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Review

Comparing the periodontal clinical effect between conventional and self-ligating brackets: Systematic review and meta-analysis.

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Abstract: Introduction: Orthodontists constantly seek to reduce the duration of their provided treatments and the patient's time in the office. For this reason, different bracket systems are currently used in orthodontics; an example is self-ligating brackets (SLB) which are believed to offer advantages over conventional brackets (CB). Objective: To evaluate and compare the clinical periodontal effect of CB and SLB through a systematic review and a meta-analysis. Material and Method: A search of the literature was carried out until December 2017, in the biomedical databases: PubMed, Embase, SciELO, ScienceDirect, SIGLE, LILACS, BBO, Google Scholar and the Cochrane Central Register of Controlled Trials. The selection criteria of the studies were defined as such: randomized clinical trials, up to 5 years old and that report the clinical effects (probing depth, bleeding on probing, gingival index and plaque index) from the use of CB and SLB. The risk of study bias was analyzed through the Cochrane Handbook of systematic reviews of interventions. Results: The search strategy resulted in 12 articles, eight of which reported no difference in the reduction in probing depth, bleeding on probing, gingival index and plaque index (p>0.05) between CB and SLB. Conclusion: The literature reviewed suggests that there are no differences in the periodontal clinical effect among patients who received orthodontic treatment with CB or SLB.

Keywords: Self-ligating bracket; conventional bracket; periodontal health; review; meta-analysis.

INTRODUCTION.

Orthodontists constantly seek to reduce the duration of the treatments they provide and the time patients spend in the office. Although the average treatment lasts between 1 and 2 years, there is still a continuous attempt to reduce it. To achieve this, several techniques and devices have been recommended, including surgical procedures, vibration stimulation, greater use of individualized arches and brackets, as well as prescribing exodontia less frequently.[1,2]

Self-ligating brackets (SLB) are orthodontic devices that unlike conventional brackets (CB) do not require elastomeric ligation methods or ligature wires to keep the arch in place. They were first presented by Stolzenberg in 1935 and were discovered as an accessory of the Russell attachment fabricated in the 1930s; however, it was not until the last 20 years that they have had their greatest use.[4-8]

Currently, different types of SLB are used during orthodontic treatment. The manufacturers and proponents of SLB claim that these

offer advantages over CBs, such as: reducing the friction between the arch and the bracket, faster alignment and reduction of gap space, greater expansion of the arch with a less incisor proclination, fewer extractions needed to gain space and relieve crowding, lower number of office appointments needed, shorter appointment time, shorter overall treatment time, greater patient comfort, better oral hygiene and greater patient cooperation and acceptance.[3-6]

However, despite the popularity and advantages commercially attributed to SLB for both orthodontists and patients, orthodontists are still wondering whether SLB really offer the supposed advantages over CB and whether the latter should be replaced by the SLB. To date, many studies have investigated the efficiency and clinical efficacy of SLB compared to CB through several methods, in an attempt to reach a conclusion, although these studies have varied greatly in methodology and results.[8-10]

While current literature offers conclusions regarding friction and the efficiency of treatments with the use of SLB compared to CB, it does not present conclusive remarks regarding the periodontal health differences. Therefore, the objective of this article is to evaluate and compare the clinical periodontal effect between the use of SLB and CB.

MATERIALS AND METHODS.

This review was carried out in accordance with a previously prepared research protocol following the guidelines of the PRISMA guidelines.[11]

Bibliographic search

A broad search strategy was carried out in the following biomedical databases: PubMed, Embase, SciELO, ScienceDirect, SIGLE (System for Information on Grey Literature in Europe), LILACS, BBO, Google Scholar and in the Cochrane Central Register of Controlled Trials, and a manual search was also performed in the journals of periodontics and orthodontics of greater impact such as: *Periodontology 2000, Journal of Clinical Periodontology, Journal of Periodontology, American Journal of Orthodontics and Dentofacial Orthopedics, European Journal of Orthodontics, The Angle Orthodontics* and *Dental Press Journal of Orthodontic*s, from January 2, 2012 up to December 1, 2017; using a combination of thematic headings using the following keywords: ("conventional bracket" OR "conventional brackets" OR "self-ligating brackets" OR "self-ligating bracket" OR "bracket convencional" OR "bracket de autoligado") AND ("periodontal" OR "periodontium" OR "gingival" OR "biofilm" OR "periodont" OR "plaque" OR "bleeding" OR "inflammation" OR "oral higiene" OR "placa" OR "sangrado" OR "inflamación").

Selection criteria

Inclusion criteria:

- Articles that report the use of CB and SLB in periodontally healthy patients.

- Articles that report the clinical effects on periodontal health parameters (probing depth, bleeding on probing, gingival index and plaque index) when using CB and SLB.

- Articles up to of 5 years old.

- Articles that are clinical trials, without language restriction.

Exclusion criteria:

- Articles from non-indexed journals.

- Articles reporting on children or elderly patients.

Process of selection and extraction of data

We reviewed the titles and abstracts of each of the studies obtained with the inclusion and exclusion criteria described above, and the full texts of the articles that met these parameters were obtained in order to determine their bias risk.

A checklist was made in duplicate to assess the studies, in order to extract the information of interest and to compile the data. Two reviewers (LG and EI) independently performed the evaluation of the articles regarding name, author, year of publication, type of study, number of patients, patient ages, follow-up time, country where the study was performed, study groups, number of patients per study group, probing depth, bleeding on probing, gingival index, plaque index and risk of bias. For the resolution of any discrepancy between the reviewers, they met and discussed together with a third reviewer (SR) in order to reach an agreement.

Assessing the studies' risk of bias

For the assessment of risk of bias, each study was analyzed according to the Cochrane Handbook of Systematic Reviews of Interventions.[12]

Analysis of results

The data from each study were placed and analyzed in the program RevMan version 5.3 (Grupo Cochrane, UK).

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Figure 1. Article selection flowchart.

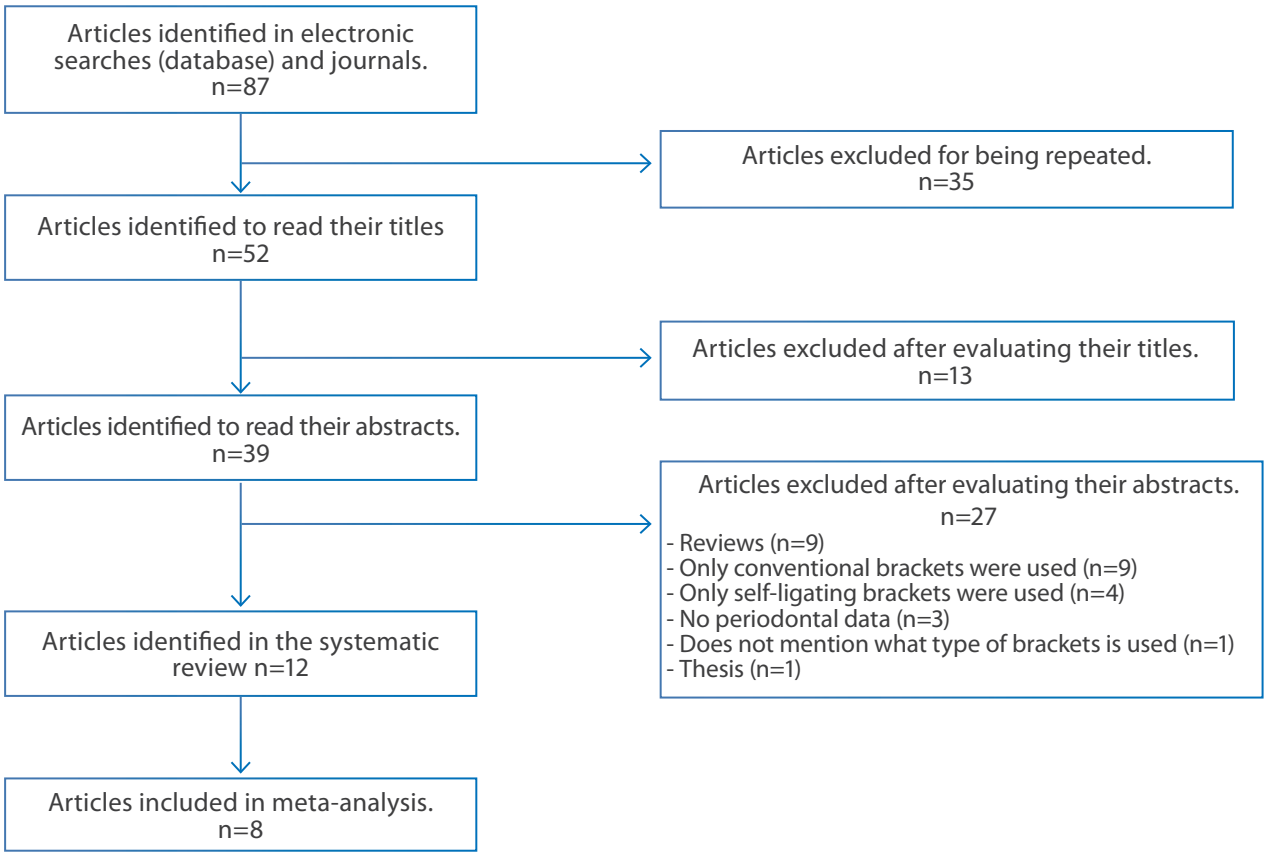

Figure 2. Risk of bias of articles.

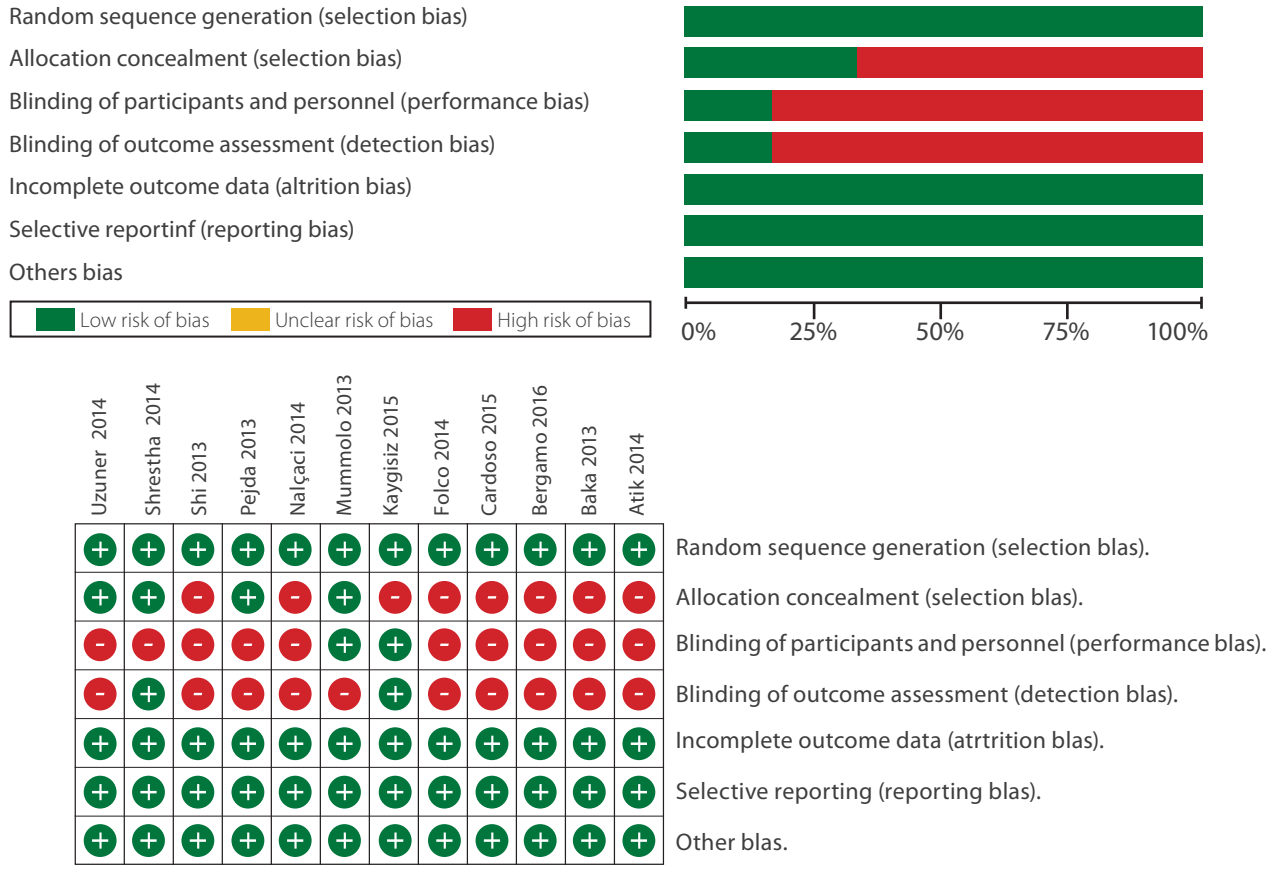

Figure 3. Forest plot of the event "Depth of probing between conventional brackets and self-ligating brackets"

Study or Subgroup	Conventional Bracket Mean	SD	Total	Self-ligating Bracket Mean	SD	Total	Weight	Std.Mean difference IV Random, 95% CI
Atik 2014	0.25	0.35	17	0.12	0.27	16	13.4%	0.40[-0.29, 1.09]
Baka 2013	0.68	0.32	20	0.72	0.31	20	16.6%	-0.12[-0.74, 0.50]
Kaygisiz 2015	0.13	0.45	20	-0.02	0.48	20	16.4%	0.32[-0.31, 1.94]
Shi 2013	0.34	0.52	15	0.15	0.58	15	12.2%	0.34[-0.39, 1.06]
Shrestha 2014	0.27	0.23	50	0.28	0.31	50	41.5%	-10.04[-0.43, 0.36]
Total (95% CI)			122			121	100.0%	0.11[-0.14, 0.36]

Heterogeneity: Tau²=0.00; Chi²=2.57, d_f=(p=0.63); I²=0%
Test for overall effect: Z=0.86 (p=0.39)

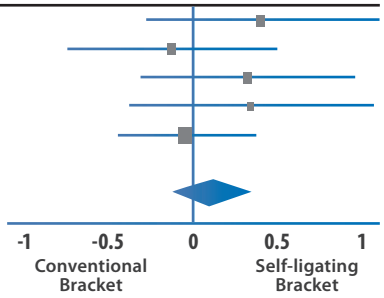

Figure 4. Forest plot of the event "Bleeding on probing between conventional brackets and self-ligating brackets"

Study or Subgroup	Conventional Bracket Mean	SD	Total	Self-ligating Bracket Mean	SD	Total	Weight	Std.Mean difference IV Random, 95% CI
Bergamo 2016	0	0.39	20	-0.05	0.42	20	25.1%	0.12[-0.50, 0.74]
Kaygisiz 2015	0.33	1.25	20	-0.16	1.61	20	25.1%	0.33[-0.29, 0.96]
Nalçaci 2014	0.15	0.04	23	0.05	0.02	23	23.6%	3.11[2.23, 3.99]
Shrestha 2014	0.05	0.12	50	0.09	0.09	50	26.1%	0.37[-0.77, 0.02]
Total (95% CI)			113			113	100.0%	-0.37[-0.77, 0.02]

Heterogeneity: Tau²=1.45; Chi²=60.23, d_f=3(p<0.00001); I²=94%
Test for overall effect: Z=1.20 (p=0.23)

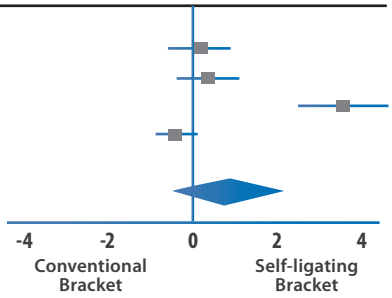

Figure 5. Forest plot of the event "Gingival index between conventional brackets and self-ligating brackets"

Study or Subgroup	Conventional Bracket Mean	SD	Total	Self-ligating Bracket Mean	SD	Total	Weight	Std.Mean difference IV Random, 95% CI
Atik 2014	-0.08	0.62	17	0.16	0.39	16	14.4%	-0.45[-1.14, 0.24]
Bergamo 2016	0.05	0.53	20	0	0.51	20	14.7%	0.09[-053, 071]
Cardoso 2015	-0.2	0.95	16	-0.4	0.74	16	14.4%	0.23[-0.47, 0.92]
Kaygisiz 2015	-0.02	0.6	20	0.32	0.64	20	14.7%	0.54[-1.17, 0.09]
Nalçaci 2014	0.69	0.12	23	0.17	0.08	23	12.0%	-5.01[3.79, 6.23]
Shi 2013	1.17	0.87	15	0.69	0.72	15	14.3%	0.58[-0.15, 1.32]
Shrestha 2014	0.48	0.3	50	0.48	0.32	50	15.5%	0.00[-0.39, 0.30]
Total (95% CI)			161			160	100.0%	0.59[-0.25, 1.43]

Heterogeneity: Tau²=1.15; Chi²=70.71, d_f=6(p=0.00001); I²=92%
Test for overall effect: Z=1.37 (p=0.17)

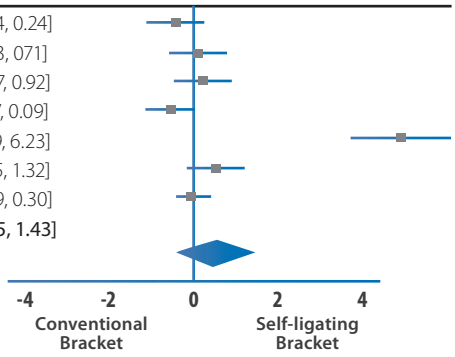

Figure 6. Forest plot of the event "Plaque index between conventional brackets and self-ligating brackets"

Study or Subgroup	Conventional Bracket Mean	SD	Total	Self-ligating Bracket Mean	SD	Total	Weight	Std.Mean difference IV Random, 95% CI
Atik 2014	0.23	0.52	17	0.17	0.45	16	12.4%	0.12[-0.56, 0.08]
Baka 2013	1.37	0.34	20	1.16	0.38	20	12.7%	0.57[-0.06, 1.20]
Bergamo 2016	0.25	0.68	20	0.25	0.66	20	12.8%	0.00[-0.62, 0.62]
Cardoso 2015	-0.61	1	16	-0.51	1.03	16	12.3%	-0.10[-0.79, 0.60]
Kaygisiz 2015	0.4	0.69	20	0.48	0.61	20	12.8%	-0.12[-0.74, 0.50]
Nalçaci 2014	0.53	0.1	23	0.2	0.1	23	10.9%	3.24[2.34, 4.15]
Shi 2013	0.97	0.81	15	0.67	0.62	15	12.1%	0.40[-0.32, 1.13]
Shrestha 2014	0.62	0.61	50	0.51	0.44	50	14.0%	0.21[-0.19, 0.60]
Total (95% CI)			181			180	100.0%	0.49[-0.08, 1.06]

Heterogeneity: Tau²=0.56; Chi²=45.94, d_f=7(p=0.00001); I²=85%
Test for overall effect: Z=1.69 (p=0.09)

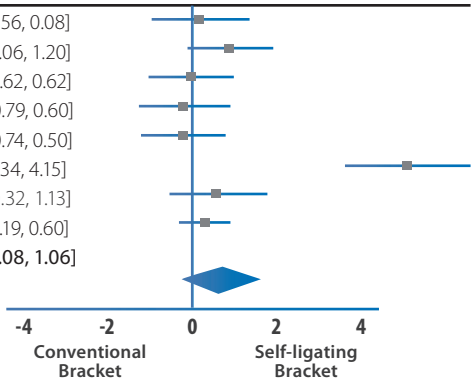

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Table 1. Characteristics of included articles.

Author	Year	Type of study	N° Patients (males/ females)	Mean Age (range)	Follow-up time	Country	Groups of study	N° of patients per group	PS (mm)	SS (mm)	IG (mm)	IP (mm)
Bergamo *et al.*[13]	2016	ECA	20 (11 / 9)	13.3 ± 1.03 (11 – 15)	2 months	Brazil	BC	20	NR	0 ± 0.39	0.05 ± 0.53	0.25 ± 0.68
							BAA	20	NR	-0.05 ± 0.42	0 ± 0.51	0.25 ± 0.66
							BAP	20	NR	0.1 ± 0.45	0.05 ± 0.54	0.6 ± 0.71
Cardoso *et al.*[14]	2015	ECA	16	(12 – 16)	6 months	Brazil	BC	16	NR	NR	-0.2 ± 0.95	-0.61 ± 1
							BA	16	NR	NR	-0.4 ± 0.74	-0.51 ± 1.03
Kaygisiz *et al.*[15]	2015	ECA	60 (32 / 28)	14.37 (12 – 18)	2 months	Turkey	BC	20	0.13 ± 0.45	0.33 ± 1.25	-0.02 ± 0.6	0.4 ± 0.69
							BA	20	-0.02 ± 0.48	-0.16 ± 1.61	0.32 ± 0.64	0.48 ± 0.61
							Control	20	0.13 ± 0.77	-0.24 ± 1.14	0.23 ± 0.58	0.28 ± 0.82
Shrestha *et al.*[16]	2014	ECA	100 (39 / 61)	14 ± 2.34 (12 – 20)	3 months	China	BC	50	0.27 ± 0.23	0.05 ± 0.12	0.48 ± 0.3	0.62 ± 0.61
							BA	50	0.28 ± 0.31	0.09 ± 0.09	0.48 ± 0.32	0.51 ± 0.44
Uzuner *et al.*[17]	2014	ECA	40 (11 / 29)	(14 – 16)	1 months	Turkey	BC	20	Mediana	NR	Mediana	Mediana
							BA	20	Mediana	NR	Mediana	Mediana
Folco *et al.*[18]	2014	ECA	22	(16 – 30)	2 months	Argentina	BC	11	NR	NR	NR	NR
							BA	11	NR	NR	NR	NR
Atik *et al.*[19]	2014	ECA	33 (0 / 33)	14.65 (13 – 17)	6 months	Turkey	BC	17	0.25 ± 0.35	NR	-0.08 ± 0.62	0.23 ± 0.52
							BA	16	0.12 ± 0.27	NR	0.16 ± 0.39	0.17 ± 0.45
Nalçaci *et al.*[20]	2014	ECA	46 (22 / 24)	13.89 (11 – 16)	1 month and 1 week	Turkey	BC	23	NR	0.15 ± 0.04	0.69 ± 0.12	0.53 ± 0.1
							BA	23	NR	0.05 ± 0.02	0.17 ± 0.08	0.2 ± 0.1
Baka *et al.*[21]	2013	ECA	20 (20 / 0)	14.2 ± 1.5 (11 – 16.7)	3 months	Turkey	BC	20	0.68 ± 0.32	NR	NR	1.37 ± 0.34
							BA	20	0.72 ± 0.31	NR	NR	1.16 ± 0.38
Mummolo *et al.*[22]	2013	ECA	60 (27 / 33)	20.15 (18 – 23)	6 months	Italy	BC	20	NR	NR	NR	NR
							BA	20	NR	NR	NR	NR
							Control	20	NR	NR	NR	NR
Pejda *et al.*[23]	2013	ECA	38 (13 / 25)	14.6 (11 – 18)	4 months and 2 weeks	Croatia	BC	19	NR	NR	NR	NR
							BA	19	NR	NR	NR	NR
Shi *et al.*[24]	2013	ECA	30	15.15	3 months	China	BC	15	0.34 ± 0.52	NR	1.17 ± 0.87	0.97 ± 0.81
							BA	15	0.15 ± 0.58	NR	0.69 ± 0.72	0.67 ± 0.62

NR: Not reported. **RCT:** Randomized clinical trial. **BC:** Conventional bracket. **BA:** Self-ligating bracket. **BAA:** Active self-ligating bracket. **BAP:** Passive self-ligating bracket. **PS:** Depth on probing. **SS:** Bleeding on probing. **IG:** Gingival index. **IP:** Plate index. **mm:** Millimeters.

RESULTS.

Study selection

The initial search in the biomedical databases yielded a total of 87 titles, from January 2012 to December 2017, 35 of which consisted of repeated titles, with 52 unique ones remaining. The titles were read and 13 were excluded, leaving 39; subsequently their abstracts were read discarding those that did not meet the inclusion criteria. Twelve articles were selected for an exhaustive review of its content and methodology. Four articles were discarded as they did not report metadata related to periodontal health parameters or because these were reported using another measure of central tendency that was not the mean. (Figure 1)

Characteristics and results of studies

The number of patients ranged between 16 and 100 in the included studies with a follow-up time of between 1 month and 6 months.[13-24] Nine studies[13,15,16,19-24] reported patients aged between 13.3 and 20.15 years. Nine[13,15-17,19-23] reported that the total number of patients in relation to their gender (men and women) was 175 and 242, respectively. Eleven studies[13-23] reported that the age of patients ranged between 11 and 30 years. The countries where the studies were conducted were Brazil,[13,14] Turkey,[15,17,19-21] China,[16,24] Argentina,[18] Italy[22] and Croatia.[23] Periodontal treatments were performed prior to the placement of the brackets in all studies.[13-23] (Table 1)

The total number of treated patients was 485. In two studies[15,22] a control group was used and in one study 13 a group of active self-ligating brackets and a passive self-ligating bracket were considered. (Table 1)

Regarding the evaluated periodontal clinical parameters probing depth was reported in five of the

studies,[15,16,19, 21,24] bleeding on probing was reported in five studies,[13,15,16, 20,21] gingival index was reported in seven studies,[13-16,19,20,24] and plaque index was reported in eight studies;[13-16,19-21,24] which ranged from -0.02 a 0.72mm, -0.24 a 0.33mm, -0.4 a 1.17mm and from -0.61 a 1.37mm respectively. (Table 1)

Analysis of the studies' risk of bias

All studies[13-24] showed a high risk of bias. (Figure 2)

Summary of Results (Meta-analysis)

Probing depth:

- Depth of probing was determined in five studies[15,16,19,21,24] revealing that there was not a significant difference. (Figure 3)

Bleeding on probing:

- Bleeding on probing was determined in four studies[13,15,16,20] revealing that there was no significant difference. (Figure 4)

Gingival index:

- The gingival index was determined in seven studies[13-16,19,20,24] revealing that there was no significant difference. (Figure 5)

Plaque index:

- The plaque index was determined in eight studies[13-16,19-21,24] revealing that there was no significant difference. (Figure 6)

DISCUSSION.

Orthodontics and periodontics are inter-related as a correct teeth alignment facilitates good oral hygiene. However, the process of dental alignment through orthodontic therapy can have negative effects on the periodontium, causing gingival inflammation and decreasing the effectiveness of tooth brushing. Additionally, the biology of tooth movement requires creating an area of bone turnover adjacent to the teeth, which could increase the risk of losing support in that area. Therefore, it is important to understand that the relationship between periodontics and orthodontics is increasingly important since these two areas are clinically associated.[25]

An example of this relationship is illustrated by the increase in biofilm, which is a known and relevant problem occurring during the course of fixed orthodontic therapy and which could depend on the orthodontic system used.[15,19-21,23,26,27] Oral hygiene as a risk factor for plaque accumulation has been carefully reviewed in previous studies.[27,28,29] For this reason, the aim of this systematic review and meta-analysis was to evaluate and compare the clinical periodontal effect of CB and SLBs in randomized clinical trials (RCTs). The results showed that SLB do not present any difference regarding its periodontal clinical effect (depth on probing, bleeding on probing, gingival index and plaque index) compared to CB.

In this study, a random effects model was used for the meta-analysis, in which it was additionally shown that there were differences between the parallel design[15-20,22-24] and crossover[13,14,21] randomized controlled trials (RCT), since positive periodontal clinical effects from CB were shown by some studies while others showed positive periodontal clinical effects from SLB; This is why, although no significant differences between the two bracket types were found, possibly this variation between studies marked a tendency towards the SLB in the results of each periodontal parameter analyzed.

One of the strengths of this systematic review was the selection of the studies because an exhaustive search was carried out in the most important databases and strict inclusion criteria were used. However, there is an important limitation, because all the incorporated RCTs present a high risk of bias. This limitation causes this study to have moderate quality of evidence, considering that most of the orthodontic meta-analyzes reported in the literature are of low or very low quality of evidence.[27,28]

Comparing the results obtained in the present study with those obtained in the systematic reviews carried out previously on this topic,[27,30] confirms there is no difference in the periodontal clinical effect when using CB or SLB, taking into account that these reviews covered RCTs older than those presented in this study.

Based on the above, the results of the present study cannot be yet generalized, as most of the RCTs present high heterogeneity and all evaluated RCTs have a high risk of bias, despite having been performed in different countries worldwide. This is why we recommend that well-designed and properly reported RCTs on this subject be executed and published, following the CONSORT guidelines,[31] in order to avoid future systematic reviews and meta-analyzes of moderate, low or very low quality.

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CONCLUSION.

Overall, no differences were detected in the periodontal clinical effect of patients who received orthodontic treatment with conventional and self-ligating brackets.

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