Comparison of Screw- and Cement-Retained Dental Implant from Biological, Clinical, and Technical Complications: A Systematic Review

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Abstract

The objective of this systematic review was to compare the biological, clinical, and technical complications between cement- and screw-retained implants. Three electronic databases were searched through 2011-2021. The terms "(cement* AND screw retain*) AND (implant OR prosthesis) AND (biological OR bone loss OR soft tissue OR clinical OR prosthetic OR technical OR mechanical OR complication* OR outcome*)" was chosen. Articles meeting the inclusion and exclusion criteria were selected. The database search resulted in a total of 379 potential studies. After screening titles and abstracts and applying inclusion and exclusion criteria, 34 studies were collected for a full text assessment. Full text assessment resulted in 17 studies that were eligible of qualitative synthesis. Vote-counting method resulted that there was no significant difference in biological, clinical, and technical complications between cement- and screw-retained implants. Dental implants treatment can be done with cement- or screw-retained without affecting its biological, clinical, and technical aspects.

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Introduction

Dental implant use has been increased greatly in the past few decades[1]. This is caused by the ability of dental implants to replace missing teeth similar to real teeth, give good retention, good stability and functional efficiency, comfort, and aesthetic.[1-5] Thus, implant usage can increase a patient's quality of life.[6] One of the most important factors in dental implant treatment is choosing the retention type in the final restoration whether that be cement- or screw-retained.[7]

Both types of retention have their advantages and disadvantages that can affect the complications rate.[6] Previous literatures have mentioned the advantages of cement-retained implants such as better aesthetics, simplicity in treatment technique, cheaper, better passive fit, and easier access to the posterior region specifically in patients with limited mouth opening.[8-10] The absence of a screw access hole makes the occlusal surface untouched and have better occlusion control.[11] Meanwhile, the advantages of screw-retained implants are that it needs smaller interocclusal space (4mm minimum), no risk of excess cement in sulcus, and retrievability that facilitate evaluation, maintenance, repair, or surgery without damaging the implant component.[10] The disadvantages of cement-retained implants are difficulties removing excess cement, it needs wider interocclusal space (5mm minimum), and in sensitive-patients cement can be toxic to the surrounding tissue.[11-13] Meanwhile, the disadvantages of screw-retained implants are more expensive, screws can be loosen and create a gap that can cause bacterial colonization, and bad angulation can cause an undesired aesthetic.[9,10,14] These disadvantages can cause plenty of implant complications. Complications can happen in every step of the treatment such as in the surgical phase, restoration phase, and follow-up phase.[2] Generally, the complications that can happen are

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biological, clinical, and technical complications.[3,15]

Several studies concluded that there was no significant difference in complication rate between screw- and cement-retained implants.[16,17] Several studies concluded that complication happened more in cement-retained implants compared to screw-retained implants, meanwhile several stated otherwise.[18-21] Those studies suggested that there needs to be further research to know which type of retention is the better one. Therefore, this systematic review was done as an updated reference in discussing complications in cement- and screw-retained implants.

Materials and methods

Search Strategy and Data Extraction

An online literature search was conducted using PubMed, EBSCO, and Cochrane Central Register of Controlled Trials (CENTRAL). The search was done with Boolean system with the keyword "(cement* AND screw retain*) AND (implant OR prosthesis) AND (biological OR bone loss OR soft tissue OR clinical OR prosthetic OR technical OR mechanical OR complication* OR outcome*)". PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) was used to get the suitable articles for analysis. PICOS (Population, Intervention, Comparison, Outcome, Study) was used to narrow the scope of the articles search (Table 1).[22]

Criteria	Inclusion	Exclusion
Database	PubMed, EBSCO, and Cochrane Central Register of Controlled Trials (CENTRAL)	Other database and grey literature
Publishing year	2011 – 2021	Study published before 2011
Language	English	Other languages
Publication type	Journal	Other publication type
Journal quality	High and medium quality	Low quality
Populations	Edentulous patients treated with dental implant	Edentulous patients treated with other type of denture
Intervention	Patients treated with cement-retained implant	Patients treated with other type of implant retention
Comparison	Patients treated with screw-retained implant	
Outcome	Biological, clinical, and technical complications of cement- and screw-retained implant	Other complications
Study	RCT (Randomized controlled trials), and cohort	Other study type

Table 1. Inclusion and exclusion criteria.

Study Selection

The selection process began with filtering identified articles by reading the abstracts. Full texts of the relevant articles were then evaluated. Evaluation was done with inclusion and exclusion criteria based on PICOS (Table 1).[23,24]

Quality assessment

Quality assessment was done using 2 criteria according to the study design of the assessed journals. Randomized controlled trial (RCT) used Jadad criteria while cohort used Newcastle-Ottawa criteria. Jadad criteria consist of 8 questions that can be given -1, 0 or 1 point (Table 2).

Journal	Point	Quality
Nissan et al. (2011)[20]	6	High
Vigolo et al. (2012)[8]	6	High
Cacaci et al. (2016)[30]	6	High
Paolantoni et al. (2016)[31]	6	High
Amorfini et al. (2018)[32]	6	High
Thoma et al. (2018)[14]	6	High
Weigl et al. (2018)[4]	6	High
Heierle et al. (2019)[33]	5	High
Kraus et al. (2019)[3]	5	High

Table 2. Jadad criteria.

Journal	Selection	Comparability	Exposure	Quality
Sherif et al. (2011)[38]	***	**	***	High
Kolgeci et al. (2014)[28]	***	*	***	High
Korsch et al. (2015)[29]	**	*	***	Medium
Woelber et al. (2015)[35]	**	**	***	Medium
Al Amri et al. (2017)[16]	***	*	***	High
Anitua et al. (2019)[36]	**	**	***	Medium
Papaspyridakos et al. (2019)[34]	**	**	**	Medium
Shi et al. (2020)[19]	***	**	***	High

Table 3. Newcastle-Ottawa criteria.

The total points then were added up, journals with 4-8 points were considered high-quality and 0-3 points were considered low-quality.[25] Newcastle-Ottawa criteria consist of 8 questions that are divided into 3 groups such as selection, comparability, and exposure. Journals then can be classified into high, medium, and low-quality (Table 3).[26,27]

Data Analysis

Data analysis was done qualitatively using the vote-counting method with the most study number gives the best estimate about the comparison between groups.[28]

Results

Three hundred and seventy nine articles were obtained from PubMed, CENTRAL, and EBSCO databases. The articles were checked for duplicates which were then deleted, leaving 320 articles. The remaining articles were then checked for the titles and abstracts according to the inclusion and exclusion criteria based on PICOS, leaving 34 articles. Furthermore, the full texts of these articles were analyzed resulted in 17 articles that could be used in this systematic review (Figure 1).

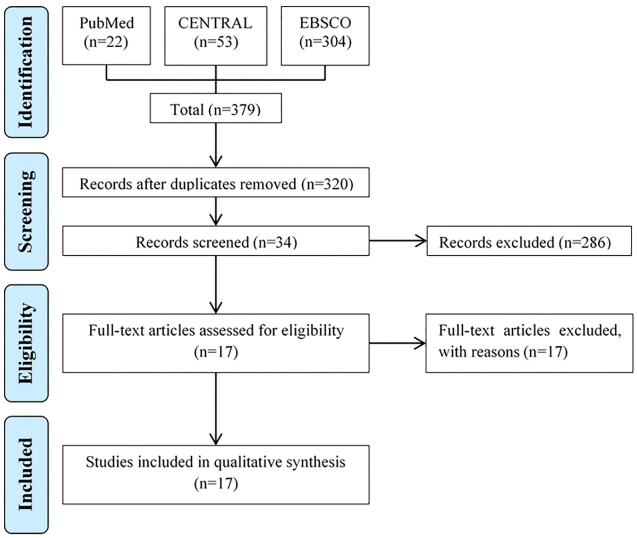

Figure 1. Study workflow and finding.

All articles were analyzed and data were extracted. The data needed include the incidence of biological, clinical, technical complication, and the conclusions from the study. (Table 4-6).

The result observed in 1 of 10 studies addressed that cement-retained implants have significantly lower rates of biological complications than screw-retained implants, 2 articles concluded that screw-retained implants have significantly lower rates of biological complications than cement-retained, and while 7 articles concluded that there was no significant difference between the 2 groups. Based on the vote-counting method, it can be concluded that there was no significant difference in the comparison of biological complications between cement-retained and screw-retained dental implants.

Of the 11 studies that assessed the clinical complication, in 1 study, the result showed that cement-retained implants have significantly lower rates of clinical complications than screw-retained implants, 2 articles concluded that screw-retained implants have significantly lower rates of biological complications than cement-retained implants, while 8 articles concluded that there was no significant difference between those 2 groups.[4,9,15,26,29-32,34-37] Based on the vote-counting method, it can be concluded that there was no significant difference in the comparison of clinical complications between cement-retained and screw-retained dental implants.

Two out of 12 articles concluded that cement-retained implants have significantly lower rates of technical complications than screw-retained implants, while 10 articles concluded that there was no significant difference between those 2 groups. Based on the vote-counting method, it can be concluded that there was no significant difference in the comparison of technical complications between cement-retained and screw-retained dental implants.

Discussion

This systematic review aimed to identify published articles comparing complications among cement- and screw-retained dental implant. A total of 17 articles were obtained after going through the identification process to quality assessment and were eligible to be analyzed in this systematic review. Nine articles with RCT design and 8 articles with cohort design were published in 2011-2020. In RCT studies, retention types were chosen by flipping coin, sealed envelope, and computer-aided randomization. All patients participated in these studies were asked to sign informed consent. Patients who participated in these studies came

from various age groups ranging from young adults to the elderly. Patients were divided into 2 groups based on retention types. Those studies were conducted in various countries such as Saudi Arabia, Italy, Spain, Germany, Switzerland, US, China, and Israel. Patients in those studies came from different countries thus the background, habits, and social status are very varied.[3,4,15,20,21,29-35]

Regarding the type of the cement, zinc oxide-based cement could minimize the number of microbes in the peri-implant sulcus compared to other types of cement with more microbial counts [17,36]. Cement with a low retention value such as zinc oxide is not too difficult to clean the remaining cement but can pose a risk of decementation.[36] The success of zinc oxide cement is attributed to less pathological bone resorption on the distal and mesial sides of the implant.[9] A study showed a significant difference in pathological bone resorption on the distal side with an average on cement-retained implants was 0,4746 mm and screw-retained implants was 0,1517 mm using radiopaque glass ionomer cement.[37] The other study found no sign of greater peri-implant bone loss in the cement-retained group, possibly because the shoulder of the juxta-gingival customized abutment made it easier to clean.[33] Furthermore, a study that compared at 36th and 38th months follow-up showed no pathological bone resorption in radiography around dental implants. However, at 48 months follow-up, pathological bone resorption was noted with mean 1,17 mm in cement-retained and 1,4 mm in screw-retained group. The abutments and screws used were zirconia. This was attributed to the laboratory finding that the physical bond of zirconia, like other ceramics, could deteriorate over time. Zirconia abutments (zirconium dioxide) has the advantages of less bacterial adhesion, lower or no cytotoxicity, and mucosal adhesion is very similar to titanium.[32] Regarding the location of the implant, maxilla and mandible showed no significant difference in biological complications of cement- and screw-retained dental implants.[17,37]

Clinical complications of both cement- and screw-retained implants are often associated with excess cement residue in the peri-implant sulcus or the presence of gaps in the abutment with an overlying superstructure that can create microbial growth. On the examination, patients were examined using a mouth mirror and periodontal probe.[4,21,31,32] Plaque accumulation and bleeding on probing were highly correlated, which indicated by high score of plaque accumulation and bleeding on probing.[37] This was caused by excess cement residue that can result in gingival irritation which then manifests as an accumulation of bacteria (plaque) and inflammation (bleeding).[19,37]

Several recent studies also mentioned that clinical complications usually occur more in the cement-retained groups associated with restorations that did not use Computer-Aided Design (CAD) / Computer-Assisted Manufacture (CAM).[33,36] Computer-Aided Design (CAD)/ Computer-Assisted Manufacture (CAM) cement restorations can help move the cementing line closer to the gingival margin, resulting in easier removal of excess cement.[33] Recent in vitro study have also found the extra oral cementation technique was superior to other conventional cementation techniques concerning the excess cement.[36] This technique allows dentists to remove excess cement before attaching the restoration to the implant abutment.[36]

The research instruments used to evaluate technical complications are mostly not mentioned, but there are 3 articles that use the USPHS (United States Public Health Service) criteria. This does not make any difference to the articles that did not use the USPHS criteria because the technical complications observed remained the same.[3,15,31]

The use of artificial crowns in the studied articles were made of various materials such as porcelain-fused-to-metal (PFM), porcelain, zirconia, ceramics, lithium disilicate, and zirconium layering ceramic. This certainly can affect the strength of the artificial crown to receive forces associated with technical complications such as crown chipping and crown fracture. Further research can be carried out to compare the resistance of various types of materials with the type of retention used.

Most of the articles reporting technical complications were using resin-based cement to attach the artificial crowns to abutments in the cement-retained group, 2 studies used ZOE cement, 1 study used RMGIC cement, and 2 studies used GIC cement.[3,4,15,20,21,29-35] Both studies using ZOE cement concluded that cement-retained implants show significantly fewer technical complications compared to

screw-retained implants.[21,30] Both studies did not report any incidence of decementation. This is related to the nature of ZOE cement which has good sealing properties.[21,30]

Even though there is substantial volume of articles available comparing about cement and screw-retained dental implants, almost all of these articles are lack of the complications aspect. This systematic review still has limitations such as the inclusion criteria that are not specific enough so that several things such as patient age, type of cement, and implants used are still varied. In addition, the use of databases in this study was limited to databases that can be fully accessed. Further research can be carried out using more databases in order to capture more articles and use more specific inclusion criteria to reduce bias in research results.

Conclusions

Within the limitations of this systematic review, it can be concluded that there is no significant difference in the use of implant-supported dentures with cement- or screw-retained in biological, clinical, or technical aspects. Dental implants treatment can be done with cement- or screw-retained without affecting its biological, clinical, and technical aspects.

Declaration of Interest

The authors report no conflict of interest.

Author & Year	Retention Type	Age	N	Follow-up (month)	Peri-implant mucositis	Peri-implan titis	Suppuration	Pathological bone resorption	Conclusion
Al Amri et al. (2017)	Cement	38,4 ± 0,8	26	60	N/A	N/A	N/A	1,7 ± 0,5 mm	There is no significant
	Screw	37,5 ± 0,4	25		N/A	N/A	N/A	1,7 ± 0,4 mm	difference
Amorfini et al. (2018)	Cement	25-76	15	120	1	N/A	N/A	0,95 ± 0,44 mm	There is no significant
	Screw	24-73	15		1	N/A	N/A	0,82 ± 0,33 mm	difference
Anitua et al. (2019)	Cement	32-77	51	12-108,9	N/A	N/A	N/A	0,4746 ± 0,80 mm	Screw is significantly
	Screw		77		N/A	N/A	N/A	0,1517 ± 0,59 mm	better
Nissan et al. (2011)	Cement	38-70	221	18-159	N/A	N/A	N/A	0,69 ± 0,5 mm	Cement is significantly
	Screw			18-180	N/A	N/A	N/A	1,4 ± 0,6 mm	better
Paolantoni et al.	Cement	53 ± 4	29	48	N/A	N/A	N/A	1,17 ± 0,89 mm	There is no significant
(2016)	Screw		45		N/A	N/A	N/A	1,4 ± 0,99 mm	difference
Vigolo et al. (2012)	Cement	27-42	16	120	0	0	N/A	1,1 1± 0,2 mm	There is no significant
	Screw		16		0	0	N/A	1,12 ± 0,2 mm	difference
Woelber et al. (2015)	Cement	64,19 ± 12,	57	158,4±	18 (31,58%)	0	N/A	N/A	Screw is significantly
	Screw	59	36	38,4	9 (25%)	0	N/A	N/A	better
Shi et al. (2020)	Cement	18-68	20	12	N/A	N/A	N/A	0,41 ± 0,38 mm	There is no significant
	Screw	18-66	23		N/A	N/A	N/A	0,31 ± 0,30 mm	difference
Papaspyridakos et al.	Cement	39-88	36	12-144	N/A	Annual rate: 1,5%	N/A	N/A	There is no significant
(2019)	Screw		19		N/A	Annual rate: 1,9%	N/A	N/A	difference
Sherif et al. (2011)	Cement	47,3± 14,9	90	3-60	N/A	N/A	N/A	97,8%	There is no significant
	Screw		103		N/A	N/A	N/A	95,2%	difference

Table 4. Biological complications.

Author & Year	Retention Type	N	Follow-up (month)	Clinical Complication					Conclusion
				Plaque Accumulation	Bleeding on probing	Gingival Inflammation	Periodontal pocket depth	Width changes in keratinized tissue	
Al Amri MD, et al. (2017)[63]	Cement	26	60		10,2 ± 0,6 %		2,5 ± 0,1 mm		There is no significant difference
	Screw	25			8,6 ± 0,4 %		2,3 ± 0,3 mm		
Amorfini L, et al. (2018)[64]	Cement	15	120	0,1 ± 0,4 %	0,4 ± 0,4 %		3,3 ± 0,6 mm		There is no significant difference
	Screw	15		0,1 ± 0,3 %	0,4 ± 0,3 %		3,4 ± 0,6 mm		
Cacaci C, et al. (2016)[35]	Cement	61	36	0,6 ± 0,1 %	0,7 ± 0,1 %	0,4 ± 0,1 %			There is no significant difference
	Screw	53		0,4 ± 0,1 %	0,5 ± 0,1 %	0,3 ± 0,1 %			
Shi JY, et al. (2020)[65]	Cement	20	12		33,3 ± 33,8 %		2,48 ± 0,50 mm		Screw is significantly better
	Screw	23			11,6 ± 19,1 %		2,31 ± 0,60 mm		
Nissan J, et al. (2011)[13]	Cement	221	61 ± 40			0,09 ± 0,3 %			Cement is significantly better
	Screw		66 ± 47			0,48 ± 0,5 %			
Paolantoni G, et al. (2016)[66]	Cement	23	48	0,48 ± 0,51 %	0,24 ± 0,44 %				There is no significant difference
	Screw	51		0,47 ± 0,50 %	0,47 ± 0,50 %				
Sherif S, et al. (2011)[12]	Cement	90	60	0,22 ± 0,35 %	0,37 ± 0,52 %			4,5 ± 1,2 mm	Screw is significantly better
	Screw	103		0,12 ± 0,28 %	0.08 ± 0.21 %			5,1 ± 4,0 mm	
Thoma DS, et al. (2017)[5]	Cement	16	6	11 ± 17 %	31 ± 29 %		3 ± 0,74 mm	3,25 ± 1,13 mm	There is no significant difference
	Screw	15		7 ± 14 %	14 ± 21 %		3,08 ± 0,51 mm	3,64 ± 1,01 mm	
Vigolo P, et al. (2012)[39]	Cement	18	120	14 %	6,9 %	4,7 %	3,1 mm	1,6 ± 1,2 mm	There was no significant difference
	Screw	18		14 %	6,9 %	4,5 %	3,1 mm	1,5 ± 1,1 mm	
Weigl P, et al. (2018)[6]	Cement	22	12	27,3 %	9,1 %				There is no significant difference
	Screw	22		9,1 %	4,5 %				
Woelber JP, et al. (2015)[67]	Cement	57	120-276		31,58 %		3,74 ± 1,01 mm		There is no significant difference
	Screw	36			25 %		3,76 ± 0,54 mm		

Table 5. Clinical complications.

Author & Year	Retention Type	N	Follow-up (month)	Crown damage				Loss of retention		Conclusion
				Crown chipping	Crown fracture	Framework fracture	Decementation	Screw/ abutment loosening	Screw/ abutment fracture	
Nissan et al. (2011)	Cement	221	180	-	4%±0,1%	0%	-	9%±0,2%	-	Cement is significantly better
	Screw			-	38%±0,3%	0%	-	32%±0,3%	-	
Kolgeci et al. (2014)	Cement	25	84	1	-	0	3	5	-	There is no significant difference
	Screw	168		2	-	3	-		-	
Korsch et al. (2015)	Cement	37	42	-	-	-	-	4	1	Cement is significantly better
	Screw	52		-	-	-	-	17	3	
Cacaci et al. (2016)	Cement	61	36	2	-	-	-	-	-	There is no significant difference
	Screw	53		0	-	-	-	-	-	
Paolantoni et al. (2016)	Cement	29	48	-	3	-	-	0	-	There is no significant difference
	Screw	45		-	2	-	-	0	-	
Amorfini et al. (2018)	Cement	15	120	0	-	-	1	1	1	There is no significant difference
	Screw	15		1	-	-	-	1	0	
Thoma et al. (2018)	Cement	17	6	2	-	-	-	-	-	There is no significant difference
	Screw	16		0	-	-	-	-	-	
Weigl et al. (2018)	Cement	22	12	2	-	-	2	0	0	There is no significant difference
	Screw	22		0	-	-	-	1	0	
Heierle et al. (2019)	Cement	14	36	1	-	-	-	-	0	There is no significant difference
	Screw	13		1	-	-	-	-	1	
Kraus et al. (2019)	Cement	14	36	1	0	2	0	0	2	There is no significant difference
	Screw	18		0	0	4	-	0	4	
Papaspyridakos et al. (2019)	Cement	243	144	3,6%	1,1%	1	10	6	2	There is no significant difference
	Screw	116		0,6%	0,08%		-			
Shi et al. (2020)	Cement	20	12	-	-	-		1		There is no significant difference
	Screw	23		-	-	-	-	2	-	

Table 6. Technical complications

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