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EPA Consensus Project Paper: The Influence of Prosthetic Factors on the Incidence of Peri-implantitis Around Single Implants: A Systematic Review

Keywords

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Authors

George Papavasiliou *
(DDS, MSc, PhD)

Alexandra Tsigarida §
(DDS, MS)

Ioannis Papathanasiou ‡
(DDS, MSc, PhDc)

Elli Anna Kotsailidi ^
(DDS, MS)

Abdul Basir Barmak †
(MD, MSc, EdD)

Address for Correspondence

George Papavasiliou *

Email: geopap@dent.uoa.gr

* *Assistant Professor, Department of Prosthodontics, School of Dentistry, National and Kapodistrian University of Athens, Athens, Greece*

§ *Associate Professor and Program Director, Department of Periodontology, Eastman Institute for Oral Health, University of Rochester, Rochester, NY, USA*

‡ *Prosthodontist, PhD candidate, Department of Prosthodontics, School of Dentistry, National and Kapodistrian University of Athens, Athens, Greece*

^ *Assistant Professor, Department of Periodontology, Eastman Institute for Oral Health, University of Rochester, Rochester, NY, USA*

† *Associate Professor, Clinical Research and Biostatistics, Eastman Institute for Oral Health, University of Rochester, New York, USA*

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ABSTRACT

Introduction: The purpose of this systematic review was to evaluate how prosthetic factors affect the incidence of peri-implantitis in patients treated with single implant restorations. Methods: Electronic and manual search of two indexed databases up to April 2023 were conducted, to identify clinical studies reporting on the effect of different prosthetic factors on the incidence of peri-implantitis around single implants and with at least 1 year follow-up. The risk of bias was assessed with the Joanna Briggs Institute critical appraisal checklist, the ROB2 and the ROBINS-I tools. Results: From the 521 screened articles, 11 studies (1 randomized controlled trial, 7 cross-sectional, 3 retrospective) met the inclusion criteria. Based on three studies, emergence angle>30°, convex emergence profile and external connection are associated with a higher incidence of peri-implantitis. Nine studies pertaining to the effect of retention type on the prevalence of peri-implantitis reported conflicting results. Six out of eleven included studies presented some risk of bias. Conclusions: There is insufficient evidence regarding the influence of prosthetic factors on the incidence of peri-implantitis around single implants. Further studies are needed to draw definitive conclusions on this issue.

INTRODUCTION

Dental implant placement is a well-documented treatment alternative for the replacement of single missing teeth.[1,2] Although single implant restorations have been reported to have a 5-year survival rate ranging from 97.6% to 98.3%,[2] technical and biological complications may arise.[1,2] Peri-implantitis has been identified as the major biologic complication for implant supporting either single crowns or fixed dental prostheses.[1-3]

According to the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions, peri-implantitis is defined as a pathological condition occurring in tissues around dental implants, characterized by inflammation in the peri-implant connective tissue and progressive loss of supporting bone.[4] Peri-implantitis is diagnosed when bleeding and/or suppuration on gentle probing is combined with increased probing depth and radiographic bone loss compared with previous examinations.[5] In the absence of previous radiographs, radiographic bone level

≥3 mm in combination with BOP and probing depths ≥6 mm is indicative of peri-implantitis.[5] The mean prevalence has been documented to range from 9.25% at implant level to 19.83% at patient level.[6] Particularly around single-crown implant, the 5-year rate of peri-implantitis has been estimated to be as high as 5.1% and 5.3% for metal-ceramic and zirconia implant-supported single crowns, respectively.[1,2]

Several factors have been suggested to influence the prevalence of peri-implant diseases, such as history of periodontitis, poor oral hygiene, lack of maintenance, diabetes and smoking.[4,7,8] Apart from patient-related factors, current evidence points towards an association of emergence angle and emergence profile,[9,10] type of retention[11,12] and type of implant-abutment connection[13-15] with the incidence of peri-implantitis. Previous systematic reviews have individually evaluated the potential influence of several of these prosthetic risk factors,[10,11,13-18] either on peri-implant bone loss, rate of complications or peri-implantitis. However, the most current diagnostic criteria for peri-implantitis[5] were not utilized in any of these reviews. Additionally, several clinical studies have been published investigating the potential effect of specific prosthetic factors on the incidence of peri-implantitis around single implants, as defined according to the recently established diagnostic criteria.

Therefore, the aim of this study was to systematically review the influence of prosthetic factors on the incidence of peri-implantitis around single implants.

METHODS

REPORTING FORMAT

This systematic review was conducted in accordance with the guidelines of Transparent Reporting of Systematic Reviews and Meta-analyses (PRISMA-statement).[15,19]

FOCUSED QUESTION

In patients treated with single implant supported crowns, do prosthetic factors such as emergence angle, restoration profile, retention type, connection type, abutment angulation, crown/abutment material, crown-implant ratio and platform switching affect the incidence of peri-implantitis?

PATIENT, INTERVENTION, COMPARISON, OUTCOME (PICO) QUESTION

The focused question of the present systematic review was proposed by following the PICO format:

P (Population): Partially edentulous patients

I (Intervention): Single implant supported crowns

C (Comparison): Retention type, connection type, emergence angle, restoration profile, abutment angulation, crown/abutment material, crown-implant ratio and platform switching of single implant crowns

O (Outcome): Incidence of peri-implantitis based on diagnostic criteria reported by the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions[5]

ELIGIBILITY CRITERIA

Inclusion Criteria

- Studies were included according to the following inclusion criteria:
- Randomized clinical trials, prospective, retrospective cohort studies
- Follow-up of at least 1 year after prosthesis insertion (baseline)
- Studies reporting on at least 10 patients with at least one single implant-supported crown each
- Studies with clear documentation/definition of peri-implantitis based on the new classification of peri-implant diseases[4]
- Studies published in English language.

Exclusion Criteria

Studies were excluded according to the following exclusion criteria:

- Case reports or case series
- Insufficient data available to report on peri-implantitis or number of patients
- Studies with a follow up less than 1 year
- No email response from the corresponding author to inquiry email
- Multiple publications on the same patient population; only the most recent one was included

INFORMATION SOURCES AND SEARCH STRATEGY

Electronic Search

Two electronic databases [MEDLINE-PubMed (National Library of Medicine) and EMBASE (Excerpta Medical Database by Elsevier)] were searched up to April 2023. The following journals were hand searched for potentially relevant articles: Clinical Oral Implants Research, Journal of Periodontology, Journal of Clinical Periodontology, International Journal of Oral and Maxillofacial Implants, Journal of Prosthetic Dentistry, International Journal of Prosthodontics, Implant Dentistry and Journal of Oral Implantology. Keywords and medical subject headings were utilized along with Boolean operators (OR, AND) for the identification of relevant studies; the customized search strategy was developed as follows: ((peri-implantitis) AND [((crown material) OR (abutment material)) OR ((screw-retained) OR (cement-retained)) OR ((abutment

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height) OR (crown implant ratio)) OR ((emergence profile) OR (emergence angle) OR (restoration contour) OR (crown contour) OR (platform switching) OR ((occlusal scheme) OR (occlusion)) OR ((dental implant-abutment design) OR (dental implant-abutment interface) OR (dental implant-abutment connection))]) AND ((peri-implantitis) AND (((crown material) OR (abutment material)) OR ((screw-retained) OR (cement-retained)) OR ((abutment height) OR (crown implant ratio)) OR ((emergence profile) OR (emergence angle) OR (restoration contour) OR (crown contour) OR (platform switching) OR ((occlusal scheme) OR (occlusion)) OR ((dental implant-abutment design) OR (dental implant-abutment interface) OR (dental implant-abutment connection)))).

STUDY SELECTION

Articles were collected in reference manager software (EndNote, Thomson Reuters) and duplicates were electronically removed. A calibration exercise with two reviewers (EAK, AT) was conducted prior to commencing screening. Using the inclusion criteria, a random sample of 10% of citations from the search were screened independently by both reviewers. Screening only began when percent agreement was >90% across the two reviewers. A similar calibration exercise was completed prior to screening full-text articles for inclusion. The two reviewers screened independently titles and abstracts for potential inclusion, and in case of doubt, the full text of the articles in question was obtained. Full-text reading of the selected publications was carried out independently by the two reviewers. The electronic search was also supplemented by search of the database citations and the references of the selected articles. In cases of missing information, the authors were contacted by email. Consensus was reached in every step of the review. Any disagreement was resolved by discussion with the other two researchers (GP, IP). Inter-reviewer agreement was determined using the Cohen kappa statistics.

DATA EXTRACTION

Data collection was done using an electronic spreadsheet. Data were independently extracted and inserted into a computer by two reviewers (AT, EAK) using specifically designed data-collection forms *(Table 1)*. The type of study, number of participants, gender, evaluated prosthetic factors, implant type, timing of implant placement, number of single implants per patient, implant location, follow-up period, type of radiograph and smoking status were systematically recorded. Any disagreements were resolved through discussion with the other two researchers (GP, IP). If a study did not provide adequate information regarding the incidence of peri-implantitis, attempts were made to contact the respective authors (at least once through email to the corresponding author). The study was excluded if the attempts were not successful.

QUALITY ASSESSMENT

Quality assessment was performed for all the included articles. For RCTs, the Revised Cochrane risk of bias tool for randomized trials (RoB 2.0) was used.[20] "High risk of bias", "Some concerns", or "Low risk of bias" were assigned to each assessment item. For prospective and retrospective studies, the Risk of Bias In Non-randomized Studies – of Interventions (ROBINS-I) assessment tool was used.[21] "Low", "moderate", "serious", "critical" risk of bias, or "no information" was assigned to the reviewed papers. For cross-sectional studies, the Joanna Briggs Institute critical appraisal checklist was used[22] and eight assessment questions were answered for each study as either "yes", "no", "unclear" or "not/ applicable". The assessment was performed independently by two examiners (EAK, AT). Any discrepancy between the examiners in quality assessment was resolved via discussion.

RESULTS

STUDY SELECTION

A total of 522 records were obtained from the initial search. After removal of duplicates and screening by titles and abstracts, 52 articles were reviewed by full-text assessment. Finally, 41 articles were excluded (Appendix 1) and 11 studies were included in the present systematic review. Among these, 7 were cross-sectional studies,[23-29] 3 were retrospective in design[30-32] and 1 was a randomized clinical trial.[33] Figure 1 presents the literature search based on the PRISMA guidelines. With respect to the selection of articles by reviewing titles/abstracts and full text, there was significant agreement between the 2 investigators with Cohen Kappa equal to 0.97 (P<.001) and 0.98 (P<.001) respectively.

CHARACTERISTICS OF THE INCLUDED STUDIES

Of the 11 studies included, 2 evaluated emergence angle,[24,27] 1 study evaluated restoration profile,[24] 9 studies evaluated retention type[23,25,26,28-33] and 2 studies evaluated connection type.[24,29] The general characteristics of the included studies are outlined in Table 1.

INFLUENCE OF PROSTHETIC FACTORS ON THE INCIDENCE OF PERI-IMPLANTITIS

Retention Type

Nine studies evaluated the effect of the retention type (cement-retained vs screw-retained) on the incidence of peri-implantitis with conflicting results.[23,25,26,28-33] Four studies reported a positive association of cement-retained restorations with peri-implantitis,[23,28,29,32] while five studies reported that the type of retention had no effect on the incidence of peri-implantitis.[25,26,30,31,33]

Table 1. Characteristics of included studies.

Study	Type of study	Setting	No. of patients	Female/ male, mean age, age range	Evaluated prosthetic factor	Implant type	Timing of loading	Crown type	No. of implants	No. of SCs	Implant location	Follow-up (y)	Type of radiograph used	Smokers included (Yes/No)
Corbella et al. 2021	retrospective	private	112	NR, 57.3±13.7, 21-80	retention type	NR	NR	S	334	141	Mx, Md, A, P	5.3±4 (1.1-14.8)	PA	NR
Dalago et al. 2017	cross-sectional	university	183	114/69, 59.3, 27-89	retention, connection	BL	NR	S	983	167	Mx, Md, A, P	5.64 (1-14)	PA, PN	Yes
Hentenaar et al. 2020	cross-sectional	university	67	38/29, NR, NR	emergence angle	BL	DEL	S	67	67	Mx, Md, P	5	PA	No
Kissa et al. 2020	cross-sectional	private	145	68/77,NR,NR	retention type	NR	NR	S:131 MSS:511	642	131	Mx, Md, A, P	6.4 (1-6)	PA	Yes
Kotsakis et al. 2016	cross-sectional	university	139	77/58, 57.59±15.36, NR	retention type	NR	NR	S	394	192		5.5	BW, PA	Yes
Linkevicius et al. 2013	retrospective	private	77	45/32, 47.3, NR	retention type	NR	NR	S, MSS	129	43	NR	NR	PA, PANO	NR
Ramon-Morales et al. 2019	cross-sectional	university	31	24/7, 61.5±10, NR	retention type	NR	NR	S	103	NR	NR	NR	NR	Yes
Romandini et al. 2021	cross-sectional	university	99	72/64, 63.33±10.14, 31-84	retention type	BL:62 TL: 74	NA	S	458	136	Mx, Md, A, P	7.8 ±4.4	PA	Yes
Tang et al. 2020	retrospective	university	130	73/57, 50.5, 29-78	retention type	BL	DEL	S, MSS	245, 180 included	55	Mx, Md, P	4.2 (3-7)	PANO	Yes
Weigl et al. 2019	RCT (split mouth)	private	22	14/8, 43, 32-60	retention type	BL	DEL	S	44	44	Mx, Md, P	1	PA	No
Yi et al. 2020	cross-sectional	university	169	88/81, 58.9, NR	emergence angle, restoration profile, connection type	BL: 327 TL: 22	IM: 42 DEL: 308	S: 142 MSS: 207	349	142	Mx, Md, A, P	5	BW, PA	NR

Y, year; f/u, follow-up; SC, single crown; composite restoration; PC, partial coverage; FC, full coverage; P, posterior; A, anterior; Mx, maxilla; Md, mandible; BL, Bone level; Tissue level, TL; IM, Immediate; DEL, Delayed, DEL; S, single; MSS, multiple single splinted; PA, periapical; PANO; panoramic; BW, bitewing; NR, not reported

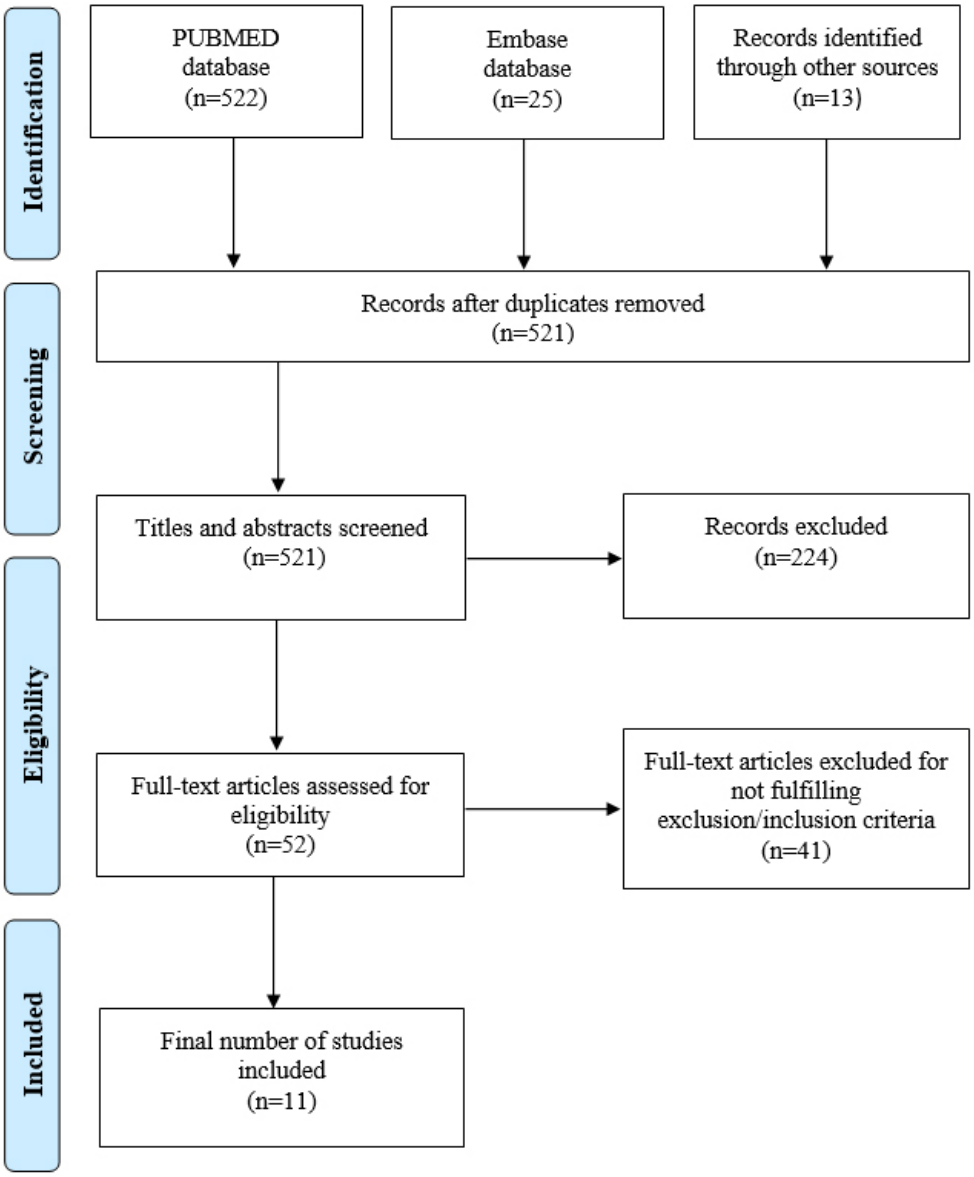

Figure 1: PRISMA flow diagram with information through phases of study selection.

Emergence Angle

Two studies evaluated the effect of emergence angle on the incidence of peri-implantitis.[24,27] The incidence of peri-implantitis for emergence angles >30° was significantly higher than the incidence for emergence angles <30°.[24] For emergence angles ranging from 0.5 to 18.7 degrees, no significant effect of emergence angle on marginal bone loss and peri-implantitis was found.[27]

Restoration Profile

In regards to restoration profile, a cross-sectional clinical study found that the incidence of peri-implantitis was significantly higher for convex than straight and concave emergence profiles.[24]

Connection Type

In regards to connection type, two studies were included. A higher incidence of peri-implantitis for external connection than for internal connection was found in both studies.[24,29]

Effect Of Abutment Angulation, Crown Material, Abutment Material, Crown-Implant Ratio and Platform Switching

There were no studies reporting on the effect of these factors on the incidence of peri-implantitis around single implants.

QUALITY ASSESSMENT OF INCLUDED STUDIES

The included RCT[33] was determined to have low risk of bias *(Figure 2)*. Out of three retrospective studies, two had moderate risk of bias[30,32] and one had serious risk of bias.[31] Overall, most retrospective studies were of moderate risk of bias *(Figure 3)*. As far as the included cross-sectional studies, four had low risk of bias,[24-27] two had unclear risk of bias,[23,29] and one had high risk of bias[28] *(Figure 4)*.

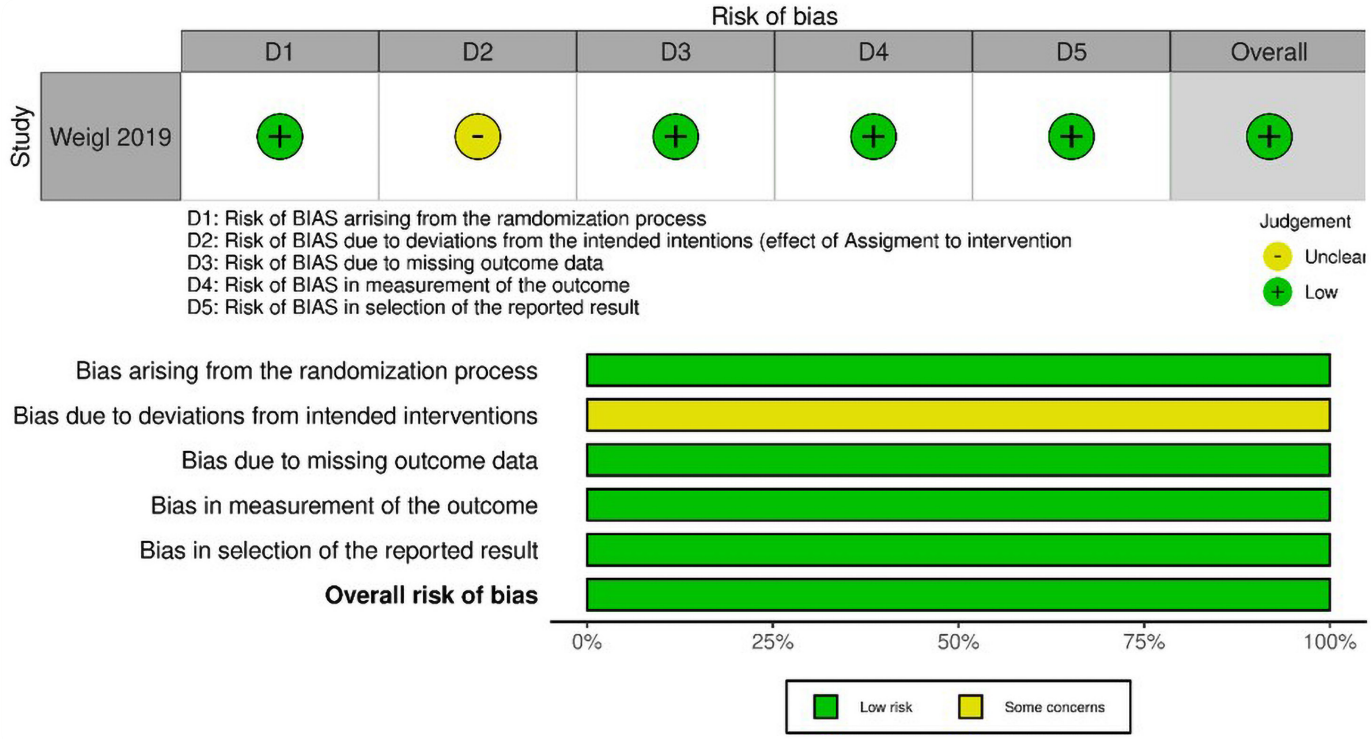

Figure 2: Risk of bias (RoB 2) assessment for randomized clinical trials.

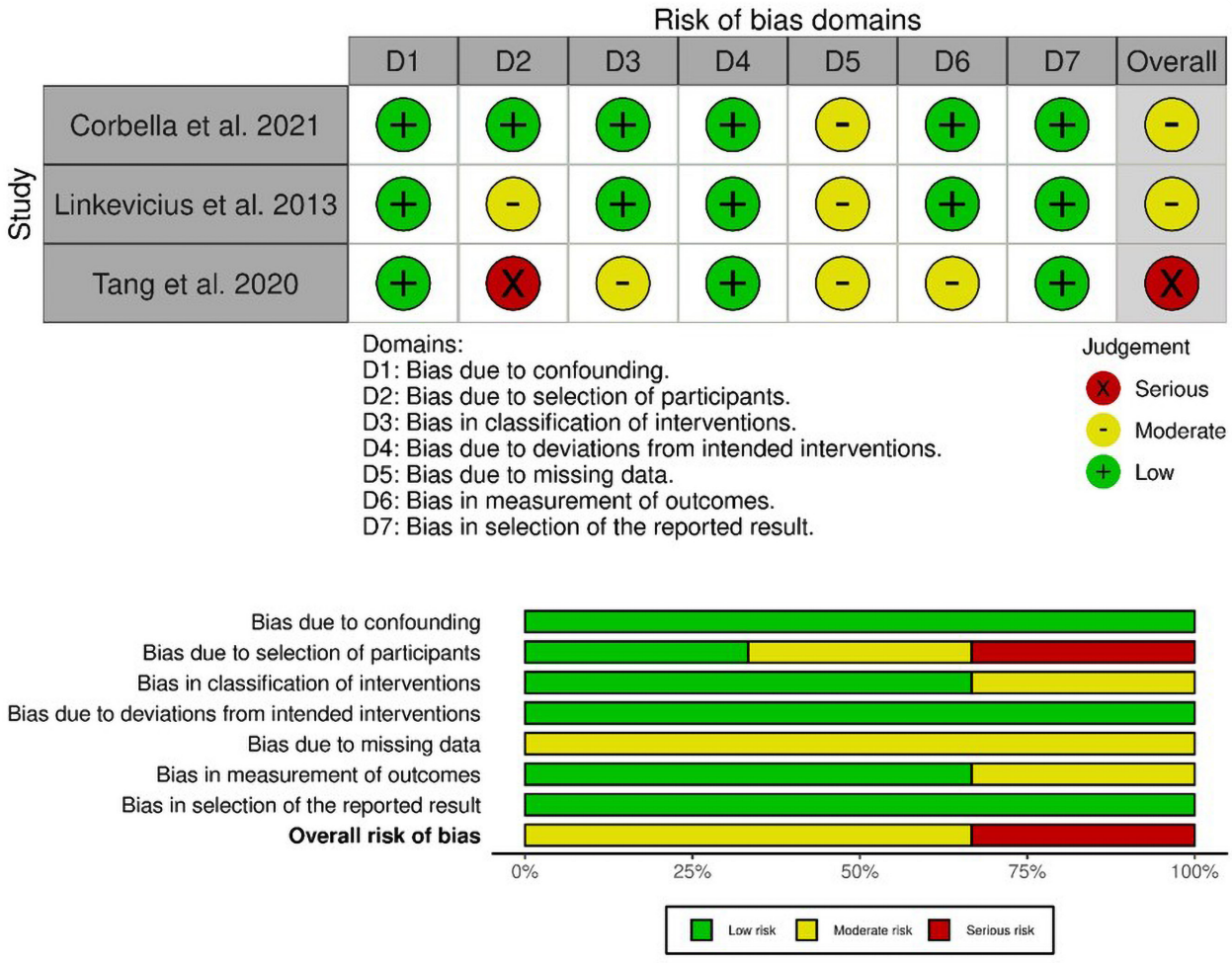

Figure 3: Risk of bias (ROBINS-1) assessment for prospective and retrospective studies.

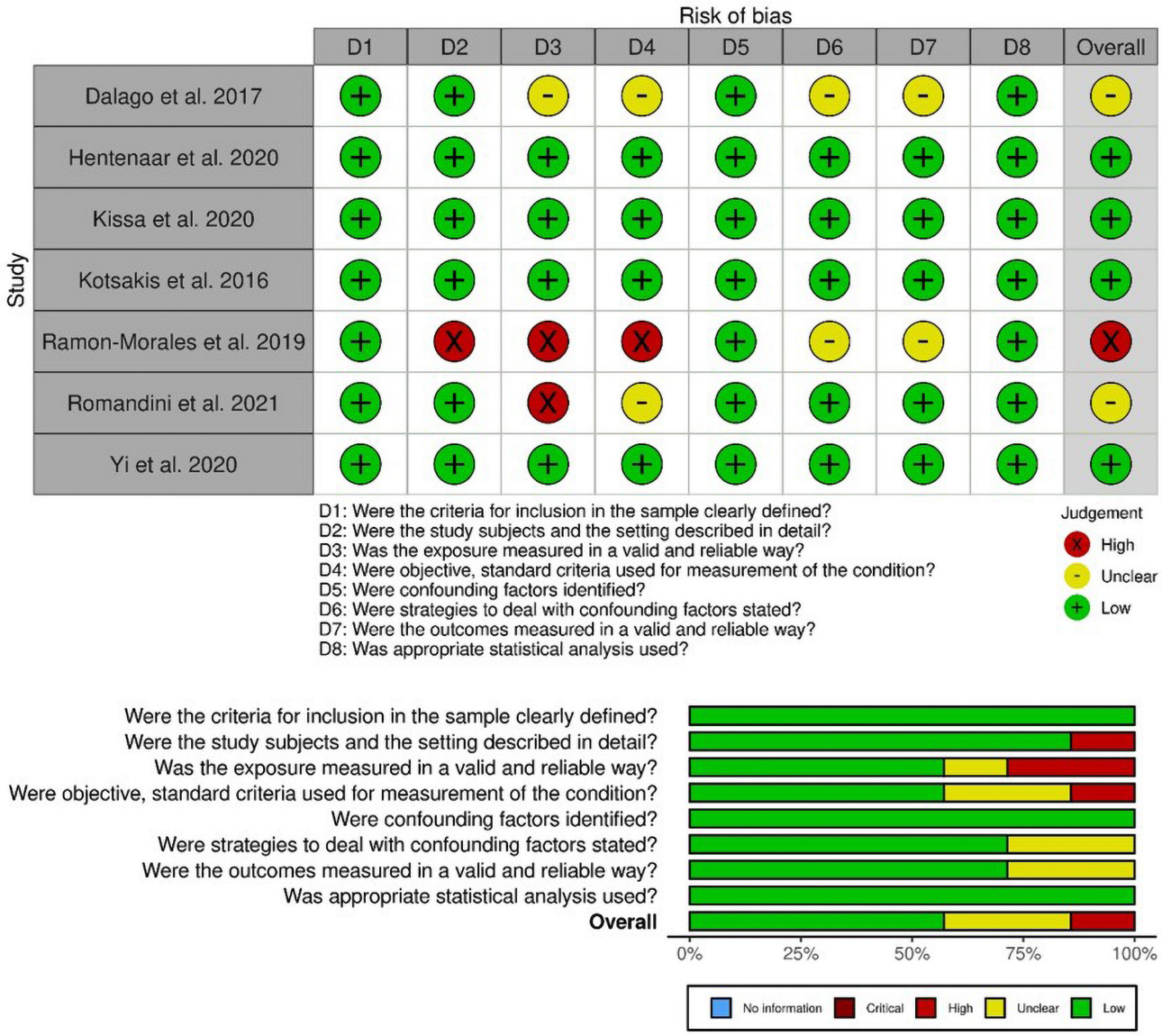

Figure 4: Joanna Briggs Institute JBI Critical Appraisal Checklist.

DISCUSSION

The objective of this systematic review was to analyze the current literature and assess the influence of prosthetic factors on the incidence of peri-implantitis around implants restored with single crowns. Limited evidence suggests that emergence angle >30°, convex emergence profile and external connection are associated with a higher incidence of peri-implantitis around implants restored with single crowns, while there is controversy regarding the association with the retention type. However, it appears that there is no sufficient evidence through power-adjusted randomized clinical trials in order to consider these prosthetic parameters as risk factors for peri-implantitis.

The comparison of the present findings to previous systematic reviews was not possible as there are no reviews broadly assessing and comparing different prosthetic factors and designs of single implant restorations as they pertain to the incidence of peri-implantitis. Notably, most studies in the existing literature correlate the aforementioned prosthetic factors with the frequency and/or magnitude of marginal bone loss, rather than the incidence of peri-implantitis. Considering that peri-implant marginal bone loss can be attributed and influenced by conditions other than peri-implantitis, such as thin peri-implant mucosa,[34] or implant placement depth relative to the alveolar crest,[35] results from existing studies on marginal bone loss cannot and should not be directly correlated with the diagnosis of peri-implantitis. Additionally, since the most recent definition of peri-implantitis was imposed among the inclusion criteria of this review, the included studies meeting this definition were limited and inevitably published after 2017, for the most part.

In regards to emergence angle and emergence profile, limited evidence suggested that the incidence of peri-implantitis was higher for emergence angles >30°[24] and convex emergence profiles[24] compared to emergence angles <30° and straight or concave profiles. Yi *et al*, in a cross-sectional clinical study evaluating single implants (n=142) and multiple splinted implants (n=207), found that the incidence of peri-implantitis

for emergence angles >30° (46.6%, 139 out of 298 implant surfaces) was significantly higher (p < .05) than the incidence for emergence angles <30° (8,5%, 34 out of 400 surfaces) 5 years after implant placement (24). This study also found that the incidence of peri-implantitis was significantly higher for convex (39%, 127/326 implant surfaces) than straight (16.4%, 37/225 implant surfaces) and concave (6.1%, 9/147 implant surfaces) emergence profiles 5 years after implant placement.[24] On the other hand, Hentenaar *et al*. in a cross-sectional study with a 5-year evaluation of 67 single posterior dental implants with mean emergence angles ranging from 0.5 to 18.7 degrees, found no significant effect of emergence angles on marginal bone loss while no implants had peri-implantitis.[27] Based on limited evidence, similar results were reported in a critical review by Mattheos *et al*.[9] and in a systematic review by Soulami *et al*.[10] assessing the influence of restoration contour on the prevalence of peri-implantitis for implant-supported restorations. These results can be explained by the fact that large emergence angles in combination with convex profile lead to overcontouring of the prosthesis that impairs accessibility to oral hygiene procedures.[10] Out of nine eligible studies in the present review, 4 studies[23,28,29,32] reported a significant relation of cement-retained restorations and the risk for peri-implantitis. Ramon-Moralles *et al*.[28] evaluated 103 implants restored with single crowns or fixed dental prostheses (52 cemented and 51 screwed) and concluded that peri-implantitis was significantly associated with cement-retained restorations both in univariate (OR = 9.4; 95% CI, 2-46; P = .006) and a multivariate model (OR = 6.8; 95% CI, 1.3-37; P = .02). Dalago *et al*. in a cross-sectional study evaluated 916 dental implants restored with fixed dental prostheses, with 9 out of 167 single crown implants having peri-implantitis. Overall cemented restorations had 3.6 times higher risk (OR: 3.6, 95% CI 1.4–9.3 P = 0.011) of peri-implantitis than screw-retained restorations.[29] Linkevicious *et al*. examined 129 and 238 implants restored with single or multi-unit implant restorations respectively.[32] Fifty-six out of 129 implants in the cement-retained group showed evidence of peri-implantitis while only 2 cases of peri-implant disease were found for the screw-retained group. Romandini *et al*. in a cross-sectional clinical study evaluating 458 dental implants and 136 single crowns found that the incidence of peri-implantitis was 13.1% (8 out of 61) for screw-retained single crowns and 17.3% for cement-retained crowns. The univariate analysis showed a significant association of peri-implantitis with retention type (p < .1), but this result did not remain significant in the multivariate analysis (p>0.05).[23]

Conversely, six studies reported that the type of retention had no effect on the incidence of peri-implantitis. Corbella *et al*. in a retrospective study with 344 implants supporting single crowns (n=141) and fixed partial dentures with a mean follow-up period of 5.3 ± 4.0 years found no significant difference between screwed and cemented restorations.[30] Kotsakis *et al*. in a similar study that examined 192 implants supporting single crowns and 202 fixed dental prostheses found also no significant association of retention type with peri-implantitis.[26] Moreover, in a cross-sectional study by Kissa *et al*. evaluating 642 implants supporting 131 single crowns (n=131) and multi-unit restorations (n=511) with a mean follow-up of 6.4 years implant-level univariate analysis showed that retention type was not significantly associated with increased probing depth or radiographical bone loss, while cement-retained restorations had significantly higher probing depth in the multivariate analysis (p=0.02).[25] Another study by Tang *et al*. with 180 short dental implants supporting 55 single crowns and 125 splinted restorations with a mean follow-up of 4.2 years, reported no cases of peri-implantitis for single implants and a non-significant relation of marginal bone loss with retention type overall in a univariate analysis, p=0.367.[31] Finally, a randomized clinical split-mouth trial comparing screw-retained monolithic zirconia implant crowns (n=22) and metal-ceramic (n=22) implant crowns reported no signs of peri-implantitis for both groups.[33]

In accordance with the present study, a critical review by Mattheos *et al*. reported inconclusive results pertaining to the association of retention type with peri-implantitis.[9] Previous systematic reviews reported conflicting results. On the one hand, Sailer *et al*. and Pjetursson *et al*. reported higher 5-year cumulative incidence of marginal bone loss exceeding 2 mm around implant supporting cemented crowns compared to screw-retained.[36,37] Furthermore, previous reviews have discussed the presence of excess cement in cement-retained restorations as a risk factor for peri-implantitis.[11,12,38] This can be attributed to the rough surface of the cement facilitating biofilm formation.[39] The placement of crown margin at the level of the mucosal margin has been recommended in order to simplify residual cement removal.[12] On the other hand, three systematic reviews found no significant difference in the incidence of peri-implantitis and marginal bone loss between cemented and screw-retained restorations.[16,18,40] Only one systematic review by Lemos *et al*. reported less marginal bone loss for cemented restorations compared to screw-retained ones.[17]

In regard to connection type, two studies[24,29] found a higher incidence of peri-implantitis for external connection than for internal connection. Yi *et al*. reported that the incidence of peri-implantitis was significantly higher for external connection (29.8%, 128/215) than internal connection implants (17.4%, 39/112) 5 years after implant placement.[24] In addition, Dalago *et al*. in a cross-sectional clinical study evaluating 400 external hexagon and 516 internal hexagon dental implants restored with fixed dental prostheses found that the incidence of peri-implantitis was 8.3% for external hexagon connection and 6.6% internal hexagon connection for cement-retained crowns.[29] However, connection type was not significantly associated with peri-implantitis (p=0.079). In accordance with these findings, two previous systematic reviews on different types of implant prostheses reported that peri-implant bone loss was higher for external connections compared to internal and conical ones[13,14] while Carrasco *et al*. suggested that conical connections provide more stable and better sealed implant-abutment interface.[14] In agreement with this, a narrative review by Lauritano *et al*. found that external connections presented a larger micro-gap

compared to internal and conical connections, which facilitates bacterial micro-leakage at the level of implant-abutment connection and may lead to peri-implant disease.[41]

The included studies and the present systematic review have certain limitations. Firstly, studies other than RCTs, such as cross sectional and retrospective, were reviewed and included, as there is a very limited number of available RCTs that would satisfy the present inclusion criteria, Also, most of the included studies evaluated both implant-supported single crowns and fixed dental prostheses but did not report separately data on the incidence of peri-implantitis for each type of prosthesis. Due to the limited number of included studies and missing data, it was not possible to perform a meta-analysis. The lack of calibration of the two reviewers (GP, IP) who participated in discussion in case of disagreement concerning study selection can be considered as a limitation. Additionally, the quality of evidence was considered moderate, because most of the studies presented some degree of bias. Furthermore, the majority of the included studies were not designed to evaluate and compare different prosthetic designs and thus failed to control for possible patient-related confounding factors such as smoking, history of periodontitis, diabetes, poor oral hygiene and lack of maintenance.[4] In addition, other prosthetic factors such as abutment angulation, crown and abutment material,[9,33] platform switching[42] and crown-implant ratio[43] that may also influence the incidence of peri-implantitis have not been evaluated in the present review, due to the lack of studies reporting on peri-implantitis while assessing these parameters. All these limitations make the evaluation of the effect of different prosthetic factors very challenging. Therefore, purpose-designed RCTs with clearly defined inclusion and evaluation criteria are needed to assess potential factors and their association with peri-implant diseases and draw clinically meaningful conclusions.

CONCLUSIONS

Based on the findings of this systematic review, the following conclusions were drawn:

1. Based on three studies, emergence angle >30°, convex emergence profile and external connection may be associated with a higher incidence of peri-implantitis.
2. Based on nine included studies, the effect of retention type on the prevalence of peri-implantitis was inconclusive.
3. Overall quality of evidence was moderate since six out of eleven included studies presented some risk of bias.
4. Due to the limited number of the included studies reported associations should be considered with caution. Further research is needed to identify prosthetic factors as true risk factors for peri-implantitis.

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APPENDIX

Appendix 1. Excluded studies and reasons for exclusion

Reason	Publications (Date)
Not accurate definition of peri-implantitis	AlJasser et al. 2021, Seyssens et al. 2020, Malchiodi et al. 2020, Pamato et al. 2020, Pimentel et al. 2018, Ekfeldt et al. 2017, Canullo et al. 2016, Sahramann et al. 2016, Duque et al. 2016, Rinke et al. 2015, Ferreiroa et al. 2015, Strauss et al. 2021 , Changi et al. 2019, De Araujo et al. 2021, Hsiao et al. 2021, Lin et al. 2020,
Focus on marginal bone loss, not peri-implantitis	Lombardo et al. 2021, Rathe et al. 2021, Ramos de Feitas et al. 2021, Prati et al. 2020, Kim et al. 2018, Mencio et al. 2017, Esposito et al. 2016, Korsch et al. 2014, Shi et al 2018, Sordi et al. 2020
Case Series	Wehner et al. 2021, Stucki et al. 2021, Nobre et al. 2014
Not related to single crowns / Cantilever	Galindo-Moreno et al. 2016, Galindo-Moreno et al. 2015, Oda et al. 2021, Schmid et al. 2021, Tsigarida et al. 2020, Gothberg et al. 2018, Katafuchi et al. 2017
No comparison based on different prosthetic design	Obreja et al. 2022, Kesar et al. 2022, Derks et al. 2016, Rinke et al. 2015
Evaluation of implants with signs of peri-implantitis	Majzoub et al. 2021