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SYSTEMATIC REVIEW

Evaluation of cement-retained versus screw-retained implant-supported restorations for marginal bone loss: A systematic review and meta-analysis

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ABSTRACT

Statement of problem. No consensus has been reached on which retention system, cement- or screw-retained, is best to avoid bone loss around the implant of a fixed implant-supported restoration.

Purpose. The purpose of this systematic review and meta-analysis was to compare cement- and screw-retained retention systems in fixed implant-supported restorations in terms of marginal bone loss, implant survival, and prosthetic complications.

Material and methods. A comprehensive search of studies published from January 1995 to March 2015 and listed in the PubMed/MEDLINE, Embase, Scopus and the Cochrane Library databases was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement. The meta-analysis was based on the Mantel-Haenszel and inverse variance methods. Marginal bone loss was the continuous outcome measure evaluated by mean difference (MD), and implant survival and prosthetic complications were the dichotomous outcome measures evaluated by risk ratio (RR), both with corresponding 95% confidence intervals (CI).

Results. The 20 studies selected for review evaluated 2139 participants, whose mean age was 47.14 years and who had received 8989 dental implants. The mean follow-up was 65.4 months (range: 12-180 months). Results of the MD for marginal bone loss showed statistically significant differences in favor of the cement-retained prosthesis (P =.04; MD: −0.19; CI: −0.37 to −0.01). The implant survival rate was higher for the cement-retained prosthesis (P =.01; RR: 0.49; CI: 0.28 to 0.85), and the prosthetic complication rate was higher for the screw-retained prosthesis (P =.04; RR: 0.52; CI: 0.28 to 0.98). Additional analysis of the mean plaque index did not show differences between retention systems (P=.58; MD: 0.13; CI: −0.32 to 0.57).

Conclusions. The current meta-analysis indicated that cement-retained, fixed implant-supported restorations showed less marginal bone loss than screw-retained, fixed implant-supported restorations during the follow-up period, which ranged from 12 to 180 months. However, the small difference between the mean values may not show clinical significance. The rates of prosthetic complication and implant survival also compared favorably with cement-retained prostheses. (J Prosthet Dent 2016;115:419-427)

Fixed implant-supported restorations have become the standard treatment for partially or totally edentulous patients, improving their mastication and appearance.[1] Restorations may be screw- or cement-retained to the implant, or both, through a cemented prosthesis with lingual or palatal fastening screws.[2]

Deciding on which retention system to use generally occurs during the planning stage when the advantages and disadvantages of each system are considered based on the proposed treatment.[3] In this context, the clinician's personal preference may influence the choice of retention system.[4]

Screw-retained systems are usually indicated for prostheses with multiple abutments to allow the prostheses to be removed for cleaning and

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Clinical Implications

Results of previous studies that have compared retention systems of fixed implant-supported restorations suggest that cement-retained rather than screw-retained prostheses lead to better preservation of bone tissue around the implant. Consequently, the rates of implant survival are higher and the rates of complications are lower.

possible repairs.[5] Furthermore, compared with cement-retained prostheses, screw-retained prostheses tend to show less marginal misfit at the crown-implant interface.[6] However, screw-retained prostheses have higher rates of complication, mainly as a result of screws loosening or fracturing and esthetic considerations when the implants are improperly positioned.[7]

Cement-retained systems are ideal where esthetics are the primary consideration, as these systems can compensate for an unfavorable angulation of an implant in relation to a crown; they are also more straightforward to fabricate, decreasing possible laboratory complications.[2] In addition, some in vitro studies have demonstrated that cement-retained prostheses exert less stress on other components and on bone tissue than do screw-retained prostheses.[8,9] As a result, cement-retained prostheses have become increasingly common, mainly in patients requiring single crowns.[4] However, care needs to be taken to avoid using too much cement, which can lead to surrounding soft tissue inflamation.[10]

As there is no consensus about the best type of retention system for fixed implant-supported restorations,[11] the purpose of this systematic review and meta-analysis was to assess the null hypotheses that no differences would be found between cement- and screw-retained implant-supported fixed prostheses with regard to marginal bone loss and that no differences would be found in relation to the survival rates of implants and prosthetic complications between the different retention systems.

MATERIAL AND METHODS

This systematic review is based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist structure[12] and in accordance with models proposed in published reports.[13-15] Moreover, this study was registered on the international prospective register of systematic reviews (PROSPERO; CRD42014015615; http://www.crd.york.ac.uk/PROSPERO/DisplayPDF.php?ID=CRD42014015615).

Two independent investigators (C.A.A.L. and V.E.S.B.) conducted an electronic search of PubMed/MEDLINE, Embase, Scopus, and the Cochrane Library for articles published between January 1995 and March 2015, using the following 6 search terms: "screw-retained and cement-retained and dental implant"; "cemented and screw-retained and dental implant"; "screw and cement and fixed or retain and dental implant"; "cemented-retained and screw-retained and dental implant"; "cemented and screwed and dental implant"; and "screw retained and cement retained and dental implant."

The same researchers manually searched for articles published between July and December in *Clinical Implant Dentistry and Related Research*, *Clinical Oral Implants Research*, *International Journal of Oral and Maxillofacial Implants*, *International Journal of Oral and Maxillofacial Surgery*, *International Journal of Prosthodontics*, *Journal of Dental Research*, *Journal of Oral Rehabilitation*, *Journal of Prosthodontics*, and *The Journal of Prosthetic Dentistry*. They also conducted a search of the non-peer–reviewed reports and as-yet–unpublished registered trials. All differences in choices between the investigators were analyzed by a third investigator (E.P.P.), and consensus was reached through discussion. Only 1 author[16] was contacted for a copy of the manuscript because this was not found in the databases.

Studies were selected and classified as included or excluded based on the title and abstract of the articles by the 2 researchers (C.A.A.L. and V.E.S.B.), working independently.

Eligible studies included randomized controlled trials (RCTs), prospective and retrospective studies (included because of the shortage of RCTs), and studies that compared screw- and cement-retained prostheses in the same study. In addition, studies needed to have at least 10 participants, have follow-up periods of longer than 1 year, and be published in English. Exclusion criteria were in vitro studies, animal studies, computer simulations, case reports, studies that evaluated only 1 type of retention without a comparison group, and published report reviews. The included prospective and retrospective studies were sorted according to their level of evidence as proposed by the National Health and Medical Research Council[17] to show their quality.

A specific question was formulated based on population, intervention, control, and outcome (PICO) criteria. The focused question was, "What is the best retention system for fixed implant-supported restorations?" According to these criteria, the population was the participants rehabilitated with dental implants; the intervention was the cement-retained prostheses, and the comparison was the screw-retained prostheses. The primary outcome was the marginal bone loss around the implant, and secondary outcomes were the survival rates of the implants, the prosthetic complications, and the marginal plaque index.

Data extracted from the articles were sorted as quantitative or qualitative by 1 of the researchers (C.A.A.L.) and then checked by 2 others (D.A.F.A. and F.R.V.). Any

Table 1. Characteristics of 20 selected studies

Study	Patients (n)	Implants (n)	Mean Age (Range) (y)	Retention System (n)	Range of Follow-up (mo)	Level of Evidence[a]	Mean (±SD) Marginal Bone Loss Over Follow-Up Period (mm)	No. of Implants that Survived (%)	No. of Prostheses that Survived (%)	Complications (n)
Ferreiroa et al[28]	80	80	44.4	C=40 S=40	48	III-3	NR	C=40 (100) S=40 (100)	C=40 (100) S=40 (100)	C=15 S=12
Crespi et al[29]	28	272	59.3 (46-77)	C=17 S=17	96	II	C=5 y: 0.29 (0.48) 8 y: 0.32 (0.21) S= 5 y: 0.46 (0.32) 8 y: 0.48 (0.40)	C=136 (100) S=134 (98.53)	C=136 (100) S=136 (100)	C=6 S=4
Cha et al[30]	120	136	47 (18.8-81.1)	C=30 S=106	60	III-3	NR	C=28 (93.1) S=96 (90.3)	C=28 (93.1) S=96 (90.3)	NR
Vigolo et al[11]	16	32	33 (27-42)	C=16 S=16	120	II	C= 4 y: 0.78 (0.23) 10 y: 1.11 (0.20) S=4 y: 0.83 (0.20) 10 y: 1.12 (0.20)	C=15 (93.75) S=15 (93.75)	C=15 (93.75) S=15 (93.75)	C=0 S=0
Nissan et al[31]	38	221	58 (38-70)	C=110 S=111	180	III-1	C=0.69 (0.5) S=1.4 (0.6)	C=110 (100) S=111 (100)	NR	C=10 S=42
Sherif et al[32]	99	193	47.3	C=90 S=103	60	III-2	NR	C=88 (97.8) S=98 (95.2)	C=88 (97.8) S=98 (95.2)	NR
Jemt[33]	35	41	31.35 (18-75)	C=23 S=18	120	III-2	C=1 year: 1.48 (0.51) 5 y: 1.49 (0.58) 10 y: 1.56 (0.71) S=1 year: 1.38 (0.42) 5 y: 1.34 (0.57) 10 y: 1.67 (0.57)	C=23 (100) S=18 (100)	C=17 (100) S=11 (100)	C=6 S=5
Cicciu et al[16]	527	1635	53.3	C=762 S= 84	60	III-3	NR	NR	C=749 (98.4) S=84 (100)	NR
Drago and Lazzara[34]	27	151	62.4 (41-75)	C=15 S=12	18	III-1	NR	NR	C=15 (100) S=12 (100)	C=0 S=0
De Boever et al[35]	105	283	59.1 (25-86)	C=127 S=45	40	III-1	NR	C=127 (100) S=45 (100)	C=127 (100) S=45 (100)	C=29 S=26
Weber et al[36]	80	152	NR	C=59 S=93	36	III-2	NR	C=59 (100) S=93 (100)	C=59 (100) S=93 (100)	C=0 S=0
Nedir et al[37]	181*	383	57.5 (18-89)	C=211 S=34	96	III-3	NR	NR	NR	C=22 S=2
Schropp et al[38]	46	43	NR	C=41 S=2	24	II	NR	NR	C=41 (100) S=2 (100)	C=5 S=0
Vigolo et al[39]	12	24	NR	C=12 S=12	48	III-1	C: 0.8 (0.4) S: 0.8 (0.8)	C=12 (100) S=12 (100)	C=12 (100) S=12 (100)	C=0 S=0
Fugazzotto et al[40]	NR	4261	NR	C=4053[b] S=208	72	III-3	NR	C=3994 (98.54) S=199 (95.67)	NR	NR
Henriksson and Jemt[41]	20	24	29 (18-62)	C=13 S=11	12	III-2	C: 0.3 (0.6) S: 0.4 (0.3)	C=13 (100) S=11 (100)	C=13 (100) S=11 (100)	C=0 S=0
Duncan et al[42]	32	84	NR	C=30 S=28	36	III-2	NR	C=41 (100) S=43 (100)	C=41 (100) S=43 (100)	C=0 S=10
Krennmair et al[43]	112	146	31.23	C=93 S=53	80	III-3	NR	C=91 (97.8) S=53 (100)	C=91 (97.8) S=53 (100)	C=19 S=7
Levine et al[44]	471	671	NR	C=600 S=71	78	III-3	NR	C=594 (99) S=71 (100)	C=594 (99) S=71 (100)	C=12 S=14
Levine et al[45]	110	157	NR	C=76 S=81	24	III-3	NR	NR	NR	C=4 S=19

C, cement-retained; NR, not reported; S, screw-retained; SD, standard deviation.
[a]Levels of evidence were based on those of National Health and Medical Research Council.
[b]Values refer only to number of prosthetic rehabilitations that used screw-retained and cemented types of retention.

disagreements were resolved through discussion until consensus was reached. The quantitative and qualitative data were tabulated for ease of comparison (Tables 1, 2).

Meta-analysis was based on the Mantel-Haenszel and inverse variance methods. Dental implant and prosthetic failures were the dichotomous outcome measures evaluated for risk ratio (RR), and marginal bone loss was the continuous outcome measure evaluated for mean differences (MD) and the corresponding 95% confidence intervals (CI). RR and MD values were considered significant when the P value was <.05. Software Review Manager v5.3 (Nordic Cochrane Centre, Cochrane Collaboration, 2014) was used for meta-analysis and to create forest plots.

The kappa coefficient value was calculated to determine inter-reader agreement in the study selection

Table 2. Summary of qualitative analysis of 20 selected studies

Study, ref	Year	Design of Study	Setting of Study	Implant System	Arch (n)	Localization	Type of Prosthesis	Complications Reported
Ferreiroa et al[28]	2015	Retrospective	Private	Lifecore Restore and Biomedical 4.1 mm (external connection)	Maxilla: 0 Mandible: 80	Anterior: 0 Posterior: 80	Single crowns	C=screw loosening, debonding, ceramic fracture, mucositis, peri-implantitis; S=screw loosening, ceramic fracture, mucositis
Crespi et al[29]	2014	Randomized controlled trial	University	Outlink Sweden and Martina (internal hexagon)	Maxilla: 192 Mandible: 80	NR	Full arches	C=screw loosening, ceramic fracture S=screw loosening, ceramic fracture
Cha et al[30]	2013	Retrospective	University	Osseospeed Astra Tech (internal connection)	Maxilla: 70 Mandible: 66	Anterior: 22 Posterior: 114	Single crowns	NR
Vigolo et al[11]	2012	Randomized controlled trial	University	3i/Implant Innovations (external hexagon)	Maxilla: 12 Mandible: 24	Anterior: 6 Posterior: 30	Single crowns	No complications for either group
Nissan et al[31]	2011	Prospective	University	Internal Hexagon Implants Biomet 3i, Zimmer Dental, Nobel Biocare, MIS Implant Technologies	Maxilla: 104 Mandible: 117	Anterior: 0 Posterior: 221	FPDs	C=ceramic fracture, abutment screw loosening S=ceramic fracture, abutment screw loosening
Sherif et al[32]	2011	Prospective	NR	ITI Straumann	Maxilla: 214 Mandible: 0	Anterior: 214 Posterior: 0	Single crowns	NR
Jemt[33]	2009	Prospective	NR	Nobel Biocare Implants	NR	NR	Single crowns	C=screw loosening, buccal fistulas, mucosal recession S=screw loosening, buccal fistulas, mucosal recession
Cicciu et al[16]	2008	Retrospective	NR	–[a]	Maxilla: 978 Mandible: 903	Anterior: NR Posterior: 1437	Single crowns and FPDs	NR
Drago and Lazzara[34]	2006	Prospective	Private	Osseotite (3i Implant Innovations)	Maxilla: 0 Mandible: 151	Immediate protocols	Full arches	No complications for either group
De Boever et al[35]	2006	Prospective	NR	ITI Straumann	(Prosthesis) Maxilla: 81 Mandible: 91	(Prosthesis) Anterior: 48 Posterior: 124	Single crown and FDPs	C=Screw loosening, debonding. polishing S=screw loosening, screw tightening, polishing
Weber et al[36]	2006	Prospective	NR	ITI Straumann	Maxilla: 152 Mandible: 0	Anterior: 152 Posterior: 0	Single crowns and FDPs	No complications for either group
Nedir et al[37]	2006	Retrospective	Private	ITI Straumann	Maxilla: 201 Mandible: 327	Anterior: 177 Posterior: 351	Single-crowns, FPDs. Full arch	C=ceramic fracture, minor veneer fracture S=ceramic fracture
Schropp et al[38]	2005	Randomized controlled trial	NR	Osseotite implant (3i Implant Innovations)	Maxilla: 37 Mandible: 9	Anterior: 24 Posterior: 22	Single crowns	C=debonding
Vigolo et al[39]	2004	Prospective	University	(3i Implant Innovations)	Maxilla: 20 Mandible: 4	Anterior: 6 Posterior: 18	Single crowns	No complications for either group
Fugazzotto et al[40]	2004	Retrospective	Private	ITI Straumann	NR	NR	Single crowns, FPDs, and full arches	NR
Henriksson and Jemt[41]	2003	Prospective	Private	Mk III implants (Nobel Biocare)	Maxilla: 24 Mandible: 0	Anterior: 24 Posterior: 0	Single crowns	No complications for either group
Duncan et al[42]	2003	Prospective	NR	ITI Straumann	NR	NR	Single crowns and FPDs	S=screw loosening; loss of composite resin of access to the screw
Krennmair et al[43]	2002	Retrospective	NR	Frialit-2 System	Maxilla: 84 Mandible: 62	NR	Single crowns	C=screw loosening, ceramic fracture, fistulae, recession S=screw loosening, ceramic fracture, recession
Levine et al[44]	2002	Retrospective	Private	ITI Straumann	Maxilla: 197 Mandible: 478	Anterior: 0 Posterior: 675	Single crowns	C=Screw loosening, abutment fracture, debonding, ceramic fracture S=Screw loosening, abutment fracture
Levine et al[45]	1999	Retrospective	Private	ITI Straumann	NR	Anterior: 22 Posterior: 135	Single crowns	C=Screw loosening S=Screw loosening, abutment loosening

C, cement-retained; FPDs, fixed partial dentures; NR, not reported; S, screw-retained.

[a]Implant innovation, Frialit 2 Synchro, Frialit 2, Xive, Frialoc, Branemark implant system and Replace implant system (Nobel Biocare), Premium, Stark and Seven implants, Camlog implants, Cresco implant, Benax implants.

process for publications in the PubMed/MEDLINE, Embase, Scopus, and Cochrane Library databases.

RESULTS

A search of the databases retrieved 1828 references, including 801 from PubMed/Medline, 532 from Embase, 478 from Scopus, and 17 from the Cochrane Library. After duplicate references were removed, 1256 studies remained. Applying the inclusion/exclusion criteria to the titles and abstracts of the selected comparative studies left 30 studies. A reading of these study texts allowed 10 studies to be excluded because they made no comparisons between cement- and screw-retained prostheses[18-21] or had insufficient data,[22-26] or the prostheses were conjugated with teeth.[27] Details of the search strategy are presented in a flow diagram (Fig. 1).

Altogether, 20 studies[11,16,28-45] (Tables 1, 2) were selected for qualitative and quantitative analyses. A total of 8989 implants were placed in 2139 participants, with a mean age of 47.14 years old; 7 studies were developed in private clinics,[28,34,37,40,41,44,45] and 5 in universities.[11,29,30,31,39] The mean follow-up was 65.4 months (range: 12-180 months).

ITI Straumann was the most commonly used implant system.[32,35-37,40,42,44,45] The mandibular arch was the most prevalent for implant placement, most implants were placed in posterior regions of the mouth, and single crowns were the type of prosthesis most studies evaluated.

The kappa interinvestigator agreement for articles selected from PubMed/MEDLINE (kappa value=0.91), Scopus (kappa value=0.87), Embase (kappa value=0.74), and the Cochrane Library (kappa value=1.00) showed a high level of agreement.[46]

Marginal bone loss was evaluated in 6 studies.[11,29,31,33,39,41] Marginal bone loss was significantly less with cement-retained prostheses than with screw-retained prostheses (P=.04; MD: −0.19; 95% CI: −0.37 to −0.01) (Fig. 2).

The assessed studies reported that 93 implants failed (1.03%) (Table 1). Eight studies showed no failures during their follow-up periods.[28,31,33,35,36,39,41,42] Quantitative analysis showed statistically significant higher survival rates for cement-retained implant-supported restorations than for that were screw-retained (P=.01; RR: 0.49; 95% CI: 0.28 to 0.85) (Fig. 3).

Loosened screws was the most prevalent complication in both of the retention systems.[28,29,31,33,35,42-45] Although loosened screws can be easily tightened, some complications such as ceramic fractures, which tend to occur in the posterior region, are not easily reparable.[28,29,31,37] Debonding is a complication reported for cement-retained retention.[28,35,38,44] Quantitative analysis of complication rates showed statistically significant differences that favored cement-retained prostheses over screw-retained prostheses (P=.04; RR: 0.52; 95% CI: 0.28 to 0.98) (Fig. 4).

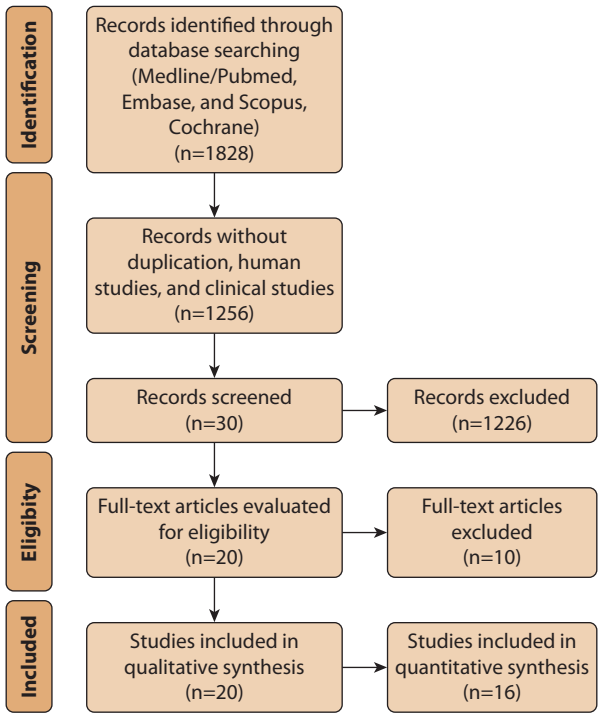

Figure 1. Literature search flow.

Two studies[32,36] evaluated the plaque index. Quantitative analysis found no significant differences between retention systems in relation to the mean plaque index (P=.58; MD: 0.13; 95% CI: −0.32 to 0.57) (Fig. 5).

DISCUSSION

Clinicians consider the advantages and limitations of each connection type for each patient when choosing the optimum retention system to use in fixed implant-supported restorations.[5] The choice should be based on evidence to improve the longevity of the restoration.

The present review included only those studies that compared cement- and screw-retained restorations in order to avoid any indirect comparisons. As a result, it was difficult to compare all quantitative variables in the studies. Nevertheless, high survival rates of implants were observed for both retention systems.

Brandão et al[47] compared marginal bone loss in a systematic review of different retention systems and observed greater loss for screw-retained prostheses, although this difference was not statistically significant. The authors, however, selected studies that evaluated only 1 type of retention and as a result found no evidence to support differences in marginal bone loss through indirect comparison.

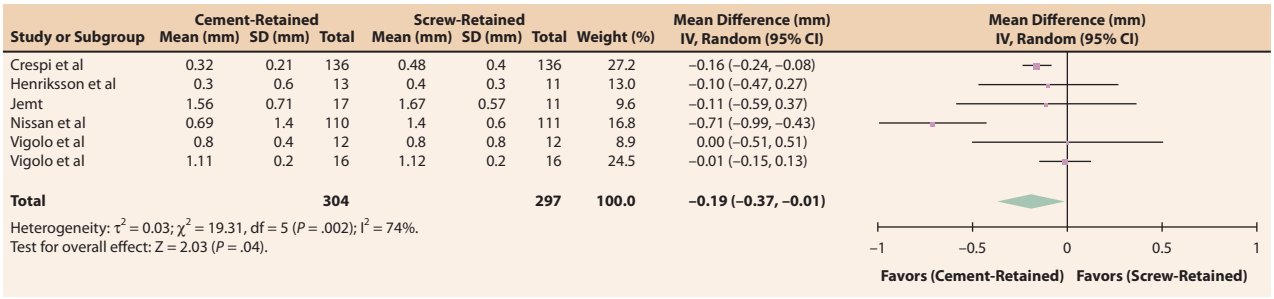

Figure 2. Forest plot: comparison of studies evaluating marginal bone loss. Purple squares, size of square reflects its weight in the analysis, green diamond: overall results of the meta-analysis. IV, inverse variance.

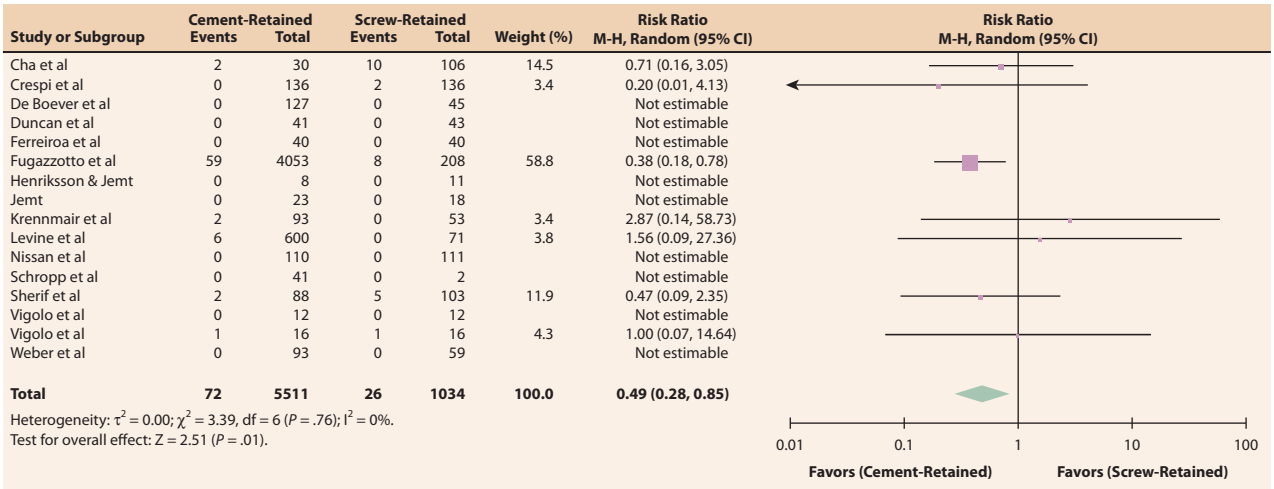

Figure 3. Forest plot: comparison of studies evaluating survival rates of implants. Purple squares, size of square reflects its weight in the analysis; green diamond, overall results of the meta-analysis. M-H, Mantel-Haenszel.

The present review, which investigated only studies with direct comparisons, found significant differences favoring cement-retained prostheses. As a result, the first hypothesis, that no differences would be found between cement- and screw-retained implant-supported fixed prostheses with regard to marginal bone loss, was rejected. Nevertheless, the differences favoring cement-retained prostheses might not be clinically relevant as the small differences in the mean values of marginal bone loss for both retention systems were within the parameters established for fixed implant-supported restorations[48,49] and do not compromise the use of screw-retained prostheses.

Some authors reported that cement-retained prostheses had greater tendency toward plaque buildup, sulcular bleeding, and gingival inflammation[32,36,39] because of the inherent difficulty in removing excess subgingival cement.[11,50] Plaque buildup may increase the risks of inflammation and, consequently, marginal bone loss.[51] However, studies that evaluated soft tissues did not demonstrate any association between different retention types and mean plaque index.[32,36] Although no additional data were reported about the depth of the prosthetic preparation, this depth could negatively affect the health of soft tissues around the prostheses.[36] Further research should be undertaken to determine the effect of the retention system on the marginal plaque index.

The biomechanics of the different retention systems may also affect marginal bone loss, with some studies reporting that cement-retained prostheses are better at stress distribution.[9,52-54] Access to the screw hole may also contribute to marginal bone loss because different restorative materials can transfer occlusal loads laterally to the implant instead of axially.[5] Furthermore, cement may be better at filling discrepancies, absorbing the strain of the deformation caused by the mismatch between the abutment and implant in the implant-abutment-prosthesis structure, and helping to equalize distribution.[55,56]

The second hypothesis was also rejected because cement-retained prostheses significantly affected the rates of survival of implants and of prosthetic complications. Survival rates of implants may have been affected by marginal bone loss and complications associated with loosened screws, which may increase implant fractures, especially in the posterior region.[30]

Study or Subgroup	Cement-Retained Events	Cement-Retained Total	Screw-Retained Events	Screw-Retained Total	Weight (%)	Risk Ratio M-H, Random (95% CI)
Crespi et al	6	17	4	17	9.6	1.50 (0.51, 4.38)
De Boever et al	29	127	26	45	12.5	0.40 (0.26, 0.59)
Drago et al	0	15	0	12		Not estimable
Duncan et al	0	30	10	28	3.7	0.04 (0.00, 0.73)
Ferreiroa et al	15	40	12	40	11.7	1.25 (0.67, 2.32)
Jemt	3	17	2	11	7.1	0.97 (0.19, 4.91)
Krennmair et al	19	93	7	53	10.9	1.55 (0.70, 3.44)
Levine et al	4	76	19	81	9.8	0.22 (0.08, 0.63)
Levine et al	12	600	14	71	11.2	0.10 (0.05, 0.21)
Nedir et al	22	211	2	34	8.0	1.77 (0.44, 7.20)
Nissan et al	10	110	42	111	11.6	0.24 (0.13, 0.45)
Schropp et al	5	41	0	2	4.0	0.79 (0.06, 11.09)
Vigolo et al	0	12	0	12		Not estimable
Vigolo et al	0	16	0	16		Not estimable
Weber et al	0	59	0	93		Not estimable
Total	**125**	**1464**	**138**	**626**	**100.0**	**0.52 (0.28, 0.98)**

Heterogeneity: $\tau^2 = 0.80$; $\chi^2 = 53.59$, df = 10 ($P < .00001$); $I^2 = 81\%$.
Test for overall effect: Z = 2.02 ($P = .04$).

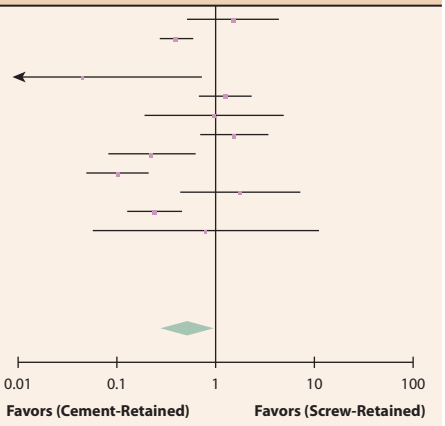

Figure 4. Forest plot: comparison of studies evaluating prosthetic complications. Purple squares, size of square reflects its weight in the analysis; green diamond, overall results of the meta-analysis. M-H, Mantel-Haenszel.

Study or Subgroup	Cement-Retained Mean	Cement-Retained SD	Cement-Retained Total	Screw-Retained Mean	Screw-Retained SD	Screw-Retained Total	Weight (%)	Mean Difference IV, Random (95% CI)
Sherif et al (Initial assessment)	0.12	0.28	90	0.15	0.41	103	24.9	−0.03 (−0.13, 0.07)
Sherif et al (Final assessment)	0.22	0.35	90	0.12	0.39	103	24.8	0.10 (−0.00, 0.20)
Weber et al (Initial assessment)	0.68	0.12	59	0.85	0.13	93	25.1	−0.17 (−0.21, −0.13)
Weber et al (Final assessment)	0.86	0.12	59	0.26	0.17	93	25.1	0.60 (0.55, 0.65)
Total			**298**			**392**	**100.0**	**0.13 (−0.32, 0.57)**

Heterogeneity: $\tau^2 = 0.20$; $\chi^2 = 619.12$, df = 3 ($P < .00001$); $I^2 = 100\%$.
Test for overall effect: Z = 0.56 ($P = .58$).

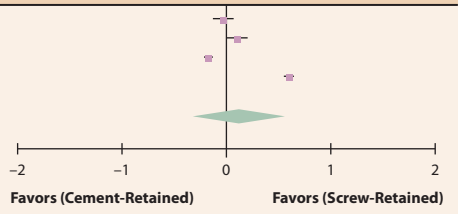

Figure 5. Forest plot: comparison of studies evaluating mean plaque index. Purple squares, size of square reflects its weight in the analysis; green diamond, overall results of the meta-analysis. M-H, Mantel-Haenszel.

Some limitations may have affected this result: analyses were not performed in a single arch or region, and factors such as high masticatory force, and a cantilever bridge can affect implant loss.[57] Eight studies did not report failures rates, which contributed to the high success rates for the implants.

Furthermore, 1 study[40] showed a higher weight (58.8%) (Fig. 4) of contribution in the meta-analysis of survival rates of the implants because of a greater number of cement-retained restorations, and this can be considered a bias in these results; thus, well-designed studies need to be performed to offer more reliable data.

Ma and Fenton[58] found no differences between retention systems in their evaluation of maintenance and complications rates in fixed implant-supported restorations. The present review found screw loosening to be the most frequently reported prosthetic complication, in agreement with studies that reported screw-retained single- and multiple-unit restorations had more technical complications than cement-retained restorations.[59] The greater preload exerted by the reduced passive fit of the screw-retained framework may explain the higher frequency of abutment screw loosening.[2,31,60]

Moreover, other factors may contribute to a higher rate of screw loosening, such as single crowns in the posterior region,[30] cantilever extensions,[37] prosthesis misfit,[61] and the screw diameter being smaller than the other components of the implants.[62] Improvements in the design and alloy of the screw could reduce the incidence of screw loosening.[5] Furthermore, careful and selective equilibration to achieve optimal occlusion and avoidance of contact in lateral and protrusive movements can also reduce the rates of screw loosening.[11]

Nonpassive fit of fixed partial prostheses increases the stress on and hence the material fatigue of the retaining screw, thus increasing the likelihood of the screw fracturing.[63] It is easier to achieve passivity in cement-retained prostheses[58] because these are more straightforward to fabricate.[2]

The advantage of screw-retained restorations is the possibility of retightening the screw without damaging the prosthesis if no screw fracture occurs. In contrast, a crown needs to be removed to repair a cement-retained prosthesis, which can compromise its integrity. For this reason, many practitioners use interim cement to ensure reversibility.[16,64]

The fracturing of veneering ceramic was independent of the retention system. Two studies showed higher fracture prevalence for screw-retained prostheses.[28,31] Screw-retained prostheses have screw access

holes that are usually restored with a material such as a composite resin that has a different elastic modulus. Some studies have reported that this difference in elasticity may favor the propagation of microcracks in ceramics and, consequently, lead to the fracture of veneering materials.[11,31,60]

Different implant connections may influence marginal bone loss, the survival rates of implants, and the rates of other complications because the choice of implant system is the first step in determining the feasibility of prosthesis retention. However, only 2 studies reported the use of external connections,[11,28] and they did not observe significant differences between the connection systems. Biomechanical studies have reported differences between external connections and internal connections and their respective abutments according to the retention system used.[9,65] Further clinical studies need to be performed in order to determine the best retention system for different connections.

Results of the present review should be interpreted with caution because of the few RCTs included in the analysis. Only 3 of the 20 studies selected were RCTs showing standardization criteria for achieving greater credibility and clinical reliability.[11,29,38] Further RCTs with longer follow-up periods are recommended to investigate the different retention systems.

CONCLUSION

The present meta-analysis indicates that cement-retained fixed implant-supported restorations result in less marginal bone loss over follow-up periods of between 12 and 180 months, fewer prosthetic complications, and higher implant survival rates than screw-retained prostheses. However, this study also confirmed the need for more trials of retention systems in fixed implant-supported restorations.

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