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Research Article

Evaluate The Effect Of Various Titanium Abutment Modifications On The Behavior Of Peri-Implant Soft Tissue Healing, Inflammation, And Maintenance: A Systematic Review And Meta-Analysis

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Abstract

Background and aim: It is not yet known what effects different titanium supports can have on the soft tissue response. Therefore, the aim of current Systematic Review and Meta-Analysis study was evaluate the effect of Various Titanium Abutment Modifications on the behavior of Peri-Implant Soft Tissue healing, inflammation, and maintenance.

Method: From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last ten years between 2011 and May 2021. For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Risk-Ratio with 95% confidence interval (CI), fixed effect model with Mantel-Haenszel method and Mean difference with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Result: 571 studies were selected to review the abstracts, the full text of 14 studies was reviewed. Finally, five studies were selected. Risk ratio of bleeding on probing and Plaque index between test and control group was -0.03 (RR, -0.03 95% CI -1.15, 1.10. P>0.05) and 0.21 (RR, 0.21 95% CI -0.30, 0.72. P>0.05), respectively.

Conclusion: The present Systematic Review and Meta-Analysis study showed that there is no difference in Bleeding on probing, Plaque index and Probing depth between machined and modified titanium healing abutments.

Key words: Titanium Abutment, Soft Tissue healing, Peri-Implant, implant, modified titanium

Introduction

One of the common methods in dentistry is the use of osseointegrated titanium implants(1). Machined titanium implants have been used in the clinic for over 50 years, and the surface properties of titanium implants have been instrumental in the success of dental implants(2). Over time, surface titanium modifications have been investigated, and moderately roughened surfaces have been able to show faster bone formation, compared to machined surfaces(3, 4).

Surface roughness plays an important role in cellular reactions, tissue improvement and implant stability(5, 6). Various methods are used to change the surface topography on the surfaces of titanium implants at different thicknesses to enhance ossification, including machining, air-abrasion, acid etching, electrochemical oxidation, and laser treatment(7, 8). Studies have shown that the exact role of modified titanium surfaces in contact with the soft tissue around the implant is unclear and should be further investigated(9). Studies have also shown that the soft tissue around the implant may form a biological seal, and some studies have reported that using machined titanium abutments there is the presence of a circular system of collagen fibers around the abutment. Recently it has been reported that modified prosthetic abutment surface promotes the creation of a perpendicular collagen fiber attachment to the abutment (10-14). Studies have shown that the treatment of titanium surface may affect the quality / quantity of cell attachment as well as the healing process and response(15, 16).

It is not yet known what effects different titanium supports can have on the soft tissue response.

Therefore, the aim of current Systematic Review and Meta-Analysis study was evaluate the effect of Various Titanium Abutment Modifications on the behavior of Peri-Implant Soft Tissue healing, inflammation, and maintenance.

Methods

Search strategy

From the electronic databases, PubMed, Scopus, LILACS, Web of Science, EBSCO, LIVIVO, and Embase have been used to perform a systematic literature over the last ten years between 2011 and May 2021. The reason for choosing studies in the last ten years is to be able to provide sufficient evidence in this area and use newer studies. Therefore, a software program (Endnote X8) has been utilized for managing the electronic titles.

Searches were performed with mesh terms:

(((((("Titanium"[Mesh]) AND "Dental Implants"[Mesh]) AND "Dental Plaque Index"[Mesh]) AND "Periodontal Index"[Mesh]) AND "Dental Implantation"[Mesh]) AND ("Dental Implant-Abutment Design"[Mesh] OR "Denture Precision Attachment"[Mesh] OR "Dental Abutments"[Mesh] OR "Dental Implantation, Endosseous"[Mesh]).

This systematic review has been conducted on the basis of the key consideration of the PRISMA Statement– Perfumed Reporting Items for the Systematic Review and Meta-analysis(17), and PECO strategy (Table1).

Selection criteria

Inclusion criteria: Randomized controlled trials studies, controlled clinical trials, and prospective and retrospective cohort studies; at least 1-month healing after abutment connection; in English. In vitro studies, case studies, case reports and reviews were excluded from the study.

Table1. PECO strategy

PECO strategy	Description
P	Population: Patients that have dental implants with titanium abutment support
E	Exposure: abutment surface modification different from machined titanium
C	Comparison: machined titanium abutment
O	Outcome: plaque index, bleeding on probing and probing depth

Study selection, Data Extraction and method of analysis

The data have been extracted from the research included with regard to the study, years, study design, number of patients and implants, time of evaluate periodontal parameter, prosthesis type and periodontal measurements. The quality of the randomized control trial studies included was assessed using the Cochrane Collaboration's tool(18). The scale scores for low risk was 1 and for High and unclear risk was 0. Scale scores range from 0 to 6. A higher score means higher quality.

For Data extraction, two reviewers blind and independently extracted data from abstract and full text of studies that included. Prior to the screening, kappa statistics was carried out in order to verify the agreement level between the reviewers. The kappa values were higher than 0.80.

Risk-Ratio with 95% confidence interval (CI), fixed effect model with Mantel-Haenszel method and Mean difference with 95% confidence interval (CI), fixed effect model and Inverse-variance method were calculated. Random effects were used to deal with potential heterogeneity and I^2 showed heterogeneity. I^2 values above 50% signified moderate-to-high heterogeneity. The Meta analysis have been evaluated with the statistical software Stata/MP v.16 (The fastest version of Stata).

Results

According to the purpose of the study, in the initial search with keywords, 610 articles were found. In the first step of selecting studies 571 studies were selected to review the abstracts. Then, studies that did not meet the inclusion criteria were excluded from the study (557 article). In the second step, the full text of 14 studies was reviewed. Finally, five studies were selected (Figure1).

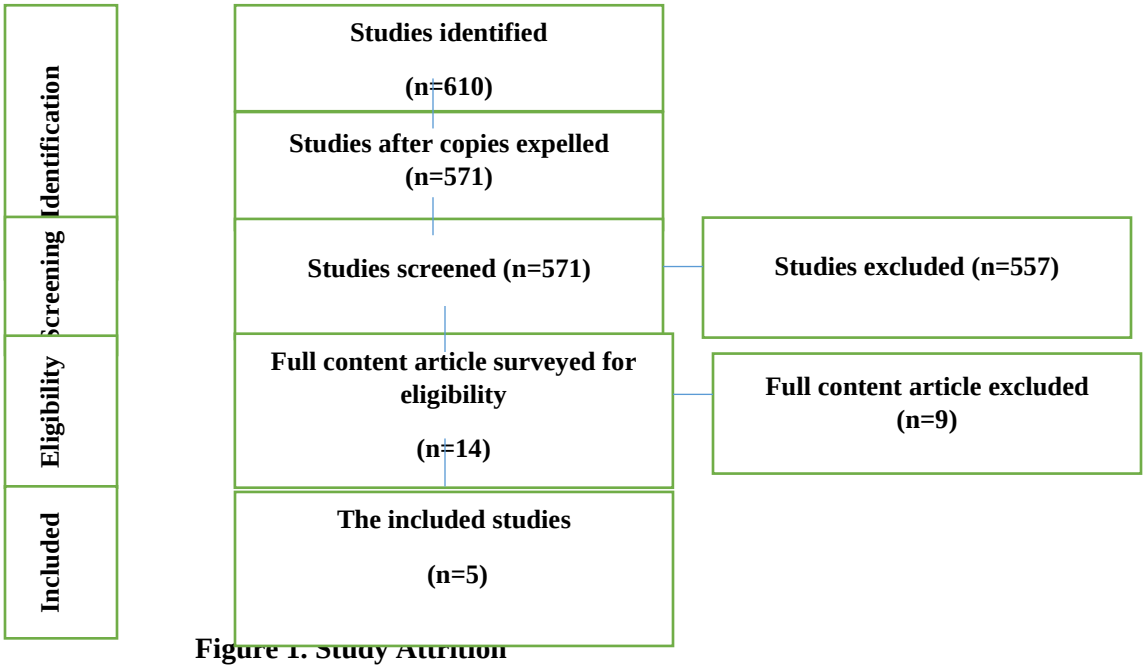

Figure 1. Study Attrition

Characteristics

Five studies (randomized controlled trial) have been included in present article. The number of patients a total was 110, the number of implant in test group and control group was 82 and 80, respectively, and a total was 162. The mean of timing for periodontal parameter evaluation was 12 weeks. In all studies prosthesis type was healing abutments. Periodontal measurements in one study not reported, in one study was 6 sites for implant and in other studies was 4 sites for implant (Table2).

Bias assessment

According to Cochrane Collaboration's tool, two studies had a total score of 6/6, and one study had a total score of 5/6 and two studies had a total score of 2/6 three studies had high quality or low risk of bias and two studies had low quality or high risk of bias (Table3).

Table2. Studies selected for systematic review and meta-analysis.

Study. Years	Study design	Number of patients	Number of implants		Time of evaluate periodontal parameter (weeks)	Prosthesis type	Periodontal measurements
			test	control			
Hall et al., 2019	RCT	32	32	32	6	Healing abutments	NR
Schwarz et al., 2018	RCT	28	15	13	12	Healing abutments	6 sites for implant
Garcia et al., 2018	RCT	30	15	15	10	Healing abutments	4 sites for implant
Menini et al., 2017	RCT	10	10	10	8	Healing abutments	4 sites for implant
Degidi et al., 2012	RCT	10	10	10	24	Healing abutments	4 sites for implant

Table3. Risk of bias assessment (Cochrane Collaboration's tool(18))

study	Random sequence generation	allocation concealment	blinding of participants and personnel	blinding of outcome assessment	incomplete outcome data	selective reporting	Total score
Hall et al., 2019	+	+	+	+	+	+	6
Schwarz et al., 2018	+	+	+	+	+	+	6
Garcia et al., 2018	+	+	+	+	?	+	5
Menini et al., 2017	+	?	-	?	+	?	2
Degidi et al., 2012	+	?	-	?	+	?	2

Low (+), unclear (?), high (-)

Bleeding on probing

Risk ratio of bleeding on probing between test and control group was -0.03 (RR, -0.03 95% CI -1.15, 1.10. P>0.05) among four studies and heterogeneity found (I^2<0%; P =0.60), there was no significant difference between two groups (Figure2).

Plaque index

Risk ratio of plaque index between test and control group was 0.21 (RR, 0.21 95% CI -0.30, 0.72. P>0.05) among four studies and heterogeneity found (I^2<0%; P =0.47), there was no significant difference between two groups (Figu3).

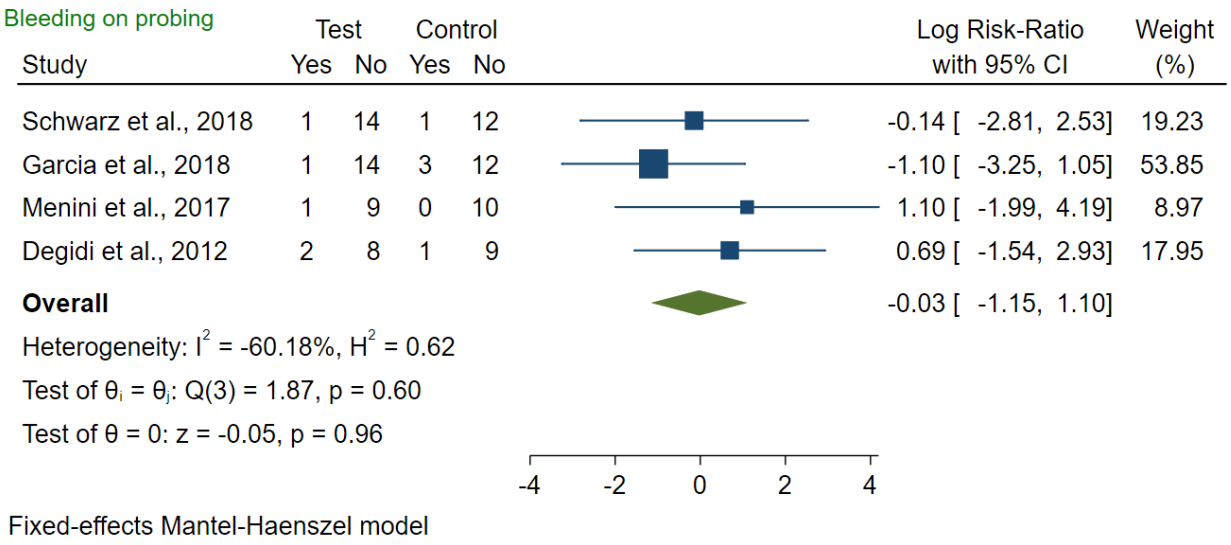

Figure2. Forest plot showed Bleeding on probing as outcome between test and control group

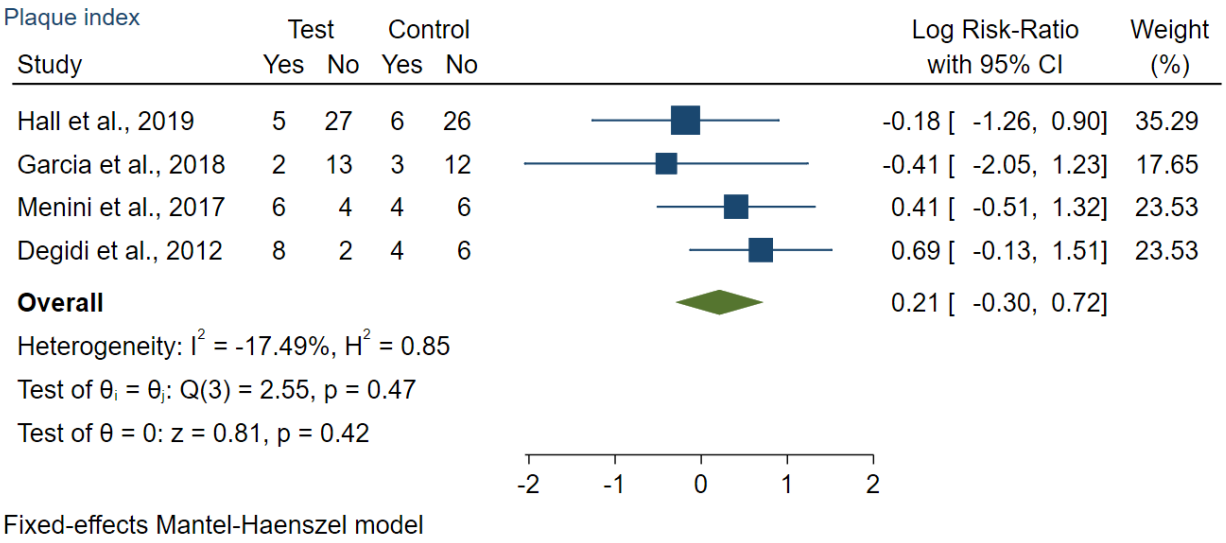

Figure3. Forest plot showed Plaque index as outcome between test and control group

Probing depth

Mean difference of probing depth between test and control group was 0.11 (RR, 0.11 95% CI -0.14, 0.35. P>0.05) among three studies and heterogeneity found (I^2<0%; P =0.94), there was no significant difference between two groups (Figu4).

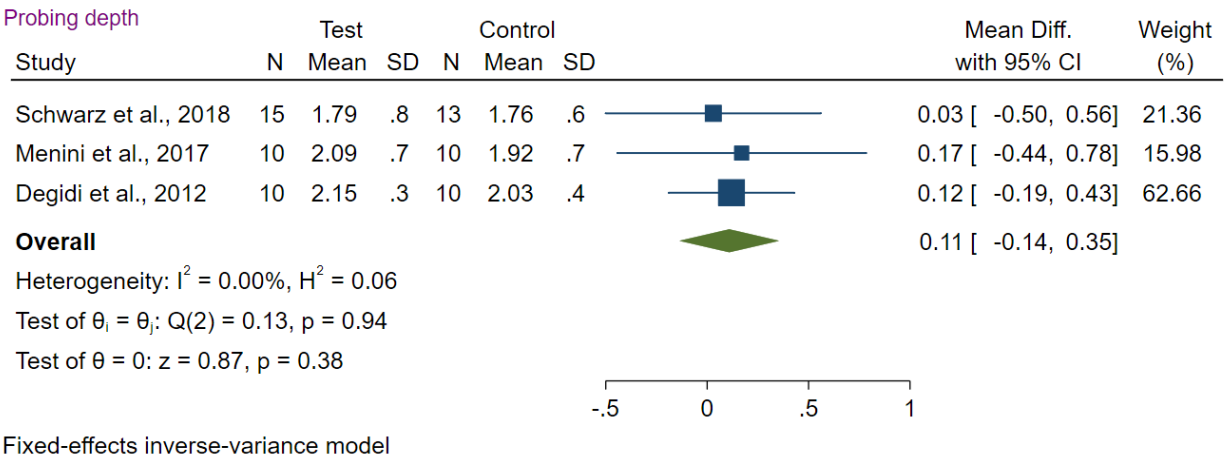

Figure4. Forest plot showed Probing depth as outcome between test and control group

Discussion

The aim of current Systematic Review and Meta-Analysis was evaluate the effect of Various Titanium Abutment Modifications on the behavior of Peri-Implant Soft Tissue healing, inflammation, and maintenance. The Meta-analysis of current study showed there was no significant difference between the machined and modified titanium healing abutments in terms of Bleeding on probing, Plaque index and Probing depth. Sanz-Martín et al., 2018 (10)in a systematic review and meta-analysis evaluate the impact of the abutment characteristics on peri-implant tissue health and to identify the most suitable material and surface characteristics, the result showed only the supporting material (zirconium vs. titanium) may affect the inflammatory status, this result showed similar results to the present study. Canullo et al.,2016 (19) and Canullo et al.,2017 (20) showed plasma of argon seemed able to improve the behavior of peri-implant soft tissue in the medium period and also showed reduced bone loss. Raes et al.,2018 (21) and Göthberg et al., 2018 (22) reported a more favorable outcome for abutment with a machined titanium surface. The results of the present study are inconsistent with traditional studies on increasing surface roughness that can facilitate biofilm formation(23, 24). All selected studies had high homogeneity between the findings, in terms of study quality, two studies were of low quality. The present study had limitations, including different treatments for level change in different studies. Another limitation of the study was the short follow-up period; to find stronger evidence, the follow-up period should be longer. More randomized clinical trial studies are needed in relation to the subject of the study with a longer follow-up period and a larger sample size to provide sufficient evidence for the results of the study.

Conclusion

The present Systematic Review and Meta-Analysis study showed that there is no difference in Bleeding on probing, Plaque index and Probing depth between machined and modified titanium healing abutments, per implant soft tissue cannot be affected by surface treatments of titanium abutments in a short time. It is suggested that future studies be performed with a long follow-up period, high sample size, and similar techniques for abutment correction.

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