

One abutment one time vs. repeatable abutment disconnections in implants, restored with cemented / screw retained fixed partial dentures: Marginal bone level changes. A systematic review and meta-analysis

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SUMMARY

Purpose. The aim of this systematic review and meta-analysis is to evaluate the impact of abutment disconnections / reconnections on peri-implant marginal bone loss changes in partially edentulous patients.

Methods. Clinical studies were selected via electronic and hand searches in English language journals until January 1, 2020. Only randomized clinical trials (RCTs) and prospective controlled clinical trials (CCTs) showing direct comparison between the definitive implant abutments and multiple abutment replacements in the same patient or different patient groups in the partially edentulous patients were considered. The outcome measures were (1) the type of the abutment was used, (2) the time the abutment was placed, (3) marginal bone loss changes, (4) biological complications, (5) mechanical complications.

Results. After evaluation, 4 controlled clinical studies were included. Majority of the articles revealed protective marginal bone loss preservation for the implants with FAP (final abutment placement) at the time of implant placement compared with the implants with MAP (multiple abutment placements) in connected dental implants, in partially edentulous patients. Meta-analysis of the four studies with 280 implants revealed significantly greater bone loss in cases with multiple abutment disconnections/reconnections. The weighted mean difference in marginal bone loss was 0.4 mm (95% confidence interval, 0.16-0.63 mm), showing bone preservation in the FAP group.

Conclusion. Within the limitations of this meta-analysis, multiple abutments disconnections significantly affected marginal bone loss changes in partially edentulous patients. The finding suggests to overview current prosthetic and surgical treatment planning protocols to prevent greater marginal bone loss.

Keywords: marginal bone loss, final abutment, definitive abutment, abutment level, one abutment one time, final abutment placement, multiple abutment placement, fixed partial dentures.

INTRODUCTION

Disconnection of healing or prosthetic abutments has always been a controversial topic in implant dentistry.

Becker *et al.* reported that disruption of the peri-implant mucosal seal affected marginal bone loss, when abutments were disconnected and reconnected twice from implants with internal conical connection

(1). Canullo *et al.* suggested on that "one abutment – one time" concept – when you place the prosthetic abutment once and leave it till the delivery of the final restoration, might be a possible additional strategy to further minimize peri-implant crestal bone resorption. He reported 0.2 mm greater MBL (marginal bone loss) in the provisional abutment group in 3 years period compared with the definitive abutment group (11).

The presence of misfit between the framework and the implant, although inevitable during the prosthetic procedures, could generate uneven stresses and strains, which may be relevant to complications such as: screw fracture, framework fracture, implant

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fracture, marginal bone loss (MBL) and implant loss (2). In contrast to abutment level (AL) setup, the accuracy of implant level (IL) framework seems to be negatively affected by implant disparallelism, when using systems with internal connections (3). However compared with cemented restorations, screw-retained fixed partial dentures (FPD) have shown a lower incidence of biologic complications and an easier retrievability (4). This abutment level setup would protect the dental implant from overload and counter balance potential misfit between framework and the implants (5).

A 1 year prospective clinical study done by Gotheberg *et al.*, used dental implants with external hexagonal connection (6). They observed greater marginal bone resorption on the IL than AL setup in screw retained restorations. Based on the current literature, the IL setup has an unclear clinical recommendations and the choice between AL and IL setup is datable (7).

Degidi *et al.* reported no statistically significant difference between the one abutment one time group and control group regarding the measurement of vertical bone healing in subcrestally (2 mm) placed postextractive tapered single dental implants, which were restored immediately (10). Although Grandi *et al.* showed opposite results – after 12 months period implants in the DA group lost an average of 0.11 mm (SD: 0.06) peri-implant bone, implants in PA group about 0.58 mm periimplant bone (SD: 0.11), statistically significant difference in bone level change between the groups (mean difference: 0.48 mm, CI 95% 0.04; 0.55, $P < 0.0001$) (12). In both studies dental implants were placed immediately and restored with immediate cemented temporary restorations without occlusive contact. Duda *et al.* revealed that two delayed placed dental implants showed less MBL (average 0.82 mm in 1 year) compared with single immediately placed and loaded dental implants (average 1.32 mm in 1 year) (13). From these presented articles it is unclear- is one abutment one time protocol could be more beneficial for the MBL compared to the standard treatment protocol according to the implant placement time, implant loading time. As well according to the prostheses fixation type, we missing articles with screw retained restorations for the one abutment one type treatment protocol. At last we cannot exclude the fact that gingiva type having a huge impact to the MBL and overall results of the treatment.

The aim of this systematic review was to evaluate the impact of abutment disconnection/ reconnection on peri-implant marginal bone loss changes in partially edentulous patients, treated with cemented and screw retained restorations.

MATERIALS AND METHODS

Search strategy

Focused question

The main research question- do the multiple implant abutment disconnections have statistically significant difference compared with definitive placed implant abutment on marginal bone loss changes in partially edentulous patients, treated with cemented and screw retained restorations. Secondary outcome would be evaluation of biological complications and mechanical complications overviewed if they are reported.

Search strategy

A MEDLINE search (PubMed) was performed to find articles published in the English language up to and including January 2020. The following combinations of search terms used: "Dental implants" {Mesh} AND "final abutment" AND "definitive abutment" AND "abutment level" AND "one abutment one time" AND "marginal bone loss" AND "clinical study" AND "clinical trial". Furthermore, the manual search included all full-text articles and other related reviews selected from the electronic search in the following journals: Clinical Implant Dentistry and Related Research, Clinical Oral Implants Research, European Journal of Oral Implants, Implant Dentistry, International Journal of Periodontics and Restorative Dentistry, Journal of Oral and Maxillofacial Surgery, Journal of Clinical Periodontology, Journal of Periodontal Research, Journal of Periodontology and European Journal of Oral Implantology. The electronic research was complemented by manual searching in the bibliographies of the most recent systematic reviews and all references of the included publications.

Inclusion criteria

The criteria for the study inclusion were as follows:

1. Clinical studies with direct comparison between definitive and / or provisional abutments in partially edentulous patients where two or more dental implants were connected, in the same patient or comparing two different groups of the patients.
2. Studies with at least 10 patients.
3. Studies with a mean follow-up of at least 1 year.
4. Studies reporting marginal bone level changes.

Exclusion criteria

1. Case series.
2. Case reports.
3. Animal studies.

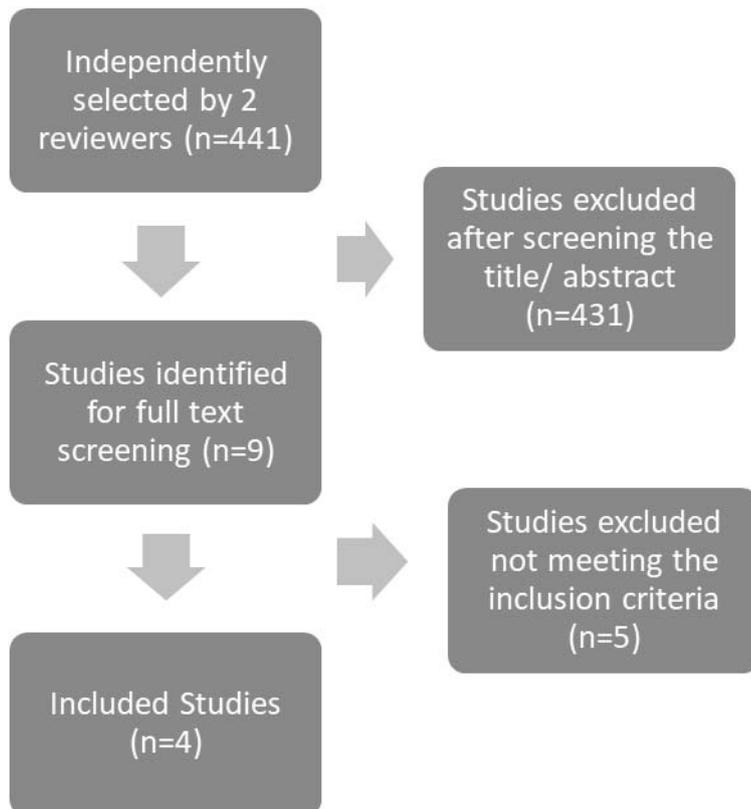


Fig. 1. Overview of the search strategy

Data extraction

Two reviewers (IV and TL) extracted relevant data from the selected articles independently, using a specially designed data extraction methodology. Any disagreement was resolved through discussion, leading to consensus. Meta-analysis was performed only if the study full fills all inclusion criteria.

RESULTS

The initial search revealed 441 article titles and abstracts (Fig. 1). After application of the inclusion criteria, 9 articles selected for the full text evaluation. Further evaluation led to the exclusion of the 5 studies. One study was excluded because of inadequate 6 months follow up period (9). Other 4 articles were excluded because the marginal bone loss changes were evaluated around single dental implants not in the partially edentulous patients where 2 or more

dental implants were connected (10-13). Four controlled clinical studies were approved by inclusion criteria, all studies reported marginal bone loss changes as an outcome.

Three of the four included studies were randomized controlled clinical studies (14, 16, 17), one – controlled clinical trial (18). Totally 280 dental implants evaluated, the average age of the participants in the studies varies between 49.9 to 58.9 years old. Post placement follow up time varies from 12 months to 36 months. All 280 implants used in the studies had a rough crestal collar, conical internal connection (Table 1). Two studies evaluated groups with 4 abutment disconnections/reconnections (16, 18), 2 studies evaluated 3 abutment disconnections/ reconnections before definitive abutment placement (14, 17). One study reported peri-implant mucosal dimensional changes, patient satisfaction (14). One study reported probing depths and bleeding on probing (17). One study declared – no significant statistical difference in terms of measured vertical bone healing (18). Although other three studies revealed – there were statistically significant differences between

the two groups for peri-implant bone loss changes (Table 2). Overall in all studies were guidelines that marginal bone loss preservation in the FAP group more predictable compared with the MAP group. The marginal bone loss changes ranged from 0.086 mm to 1.047 mm for MAP group and from 0.005 mm to 0.846 mm for the FAP group.

Two studies reported mechanical complications. In one study five patients from the definitive abutment group and four patients from the repeated disconnection group were affected by complications (difference – 4%; CI 95%: -11%, 20%; P=0.725) (14). In another study – one abutment loosening at MAP group and one chip-off fracture was reported in the FAP group, overall failure rate at 1Y was 2% (17).

Statistical Analyses

A meta-analysis integrates the quantitative findings from separate but similar studies and provides

Table 1. Main characteristics of included studies

Study	Year	Design	Funding	Implant	No. recon	Smokers	Timing of placement	Follow up months	Flap design
Degidi <i>et al.</i>	2011	CT	NA	Densply	4	Yes	Delayed	36	Full thickness
Toia <i>et al.</i>	2018	RCT	Densply	Densply	3	Yes	Delayed	12	Full thickness
Nader <i>et al.</i>	2016	RCT	NA	Zimer dental	4	Yes	Delayed	12	Full thickness
Bresson <i>et al.</i>	2017	RTC	Densply	Densply	3	Yes	Imediat	36	Flapless

NA – not available; RCT – randomized controlled trial; CT – controlled trial.

a numerical estimate of the overall effect of interest (15) Petrie *et al.*, 2003). Fixed effects model was used. Under the fixed effects model, it is assumed that all studies come from a common population, and that the effect size SMD (Standardized Mean Difference) is not significantly different among the different trials (Table 3). This assumption is tested by the "Heterogeneity test" (Table 4). If this test yields a low P-value ($P < 0.05$), then the fixed effects model maybe not the best. For meta-analysis of studies with a continuous measure (comparison of means between treated cases and controls), MedCalc uses the Hedges g statistic (in our case "Q" as a formulation for the standardized mean difference under the fixed effects model. The standardized mean difference Hedges g ("Q") is the difference between the two means divided by the pooled standard deviation, with an adjustment for small sample bias.

The meta-analysis was performed, MBL (marginal bone loss) evaluated as the primary outcome. The differences in marginal bone level changes between two groups FAP and MAP was estimated as the effect size measure. The authors used fixed and random effects model for the analysis (Table 3). Forest plots were formulated to report the weighted average of outcome and 95% confidence intervals (CIs) (Fig. 2). The a level was set at 0.5.

There were assessed four studies (14, 16-18) in the meta-analysis (Table 3) Tests for heterogeneity demonstrated slight heterogeneity ($DF=3$, $Q=1.3018$, $P=0.7287$ ($P > 0.05$)) (Table 4). The random and fixed effects model was used for the analysis. Both models

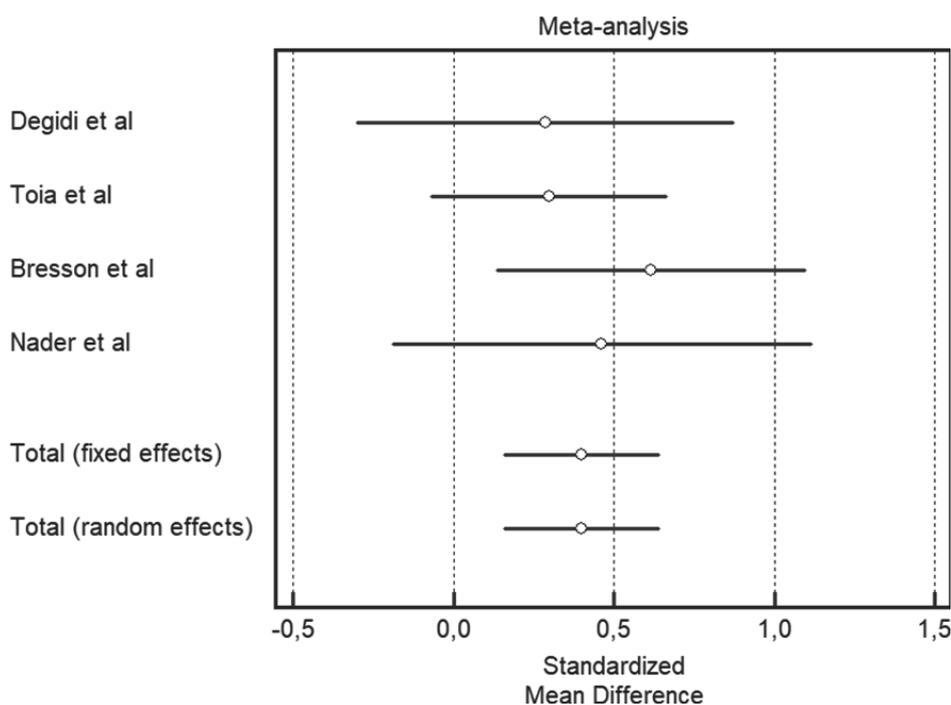


Fig. 2. Forest plot of the fixed and random effects meta-analysis of the marginal bone level outcome

Table 2. Outcome assessment of included studies

Study	MAP placed implants	FAP placed implants	MBL change \pm SD (mm) MAP	MBL change \pm SD (mm) FAP
<i>Degidi et al.</i>	24	24	0.15 \pm 0.28	0.07 \pm 0.27
<i>Toia et al.</i>	58	61	0.086 \pm 0.313	0.005 \pm 0.222
<i>Bresson et al.</i>	39	34	0.50 \pm 0.93	0.07 \pm 0.18
<i>Nader et al.</i>	20	20	1.047 \pm 0.395	0.846 \pm 0.454

SD – standard deviation; MAP – multiple abutment placements; FAP – final abutment placement; MBL – marginal bone loss.

Table 3. Meta-analysis continuous measure

Variable for studies	Study		
1. MAP groups	Variable for number of cases	Treated_N	
	Variable for mean	Treated_Mean	
	Variable for SD	Treated_SD	
2. FAP groups	Variable for number of cases	Controls_N	
	Variable for mean	Controls_Mean	
	Variable for SD	Controls_SD	

Study	MAP groups	FAP groups	Total	SMD	95% CI
<i>Degidi et al.</i>	24	24	48	0.286	-0.298 to 0.870
<i>Toia et al.</i>	58	61	119	0.298	-0.0674 to 0.663
<i>Bresson et al.</i>	39	34	73	0.615	0.136 to 1.095
<i>Nader et al.</i>	20	20	40	0.463	-0.187 to 1.113
Total (fixed effects)	141	139	280	0.400	0.162 to 0.638
Total (random effects)	141	139	280	0.400	0.162 to 0.638

SD – standard deviation; MAP – multiple abutment placements; FAP – final abutment placement.

Table 4. Test for heterogeneity

Q	1.3018
DF	3
Significance level	$P = 0.7287$ ($P > 0.05$)

meta- analysis of four studies showed the same result – an increase mean (95%CI) marginal bone loss of 0.4 mm (0.16-0.63 mm).

DISCUSSION

The results of current meta- analysis demonstrate that multiple abutment disconnections/ reconnections having an effect on marginal bone level changes around the dental implants in partially edentulous patients (Table 3).

From the experimental studies it seems that multiple (5 times) abutment disconnections and reconnections may have an effect on the soft and hard peri-implant tissue alterations (19). It was unpredictable that we found only one article with screw retained final restorations in the AL groups in partially edentulous patients (17). Other two studies did not exactly disclose the method of fixation final prostheses on the DA (14, 18). Because of that we now can make the statement that till now we do not know exactly are the AL screw retained restorations is better than IL screw retained restorations in partially edentulous patients according to the MBL.

Degidi *et al.* declared no statistically significant difference was evidenced between the one abutment one time and control groups regarding the measurement of vertical bone healing (18). In this study implants were placed at least 1 mm subcrestaly, stable conical connection and no soft tissue data could had an impact on the results of this study. Opposite results presented by Bressan *et al.* the mean MBL 3 years after loading was 0.07 (0.18) mm for the DA (definitive abutment) group and 0.50 (0.93) mm for the RA (repeated abutment) changes group (difference – 0.43 mm; CI 95%: 0.13, 0.74; P=0.007) (14). The implants in this study all so were placed subcrestaly for 1 mm, but immediate, flapless implant placement was accepted as well bone augmentation during Immediate implant placement, different implant diameters were used, nevertheless the single and multiple implant placement cases up to three implants were accepted in the groups. Similar results presented by Nader *et al.* DA group 0.84±0.45 mm, PA group 1.0±0.39 mm in 1 year period. In this study one abutment one time and standard protocol was used in the same site for the same patient, implants were placed 0.5 mm subcrestaly, only delayed implant placement and prosthetic protocols were used. Final restorations were cemented, conical connection implants used (16). It has been demonstrated that placement of the abutment margin submucosally increases the amount of undetected cement (20). It may lead to submucosal plaque accumulation. Clinical studies have shown a

correlation between the development of peri-implant mucositis and plaque accumulation (21, 22). It may lead to greater MBL changes.

More over Toia *et al.* showed the significant difference of MBL between the IL (implant level) and AL (abutment level) groups (P=0.003). At 1 year , MBL was 0.084±0.31 mm and 0.005±0.22 mm in the IL and AL groups, respectively. The study reveals that final restorations- screw retained in both groups. The more concerning fact that in the study different gingiva high definitive abutments were used, that probably means that patients had different gingiva types. Thickness of peri – implant mucosa has been reported as a significant factor determining the apico – coronal dimensions of the peri – implant mucosa (23, 24). Studies demonstrating that dental implants placed with an initially thicker peri – implant soft tissue have less radiographic MBL in the short term (25). All in the meta – analysis involved articles as a final restoration material chosen metal ceramics, these days zirconium would be more acceptable and gingiva friendly material (26).

Despite differences in treatment protocols of the included studies such as: location of the implant platform according to the alveolar crest, flap reflection type, using of artificial bone substitutes, timing of the implant placement, type of the fixation of the final or temporary prostheses, material of the final restorations, gingiva type, studies demonstrated protective effect on the marginal bone loss for FAP group. Reducing the number of disconnections/ reconnections of the dental implant abutments may be beneficial overlooking the treatment protocol.

Ensuring adequate soft tissue thickness might be useful protecting the bone underneath and having less MBL. Using soft tissue friendly material as zirconium and screw retained final restorations, research with more standardized treatment protocol could be beneficial in the future.

CONCLUSION

Within the limitations of this meta-analysis, multiple abutments disconnections significantly affected marginal bone loss changes in partially edentulous patients with cement / screw retained restorations. Future researches using AL (abutment level) screw retained restorations is necessity to understand is this treatment can be more beneficial according to the MBL in the partially edentulous patients.

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