesis with a short extension (one unit) is an acceptable restorative therapy, and might be considered as an alternative to procedures that require more advanced surgery (e.g., sinus graft, etc.) or for esthetic reasons.

Recommendations for treatment with ICFDPs

1- Increase the number, diameter, length and position of dental implants improve the transmission of stress to bone
2- With regard to spacing implants, a span of at least 8 mm between the centers of implants seems appropriate.
3- Keeping the size of the cantilever to the mesiodistal dimension of a premolar will be recommended.
4- With regard to connector, increase the stiffness and resistance to deformation of the metal substructure of the cantilever, the clinician can increase its thickness in height and width.

5- With regard to tightening of a screw in screw retained prosthesis use torque value for abutment screws according to the manufacturers' recommendations
6-Implants with rough rather than smooth dental surfaces provide better retention to bone and a greater surface area to transmit stresses to the bone
7-The clinician can modify the occlusion to reduce occlusal stress in a number of ways: place the cantilever in infra occlusion (0.1-0.2 mm), Use low cuspal inclines, use a narrow occlusal table and provide vertically directed centric contacts in the prosthesis. In addition, the patient can wear a night guard to buffer forces applied while sleeping**.**

Research recommendations

- There is a clear need for improvement, not only in the design of clinical studies but also in the quality of reporting in the field of implant- supported reconstructions.
- Long-term cohort studies on implant-supported reconstructions should have complete follow-up information for all patients, preferably with similar, well- defined observation periods.
- In terms of reporting, survival of implants/implant-supported reconstructions and presence or absence of biological, technical/mechanical complications should be well defined, assessed, and properly reported.

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