Quality Assessment of Systematic Reviews on Platform-Switching vs Platform-Matched Implants: An Overview

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The objective of this study was to perform a quality analysis of systematic reviews with meta-analyses that focused on the comparison of platform-switching (implant-abutment mismatching) and platform-matched (PM) implants. The assessment of multiple systematic reviews (AMSTAR) and Glenny (Checklist) Scales were used to qualify the studies. PubMed, Scientific Electronic Library Online (SciELO), Web of Science (formerly ISI Web of Knowledge), and Cochrane databases were searched, by topic, for systematic reviews on dental implants with switching platforms. A total of 8 systematic reviews, including 7 studies with meta-analyses, were selected. The AMSTAR scale indicated a high (n = 6) to moderate (n = 2) score for the included studies. The quantitative analysis indicated that platform-switching implants preserved more bone tissue when compared with platform-matched implants (6 meta-analyses; $P < .001$, smaller mean difference: −0.29 mm, 95% CI: −0.38, −0.19 and greater mean difference: −0.49 mm, 95% CI: −0.73, −0.26). Quantitative analysis based on 7 systematic reviews with meta-analysis indicated positive peri-implant bone preservation for implants restored with an implant-abutment mismatching (PSW). Further, there is evidence to improve the design of current systematic reviews. Future systematic reviews in this thematic area should consider searches in gray literature and different databases and include only randomized controlled clinical studies.

Key Words: review, meta-analysis as topic, data pooling, dental implant abutment design

INTRODUCTION

Physiologic bone remodeling that occurs in dental implants represents a relevant topic. In the past, it was approximately 1.5–2.0 mm in the first year after placement of implant-supported prostheses[1–8] and thereafter it was <0.2 mm/year.[9] Currently, these parameters have changed owing to surface modifications and implant connections.[10,11] The implant platform-switching (PSW) concept, which usually involves a narrower implant-supported prosthesis platform compared with the platform-matched (PM) implant, alters this concept of marginal bone loss.[2,12–14]

In fact, case reports and clinical studies[3,15,16] have indicated that PSW implants may result in less marginal bone loss compared with PM implants. These data indicate that different types of clinical studies have shown positive results for PSW implants in oral rehabilitation.[15,17,18] There are different theories that explain the mechanism of improved bone preservation in PSW implants; a positive factor could be the centralization of forces along the axis of the implant, as evidenced by biomechanical studies.[19–25] However, biological concepts provide one of the best explanations for reduced marginal bone loss, in that there may be modification of the biological space in vertical and horizontal directions or displacement of bacterial infiltrates at a distance from the marginal bone tissue.[2,9,12]

In recent years, different systematic reviews have sought to prove or refute the hypothesis of improved bone preservation in PSW implants as a form of oral rehabilitation.[1,4,7–9,12,26–28] These studies contained different inclusion criteria for their patients, along with different results formulated by the authors. Another important point is that these studies were carried out in different years, indicating that modifications occurred and new controlled clinical trials were published.[1,4,7–9,12,26–28] An earlier study, which analyzed the quality of systematic reviews, indicated significant heterogeneity among the included studies.[29]

Thus, an overview of systematic reviews represents an important step in the evaluation of all different systematic reviews of the proposed theme.[29,30] It is important in analyzing the quality of the published systematic reviews, especially for measuring possible deficiencies that should be eliminated in future studies. In this respect, scales such as the assessment of multiple systematic reviews (AMSTAR) and the Glenny checklist can be used to better delineate and evaluate the systematic reviews.[31,32]

Therefore, the objective of this study was to carry out a comprehensive overview of systematic reviews that focused on the comparison of platform-switching (implant-abutment mismatching) and platform-matched implants.

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https://doi.org/10.1563/aaid-joi-D-19-00114

Materials and Methods

Design

This overview of systematic reviews has been outlined in accordance with other overviews of systematic reviews,[29,30,33–35] as well as according to guides[36] and the Cochrane handbook for overviews of reviews.[37] This overview was also recorded in the PROSPERO database under Central Registration Depository number 42018089905. The protocol was written according to the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Protocol[38] for systematic reviews, and the PRISMA guidelines were also followed.[39]

Review question

This study analyzed previously published systematic reviews on the concept of platform switching (implant-abutment mismatching) in dental implants. The main objective was to evaluate the peri-implant bone preservation outcomes and failure rates of dental implants.

Inclusion criteria

Systematic reviews addressing the concept of platform switching were included in this overview. All the systematic reviews were verified as having the same PICO score and similar approaches to the subject. Reviews with case series, case studies, and clinical cases were excluded, as were reader opinion surveys and literature reviews. Reviews that did not address the included studies were also disregarded. It was decided to keep only systematic reviews that compared PSW to PM implants.

The PICO criteria is outlined as follows:

- *Participants/Population*. The systematic reviews included patients who underwent oral rehabilitation with osseointegrated implants.
- *Intervention*. The systematic reviews presented dental implant placements that followed the concept of platform switching (implant-abutment mismatching).
- *Comparator/Control*. Systematic reviews with or without meta-analyses that presented a group of implant placements with platform matching.
- *Outcomes*. The outcomes analyzed were: (1) the survival rate of PSW implants compared to platform-matched implants and (2) the marginal bone loss rate around PSW implants compared to platform-matched implants.
- *Search*. A search involving the single terms "systematic review" AND "dental implants" AND "platform switching" was performed by operators at different times (J.F.S., C.A.A.L.) on the PubMed, Scientific Electronic Library Online (SciELO), Web of Science, and Cochrane databases until January 2019 to identify systematic reviews that addressed platform switching. The search strategy formulated in the databases used the following single terms: "systematic review," "dental implants," "platform switching," and "dental implant-abutment design." The search strategy with Boolean operators is presented in Appendix 1.

The researchers conducted a manual search over 6 months in journals specific to implantology: *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *European Journal of Oral Implantology*, *Implant Dentistry*, *International Journal of Oral and Maxillofacial Implants*, *International Journal of Oral and Maxillofacial Surgery*, *International Journal of Periodontics and Restorative Dentistry*, *International Journal of Prosthodontics*, *Journal of Clinical Periodontology*, *Journal of Dental Research*, *Journal of Oral Implantology*, *Journal of Oral and Maxillofacial Surgery*, *Journal of Oral Rehabilitation*, *Journal of Periodontal Research*, *Journal of Periodontology*, and *Journal of Prosthetic Dentistry*.

The title and abstract of each scientific article were evaluated to verify that they belonged to the established theme. Next, the articles were evaluated in their entirety, and only the systematic reviews that addressed the concept of platform switching and compared this concept with another control group, as designated by the PICO criteria, were selected. The interexaminer kappa test for the selection of studies in the different databases indicated coefficients above 0.8; PubMed (Kappa: 0.91; 1.0), Cochrane (Kappa: 1.0); Web of Science (Kappa: 1.0), and SciELO (Kappa: 1.0). Disagreements were resolved in group meetings.

Quality of the systematic reviews

After selecting the articles, the AMSTAR scale was applied. As delineated by Oliveira-Neto et al[34] this tool is composed of 11 questions that analyze the methodology of systematic reviews. These questions can be answered as follows: Yes, No, No answer, and Not applicable. "No answer" was selected when the item was not presented by the authors, and "not applicable" was selected when the item was not relevant or not executed by the authors. On this scale, the final methodological review was high when it scored greater than or equal to 9 "yes" responses, moderate when there were between 5 and 8 " yes" answers, and low when there were 4 or fewer "yes" responses. Any difficulties in establishing a response were analyzed through a consensus meeting (J.F.S., E.P.P.).

The Glenny et al[31] scale, consisting of a set of 15 items that evaluated the structure of the topics covered, the formulation of a specific research question, and interpretation of the data, was also used. Each item with a "yes" answer was scored 1 point, and the total score obtainable was 0–15 points. A score of 10–15 indicated high quality, 5–9 points indicated average quality, and 0–4 indicated low quality.[30,31]

An analysis was also carried out to verify whether the systematic reviews were delineated according to the PRISMA-P or PRISMA 2009 tools.[39] Also, the authors analyzed if the studies had been registered on some registry databases for systematic reviews. Finally, the authors determined which bias scales were used and the type of studies included in the systematic reviews.

Data extraction

For each study, the main information collected was related to the existence of database registration, use of guides and protocols, bias scale employed, number of studies included,

types of studies included, databases consulted, main outcomes observed, number of patients, follow-up periods, type of implants, failure of dental implants, marginal bone loss, and heterogeneity.

Strategy for data synthesis

The key information identified in the different systematic reviews was synthesized based on similar topics outlined in the data extraction item.

Risk of bias (quality) assessment

In this study, we considered the quality of the tool by using the quality of the systematic review according to the AMSTAR (high, moderate, low) and Glenny scales.[29,31] We also analyzed the survival rate of the implants, the follow-up period, and the level of marginal bone loss. Two reviewers independently analyzed the studies (J.F.S., C.A.A.L.). All disagreements were resolved at group meetings with a third reviewer (E.P.P.).

Quantitative analysis

The analysis of quantitative data considered the main outcome of marginal bone loss, specifically mean difference of bone loss, standard error, number of PSW implants, and number of platform-matched implants. In the analysis of survival rate type, data were collected on the number of failures and total implants installed for the type of platform implant (PSW and PM).

Results

Initial database search identified 32 relevant articles, which, after a complete reading, was pruned down to the 8 studies included in this study (Figure 1). Four studies were excluded because they did not include the appropriate inclusion/exclusion criteria in the overview.[7,42–44]

Methodological quality of the systematic reviews

Of the included studies, only 1 was registered in a database for systematic review (PROSPERO), which indicated the elaboration of a previous protocol for execution.[12] On the other hand, 6 studies reported using the PRISMA checklist to perform the systematic review.[4,8,9,12,27,28] The methodological quality scale for the articles included in the systematic reviews was applied to all studies. The Jadad and Cochrane scales were the most used scales among the studies in the research.[1,8,9,12,27]

With 9 studies on the topic, the meta-analysis performed by Al-Nsour et al had the smallest number of included studies. Recently, Cochranovic et al included 28 studies on the topic. All of the systematic reviews included randomized controlled clinical trials; however, some also included case series,[1,4,9,28] and some studies considered prospective studies.[8,12,26,28] Only 1 study considered the inclusion of a retrospective study.[4]

In relation to the databases, only 1 study used 2 databases

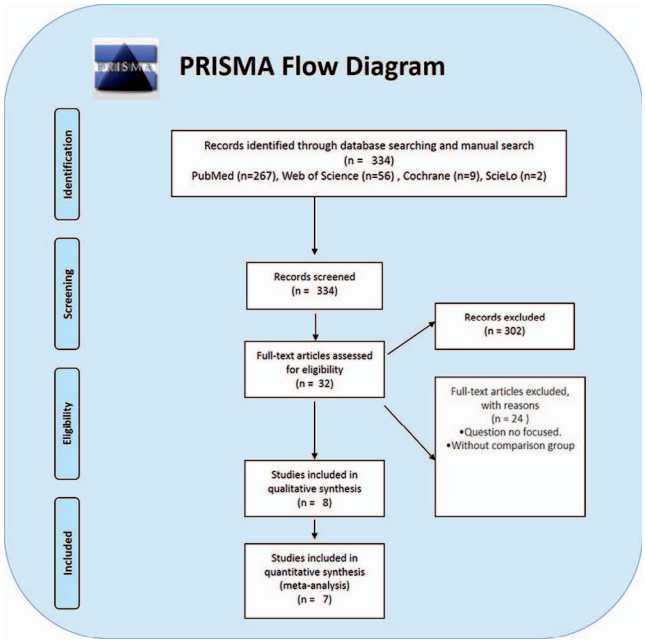

Figure 1. Diagram showing the selection of articles for the overview.

for selection of articles;[26] the other studies considered at least 3 databases, with 6 being the maximum number of databases considered.[9] The main conclusions of the included studies indicated that the platform-switching concept was effective in reducing peri-implant bone loss[1,4,8,9,12,26–28] (Table 1).

The AMSTAR scale indicated lower values as being in the 6-point range[26] and higher values as being in the 10-point range.[9] In 6 systematic reviews, high scores were obtained on the AMSTAR scale,[4,8,9,12,27,28] whereas 2 reviews received moderate scores[1,26] (Table 1). A detailed analysis of the systematic review scores using the AMSTAR scale can be seen in Table 2.

The sum of the scores from the Glenny et al[31] scale ranged from 8 to 13 (medium-to-high quality), and all of the reviews included at least 7 items. It should be noted that some of the reviews did not clarify whether the article quality review process was conducted by two reviewers;[1,4,8,26,28] however, most studies had at least two examiners select articles.[8,9,12,26,27] The question that showed the greatest deficiency of information was related to the possible search for unpublished data, with only 50% of the reviews contemplating the issue (Table 3). Other deficient aspects were literature search in all languages and evaluation of the quality of articles by more than one reviewer.

The clinical studies included in the systematic reviews had several limitations. For example, few clinical studies presented soft tissue data,[28] specific data for smokers and nonsmokers were scarce,[4,28] details about bone grafting were not reported,[4,28] complications that may have arisen in implant-supported prostheses were not reported,[28] and patient satisfaction[28] was rarely evaluated. Other studies had deficiency of information regarding the bone quality of the sites operated upon[12] and failed to clearly outline prospective studies.[12] There was also deficient information regarding the selection of studies in

TABLE 1

Analysis of the quality of the studies included in the overview of systematic reviews*

Study	Registry	Guide	Quality Scale	Included Studies	Type of studies	Database	Main Conclusions	AMSTAR	Glenny
Hsu et al[28]	No	PRISMA	CONSORT	26	Prospective, case series, RCTs	PubMed, Ovid (Medline), EMBASE, web of Science, Cochrane	PSW implants present protective effect on bone remodeling	9	9
Santiago Jr et al[49]	Yes	PRISMA	Jadad	25	Prospectives and RCTs	PubMed, Cochrane, EMBASE	PSW presented lower marginal bone loss.	9	12
Strietzel et al[8]	No	PRISMA	GRADE	22	Prospectives and RCTs	PubMed/Medline, Web of Science, Ovid, Embase	PSW showed significantly lower bone loss.	9	12
Chrcanovic et al[58]	N	PRISMA	NOS	28	RCTs, case series, retrospective	PubMed/Medline, web of Science, Cochrane	PSW showed significantly lower bone loss.	9	11
Herekar et al[1]	No	Não	Jadad, Cochrane	15	RCTs, controlled case series	PubMed, EBSCO, Quintpub, Science Direct, NY Univ. journal	PSW allows preserving peri-implant bone and soft tissue	8	10
Al-Nsour et al[26]	No	Não	Checklist Montenegro	9	RCTs and prospectives	PubMed/Medline	Use of smaller abutment prevents peri-implant bone loss	6	8
Annibali et al[27]	No	PRISMA	Jadad, Cochrane	10	RCTs	Medline, Embase, Cochrane	PSW indicates to be effective in reducing marginal bone loss	9	13
Atieh et al[9]	No	PRISMA	Jadad, Cochrane	10	RCTs and controlled case series	Medline, Embase, Cochrane, UK National register, Australian NZ Clínical trial, DARE, CPCI,	PSW can preserve peri-implant bone and soft tissue.	10	12

*RCT indicates randomized controlled trial; PSW, platform-switching.

the English language,[1,8,9] type of implants,[8] surgeons' profile,[8] patients' characteristics,[1,8] history of periodontal disease,[8] surgical steps,[1,4] immediate dental extraction surgeries,[4] location of dental implant placement,[4] different types of prostheses used, type of antagonistic arc,[4] implants' angulation, prosthesis splinting,[4] standardization of radiographic analysis,[1,9] sample size,[1,27] and patient withdrawal data.[26] Thus, future randomized controlled clinical trials should be adequately delineated to identify these factors.

Quantitative data

The number of clinical studies included in the reviews ranged from 9 to 28. The maximum number of patients analyzed was observed in the Santiago Jr study, with a total of 1098 patients. The shortest follow-up period was 6 months,[4] and the longest follow-up period was 168 months.[28] The smallest difference in marginal bone loss, comparing PSW implants with a control group was −0.23 mm (95% CI: −0.46, −0.00) in favor of PSW,[28] whereas the largest difference was -0.49 mm (95% CI: −0.73, −0.26) in favor of PSW.[8] All of the studies indicated a statistically significant mean difference in bone loss in favor of PSW implants. One exception was the study by Al-Nsour et al, wherein a systematic review was performed but not a meta-analysis.

The smallest significant difference was $P < .001$.[1,4,12] In these studies the mean difference of bone loss and confidence interval were: −0.41 mm (95% CI: −0.52, −0.29)[4]; −0.29 mm (95% CI: −0.38, −0.19)[1]; −0.34 mm (−0.37, −0.30)[12]. Regarding the heterogeneity indexes, all of the studies indicated percentages above 90% (Table 4).

Implant failure analysis

An analysis of the meta-analyses regarding the number of implant failures in PSW and PM implants, indicated that 4 studies allowed the data to be grouped as shown in Table 4. Similar number of failures was identified among the systematic reviews under consideration.[4,9,12,28]

Marginal bone loss

Marginal bone loss was analyzed in all systematic reviews that included a meta-analysis. The bone preservation identified in PSW implants in different meta-analyses is highlighted in Table 4. The lowest mean difference value was observed in the study by Hsu et al (−0.23 mm; 95% CI: −0.46, −0.00), and the highest value was observed in this study by Strietzel et al (−0.49 mm; 95% CI: −0.73, −0.26) (Table 4).

TABLE 2

AMSTAR scale, score of included studies (0 = not applicable or not; 1 = yes)*

Questions	Hsu et al[28]	Santiago Jr et al[49]	Strietzel et al[8]	Chrcanovic et al[58]	Herekar et al[1]	Al-Nsour et al[26]	Annibali et al[27]	Atieh et al[9]
1. Was an a priori design provided?	0	1	0	0	0	0	0	0
2. Was there duplicate study selection and data extraction?	1	1	1	1	1	1	1	1
3. Was a comprehensive literature search performed?	1	1	1	1	1	0	1	1
4. Was the status of publication (ie, gray literature) used as an inclusion criterion?	0	0	1	1	0	0	0	1
5. Was a list of studies (included and excluded) provided?	1	0	0	0	0	1	1	1
6. Were the characteristics of the included studies provided?	1	1	1	1	1	1	1	1
7. Was the scientific quality of the included studies assessed and documented?	1	1	1	1	1	1	1	1
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	1	1	1	1	1	1	1	1
9. Were the methods used to combine the findings of studies appropriate?	1	1	1	1	1	0	1	1
10. Was the likelihood of publication bias assessed?	1	1	1	1	1	0	1	1
11. Was the conflict of interest stated?	1	1	1	1	1	1	1	1
Total	9	9	9	9	8	6	9	10

*Shea et al[32]

DISCUSSION

The initial null hypothesis was rejected; all of the included systematic reviews indicated greater preservation of peri-implant bone tissue with PSW implants. The applied statistical analysis also indicated an average favorable difference for PSW implants. A limiting factor for the included meta-analyses was the high heterogeneity among the included studies.[1,4,8,9,12,27,28] This may have occurred because of the different sizes of the study samples; however, there was a consensus that this osseointegrable implant modality demonstrated the best bone preservation. The high heterogeneity is a factor that needs to be considered in the next randomized controlled trials and better suitability of the experimental model (implant type, trademark, operated area) is necessary.

Future systematic reviews on this theme should consider including only randomized controlled clinical trials that use a sample calculation for defining the samples or a power test of the analyses. Methodologically, the AMSTAR scale indicated a high score for 6 of the 8 included studies (Table 2). The main deficiencies observed were related to lack of registration in databases for systematic review protocols, and nondisclosure of studies excluded from the sample. There is also a need to search more databases and include gray literature in the methodologies of systematic reviews.[32]

The Glenny et al[31] scale allowed for the verification of deficiencies in the number of languages included for article selection, with our results showing that articles were predominantly written in English language. In some studies, it was not clear whether there was effective participation of two reviewers in article selection and quality analysis. Another important factor was the search for studies only in dedicated databases (for example, PubMed and Web of Science), whereas there were no searches in clinical trial record databases. These factors should be considered when designing the next protocol for systematic reviews because these deficiencies have already been pointed out in other implantology overviews.[30]

TABLE 3

Glenny scale for systematic reviews included

Questions	Hsu et al[28]	Santiago Jr et al[49]	Strietzel et al[8]	Chrcanovic et al[58]	Herekar et al[1]	Al-Nsour et al[26]	Annibali et al[27]	Atieh et al[9]
1. Did review address a focused question?	1	1	1	1	1	1	1	1
2. Did authors look for appropriate papers?	1	1	1	1	1	1	1	1
3. Do you think authors attempted to identify all relevant studies?	1	1	1	1	1	1	1	1
4. Search for published and unpublished literature	0	0	1	1	0	0	1	1
5. Were all languages considered?	0	0	0	0	0	0	0	0
6. Was any hand-searching carried out?	0	1	1	1	1	1	1	1
7. Was it stated that the inclusion criteria were carried out by at least two reviewers?	0	1	1	0	0	1	1	1
8. Did reviewers attempt to assess the quality of the included studies?	1	1	1	1	1	1	1	1
9. If so did they include this in the analysis?	1	1	1	1	1	1	1	1
10. Was it stated that the quality assessment was carried out by at least two reviewers?	0	1	0	0	0	0	1	0
11. Are the results given in a narrative or pooled statistical analysis?	pooled	pooled	pooled	pooled	pooled	0	pooled	pooled
12. If the results have been combined was it reasonable to do so?	1	1	1	1	1	0	1	1
13. Are the results clearly displayed?	1	1	1	1	1	1	1	1
14. Was an assessment of heterogeneity made and reasons for variation discussed?	1	1	1	1	1	0	1	1
15. Were results of review interpreted appropriately?	1	1	1	1	1	0	1	1
Total	9	12	12	11	10	8	13	12

Most of the included studies used a systematic review guide (PRISMA), with the exception of two studies;[1,26] however, only 1 study was registered in the PROSPERO database.[12] The use of properly established protocols in systematic reviews enhances the review's success, because following a defined and systematic protocol reduces the number of errors and extrapolations.

One study analyzed the methodological quality of systematic reviews on PSW implants.[29] In this study, there were a total of 5 systematic reviews and the included studies were

TABLE 4

Quantitative data*

Variables				Failure Rate (Implants)					Marginal Bone Loss			
Study	Number of studies	Patients	Follow-up	PSW Group (total)	Control Group (total)	N° PSW	N° Control	Standard Error	Mean Difference in Bone Loss	CI 95%	*P*	I^2%
Hsu et al[28]	19	1087	12 to 168	1047 (1059)	1142 (1160)	1125	1126	0.08935139	−0.23 (PSW)	[−0.46,−0.00]	.05	99%
Santiago Jr et al[49]	25	1098	12 to 60	1156 (1177)	1087 (1104)	1177	1104	0.064011	−0.41 (PSW)	[−0.52,−0.29]	<.00001	94%
Strietzel et al[8]†	22	549	12 to 24	NC	NC	554	566	0.06324865	−0.49 (PSW)	[−0.73,−0.26]	<.0001	96.20%
Chrcanovic et al[58]	28	729‡	6 to 60	891 (899)	892 (895)	1481	1487	0.043950282	−0.29 (PSW)	[−0.38,−0.19]	<.00001	92%
Herekar et al[1]	15	NC	NC	NC‡	NC	910	850	0.071486201	−0.34 (PSW)	[−0.37,−0.30]	<.00001	92%
Annibali et al[27]	10	435	12 to 36	NC	NC	494	379	0.1337	−0.44 (PSW)	[−0.68,−0.20]	0.0003	92%
Atieh et al[9]	10	NC	12 to 60	678 (686)	547 (553)	643	546	0.09241467	−0.37 (PSW)	[−0.55,−0.20]	<.0001	91%

*NC indicates nothing contained; PSW, platform-switching. For PSW Group (total) and Control group (total): number of implants at the end of follow-up (total implants placement at the beginning of treatment).

†Considered only randomized controlled trials.

‡Reported studies that did not account for patients.

published from 2010 to November 2013. The authors cautioned against the lack of long-term randomized studies, the existence of heterogeneity between studies, and the scarcity of multifactorial analyses. The PRISMA, AMSTAR, and Glenny scales should also be taken into account for systematic reviews on this theme.

This overview identified an increase in the number of randomized controlled clinical studies performed and identified that a large number of studies used the PRISMA criteria.[39] High methodological quality of the systematic review is very important[34,45] to adequately interpret the results of the review; therefore, the use of these guides is a relevant condition for the design of future systematic reviews.

In general, the systematic reviews presented adequate use of the different scales employed; however, the quality of systematic reviews in implantology can be improved. It is important to emphasize that specialists should address not only the main quantitative data but also the methodological deficiencies of each study included, as already highlighted in a previous overview.[46]

The most recent systematic reviews included a greater number of studies—more than twice as many—than the first systematic reviews proposed around 2010.[9] This is a positive aspect since it demonstrates that new studies have been published in the area. Future systematic reviews should not include retrospective studies or case series, owing to the lower scores on the scales of scientific evidence;[4,12,47] rather, they should only consider studies with a control and test group and that follow a defined protocol for executing the methodology. In this regard, the higher number of patients included in the recently published systematic reviews did not significantly reduce the mean difference in bone tissue preservation of PSW implants compared to PM implants, thus emphasizing the positive influence of bone preservation within this group. It is important to emphasize that analysis of the association (regression: number of patients and bone preservation) should be considered in the evaluation of the hypothesis.[4,48]

A possible explanation for the improved preservation of bone tissue when using PSW implants is the possible displacement of the inflammatory infiltrate at a greater distance from the peri-implant bone crest, as the smaller diameter of the abutment creates a greater distance from the end of the prosthesis to the bone crest.[4] Furthermore, in this concept, micromovements occur at a distance from the bone crest.[4] Another aspect indicated in the literature is the modification of the biological space due to platform switching;[2] a recent systematic review indicated the importance of the gingival tissue biotype in reducing peri-implant bone loss.[28] Thus, new studies should evaluate these microbiological concepts as well as the soft tissue quality around these implants.

Regarding the dimensions of the implants used, one study pointed out the predominant use of regular implants and that their wider diameter could explain the biomechanically favorable results.[12] Biomechanical studies using photoelasticity and finite elements have indicated that increasing the diameter plays an important role in the dissipation of stresses around implants.[20,21,49] A previous study indicated that the platform-switching concept may be effective in reducing the magnitude of stresses on bone tissue,[19–21] but it can also increase the magnitude of tensions in the structures associated with the screw and abutment of the prosthesis.[19,23,24,50,51] However, the evaluated systematic reviews did not indicate higher complication rates for PSW implant prostheses. These data need to be evaluated with adequate follow-up time.

One of the limitations reported by the authors[12,28] is the poor information regarding soft tissue quality in operated patients. This factor should be considered in upcoming clinical trials as the quality of soft tissue around dental implants may influence marginal bone preservation.[28,52,53] Another point focuses on the patient profile in the clinical study samples. The patient study samples excluded any type of systemic disease or any profile that could impair the results;[4,12,27,28] therefore, these data need to be extrapolated, with caution, to the general population.

Some studies reported that the greatest benefit of bone preservation was seen in implants that provided a greater distance between the platform and the bone tissue.[9,12,27] Chrcanovic et al[4] identified a significant difference in a meta-regression analysis; in addition, this study also indicated the importance of longevity, which was associated with increased bone preservation. Therefore, clinical studies should consider the distance from the platforms as well as a longer follow-up time.

Most of the systematic reviews considered the follow-up time to be short for clinical studies (Table 4), with emphasis on the extrapolation of long-term results. A larger difference in bone loss could be observed at the beginning of the treatment,[8] while longer term analyses could reduce this difference.[28] Thus, studies with appropriate experimental design and a long follow-up period (>5 years) are needed to further investigate this topic.

Additionally, the different types of connections used, implant markers, and cervical implant neck geometries should all be analyzed in isolation.[4] In addition, the studies highlighted the lack of standardization in the trademark, connections, and characteristics of the implants used.[4,12] These are important characteristics to standardize in future studies, as one systematic review with meta-analysis indicated that internal-type connections may present lower bone loss compared with implants with external hexagon-type connections.[54] The individualization of these factors becomes difficult when analyzing studies that were designed in different regions and with different commercial brands. These factors should be considered in the design of systematic reviews. Thus, it is important that new randomized clinical trials be standardized by including detailed information on the distances of the actual diameter mismatches between the implant and the abutment, also comparing several trademarks and geometries of different connections that may impair the analysis and quality of the results.

Other important points are the surgical techniques employed to install the implants and the bone quality of the sites operated. Studies have pointed out that the positioning of dental implants at the apical-coronal position (above the bone crest, level, and below the bone crest) may influence the observed results; thus, apical positioning of the implants may result in minimized marginal bone loss in implant switching platforms.[1,26,28] New studies should evaluate the initial

positioning of the implants and the possible effects of different placement levels.

In relation to bone grafting, information regarding bone grafting, such as material, location, and individual outcomes, were absent, as were data on microbial analysis, complications of the evaluated dental implants,[28] and the adopted hygiene protocols.[1] Another study pointed out that information such as bone quality was not presented in all of the included clinical studies.[12] This information is relevant since bone availability and quality have already been associated with higher risk of complications in dental implants.[20,55–58]

With the exception of one study, all others considered only English literature for inclusion in their primary sample.[8] This is a worrying factor considering that important studies may have been excluded. In addition, the method for evaluating marginal bone loss was not standardized among studies, with some using X rays and or computerized tomography scans, and this may have hampered the analysis of the results.[1,12] It is important to note that newer analyses considered different patient profiles, such as patients who smoke,[8] patients with bruxism and clenching,[59] and patients with local and or systemic alterations.[60–62]

The limitations of this overview relate to the fact that we retrieved data from systematic reviews rather than from primary trials, and our findings are limited to data reported in these systematic reviews, as previously described in an overview study.[63] Regarding future research for systematic reviews, randomized controlled clinical studies should employ adequate sample calculations and employ the split-mouth technique.

Conclusion

Quantitative analysis based on 7 systematic reviews with meta-analysis indicated positive peri-implant bone preservation for implants restored with an implant-abutment mismatching (PSW).

Future systematic reviews should highlight studies in more than one language and consider a larger number of databases, including clinical trial databases and gray literature. Finally, systematic reviews should consider registration on a specialized basis, and following current recommendations.

Abbreviations

AMSTAR: assessment of multiple systematic reviews

PICO: population—intervention—comparison—outcome

PM: platform-matched

PRISMA: preferred reporting items for systematic reviews and meta-analyses

PSW: platform-switching

PRISMA-P: preferred reporting items for systematic reviews and meta-analyses—protocol

Note

None of the authors has a relevant financial relationship(s) with a commercial interest.

Acknowledgments

The authors would like to express gratitude to the State of Sao Paulo Research Foundation (FAPESP) grant support (#2015/20827-2) provided. State of Sao Paulo Research Foundation: grant support (#2015/20827-2).

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Appendix 1

Uniterms used and Boolean search strategy

"systematic review" "dental implants" "platform switching"	("review"[Publication Type] OR "review literature as topic"[MeSH Terms] OR "systematic review"[All Fields]) AND ("dental implants"[MeSH Terms] OR ("dental"[All Fields] AND "implants"[All Fields]) OR "dental implants"[All Fields]) AND platform[All Fields] AND switching[All Fields]
"systematic review" "dental implant" "platform switching"	("review"[Publication Type] OR "review literature as topic"[MeSH Terms] OR "systematic review"[All Fields]) AND ("dental implant-abutment design"[MeSH Terms] OR ("dental"[All Fields] AND "implant-abutment"[All Fields] AND "design"[All Fields]) OR "dental implant-abutment design"[All Fields] OR ("dental"[All Fields] AND "implant"[All Fields] AND "platform"[All Fields] AND "switching"[All Fields]) OR "dental implant platform switching"[All Fields])
"dental implant-abutment design" "systematic review"	("dental implant-abutment design"[MeSH Terms] OR ("dental"[All Fields] AND "implant-abutment"[All Fields] AND "design"[All Fields]) OR "dental implant-abutment design"[All Fields] OR ("dental"[All Fields] AND "implant"[All Fields] AND "abutment"[All Fields] AND "design"[All Fields]) OR "dental implant abutment design"[All Fields]) AND ("review"[Publication Type] OR "review literature as topic"[MeSH Terms] OR "systematic review"[All Fields])