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Incidence of orthodontic brackets detachment during orthodontic treatment: A systematic review

Naif Almosa¹, Hamayun Zafar²

ABSTRACT

Objectives: To evaluate the incidence of orthodontic brackets detachment during orthodontic treatment.

Methods: Using electronic databases; eligible studies up to January 2018 were retrieved, independently reviewed, and screened. The Coleman Methodology Scoring System (CMS) and Cochrane Collaboration's tool were used to assess quality and risk of bias in the included studies.

Results: Of the seventeen studies included in the final synthesis, thirteen were categorized as randomized clinical trials (RCTs), one prospective cohort and retrospective survey each, whereas two studies could not be categorized. The number of patients in the selected studies ranged between 19 and 153; the mean age was between 10.5 to 38.7 years, and male to female ratio was 353:495. Almost all studies had a high risk of bias, and more than half of the studies had CMS score of 70 or above. The numbers of brackets examined in the studies ranged between 361 and 3336. The incidence of brackets detachment ranged from 0.6 to 28.3%.

Conclusions: The incidence of brackets detachment during orthodontic treatment is high.

KEYWORDS: Orthodontic treatment, Brackets detachment, Bracket de-bonding, Bracket failure, Prevalence, Incidence.

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INTRODUCTION

Orthodontic treatment enhances patients' physical appearance by correcting malocclusion of teeth. The treatment also improves oral health conditions that are related to malocclusions. These conditions include, mastication difficulties with potential to cause digestion problems, speech impairments, abnormal loading of temporomandibular joints that can lead to severe inflammation and pain, headaches or pain in the patients' face and neck. Orthodontists use various removable and fixed appliances to treat orthodontic problems. The main components of the fixed orthodontic appliances are brackets that are attached to the teeth using different types of adhesives. The movement of teeth depends on the wires and springs attached to these brackets. Therefore, it is of utmost importance that these brackets remain attached to the teeth during the course of orthodontic treatment. However, brackets

detachment “debonding” from the teeth remains one of the major concerns during orthodontic treatment with fixed appliances.¹⁻³ The bracket bonding procedure plays a major role in achieving an optimal outcome during orthodontic corrective procedures, as the required tooth movement relies upon it.⁴ Bracket detachment during corrective procedures may also lead to increased treatment duration, damage to tooth enamel, and increased chairside-time due to re-bonding procedure.^{2,3} Consequently, it could also raise the costs of the overall orthodontic treatment.⁴

Recent advancements in dental materials and bonding techniques has helped to make orthodontic brackets bonding easier, efficient, predictable, and effective.⁶ Orthodontic bonding technique has changed significantly since it was first used in 1950s.⁷ At present, there are direct and indirect bonding techniques used in orthodontic treatment with fixed appliances.^{8,9} However, both the techniques have advantages and disadvantages in relation to bond failure rates.¹⁰⁻¹² Although indirect bonding technique has more advantages in terms of shorter initial bonding appointment, higher degree of precision, and more focused results, yet the majority of the orthodontists prefer the direct bonding technique to avoid laboratory involvement.¹³

Bracket detachment is a major concern during orthodontic treatment with fixed appliances, as it can be irritating and in some instances critical in the overall success of the treatment. Presently, there is a tendency towards bonding brackets on all the teeth for providing full arch orthodontic treatment, thus making bracket detachment more critical.¹⁴⁻¹⁶ Previous studies have reported varying incidence of bracket failure following orthodontic brackets bonding.^{17,18} Several studies have also compared various techniques of orthodontic bonding and rates of brackets failure.¹⁹⁻²⁷ However, there are no systematic reviews available on incidence of orthodontic brackets detachment during orthodontic treatment. Therefore, the current study aimed to summarize the evidence regarding the incidence of orthodontic brackets detachment during orthodontic treatment.

METHODS

Search Strategies: The electronic databases, PubMed and Web of Science were searched from their inception up to January 2018. Only studies published in the English language were included. The databases were searched using the following keywords: (“Orthodontic treatment” OR “Dental

procedures”) AND (“Brackets detachment” OR “Bracket debonding” OR “Bracket bonding” OR “Bracket failure”) AND (“Prevalence” OR “Incidence”). Additionally, the studies were searched manually from the reference lists of the studies identified through databases.

Study Selection: All the studies investigating brackets detachment during orthodontic treatment with fixed appliances were included. Studies were required to report the incidence of brackets failure as one of the study outcomes.

Data Extraction: Both authors independently screened the titles and abstracts to exclude irrelevant articles. Full texts of the potential articles were then evaluated to identify eligible studies. Following data were extracted from the included studies: author(s), year of publication, study design, bonding technique used, total number of brackets used, number and incidence of bracket failure, and conclusions. Both authors discussed and reached to an agreement on various items of the collected data.

Quality Assessment: Both authors evaluated the quality of all the selected studies using the Coleman Methodology Scoring (CMS) system.²⁸ The CMS has ten sections with a total of 100 points. Additionally, the Cochrane Collaboration’s tool was used to assess the risk of bias in the included studies. Risk of bias was presented as low, unclear, or high for the each included study.²⁹ Both the authors discussed and reached to an agreement on the quality assessment.

Outcome Measure: The outcome evaluated in this systematic review was the incidence of brackets detachment during orthodontic treatment with fixed appliances.

RESULTS

Study Selection: Based on the titles and abstracts, 222 articles were initially identified. After excluding duplicates and screening the abstracts, 189 studies were not found relevant to objective of this review. Further sixteen articles were excluded due to not matching the inclusion criteria. Therefore, a total of seventeen studies were included in the final synthesis.^{1,4,20-24,27,30-38} The inter-assessor agreement was very good to excellent for initial screening and full-text eligibility ($k = 0.81$ and 0.94 respectively). Figure 1 presents details of study selection process and results of the literature search as per PRISMA guidelines.²⁴

Characteristics of Included Studies: Table-I displays the characteristics of all included studies. Among the 17 included studies,^{1,4,20-24,27,30-38} thirteen^{20-24,27,30-33,35,37,38} were categorized as RCTs, one

Table I: Study characteristics and incidence of orthodontic bracket detachment during orthodontic treatment.

Authors	Participants			Study design	Bracket numbers	Brackets type	Malocclusion class	Adhesive system	Bracket detachment incidence no. (%)	Observation Period (months)	Conclusions
	a: Number	b: Age, Mean (SD)	c: Male/female ratio								
Sfondrini et al. 2004 ³⁰	a: 83 b: 17.3 (4.5) c: 35/48			"split-mouth" with randomization	1434	stainless steel	I, II, III	Halogen light versus plasma arc light	70 (4.9)	12	No significant differences between both techniques.
Cacciafesta et al. 2004 ³¹	a: 30 b: 16.7 (3.2) c: 12/18			"split-mouth" with randomization	600	stainless steel	I, II, III	Halogen light versus plasma arc light	33 (5.5)	12	As above
Krishnaswamy et al. 2007 ²⁰	a: 30 Age range 12-20 c: 15/15			"split-mouth" with randomization	544	stainless steel	I, II, III	Light-emitting diode (LED) lamp vs halogen light	41 (7.5)	15	As above
Elektdag-Turk et al. 2008 ³¹	a: 37 b: 16.5 ? c: 14/23			"split-mouth" with randomization	672	metal	I, II	self-etching primer versus conventional	4 (0.6)	6	Improved bracket survival rate with self-etching primer than the conventional method.
Koupiis et al. 2008 ³²	a: 37 b: ? c: ?			"split-mouth" with randomization	600	nickel-titanium & stainless steel	I, II, III	Light-emitting diode (LED) lamp vs halogen light	25 (4.20)	9	No significant differences between both techniques.
Varlik et al. 2009 ²¹	a: 30 Age range 14-21 c: 14/16			universal numbering system, odd-numbered teeth as control group, even-numbered teeth experimental group.	544	Stainless steel Mini Ovation	?	highly filled light-cured sealant (HF/LCS) versus conventional adhesive	18 (3.3)	18	Pro Seal can be used as a preventive measure without affecting the bonding properties of metal brackets.
Campoy et al. 2010 ³³	a: 46 b: ? c: ?			prospective controlled clinical trial	531	Stainless steel	?	saliva contamination before bonding versus after bonding	37 (7.1)	6	Either before or after bonding, no significant increase in bracket detachment with saliva contamination
Romano et al. 2012 ⁴	a: 19 Age range 11-39 c: 7/12			?	380	nickel-titanium	I, II, III	Transbond XT (TXI) composite versus Transbond Plus Color Change (TPCC)	6 (1.6)	6	With both TXI or TPCC methods, a few brackets detached
Romano et al. 2012b ³⁴	a: 20 Age range 11-15 c: 7/13			?	400	nickel-titanium	I, II, III	Conventional Transbond XT Versus Transbond XT + Transbond Plus Self Etching Primer (TPSEP) adhesive systems Versus Orthodontic Concise and Transbond XI without primer	20 (5)	6	Fewer brackets failures with conventional Transbond XT and Transbond XT+TPSEP than Orthodontic Concise and Transbond XT without primer.
Hammad et al. 2013 ³⁵	a: 30 b: 14 (?) c: 10/20			"split-mouth" with randomization	538	straight-wire	?	Conventional adhesive versus Amorphous calcium phosphate-containing adhesive	11 (2.04); 17 (3.1)	6 12	The ACP-containing adhesive seems to be an alternative to conventional adhesives.
Bovali et al. 2014 ²²	a: 64 b: 18.5 (4.8) c: 29/35			Randomized controlled trial	?	?	?	Indirect vs direct bonding	17 (28.3)	6	Indirect bonding was statistically significantly faster than direct bonding. Both techniques showed similar risks of failure.

Author (Year)	Study ID	Study Design	Sample Size (n)	Material	Malocclusion Class	Comparison	Events (n/N)	Rate (%)	Outcome
Jung 2014 ³⁶	a: 127 b: 18.6 (6) c: 52/75	prospective cohort study	3061	straight-wire	I, II, III	Molar tubes vs. Anterior brackets	176 (5.7)	12	Bracket detachment rate for molars was greater than anterior teeth.
Menini et al. 2014 ²³	a: 52 b: 22.8 (?) c: 25/27	clinical trial	1248	Stainless steel brackets and molar tubes	I, II, III	Indirect vs. direct bonding	54 (4.32)	15	No significant differences between both techniques.
Ozer et al. 2014 ³⁷	a: 57 b: 16 (?) c: 18/39	"split-mouth" with alternating quadrants	1140	Self-ligating metal	?	Self-etching primer (SEP) vs. conventional method (CM)	26 (2.57)	22	As above
Vijayakumar et al. 2014 ³⁸	a: 30 b: 21.7 (?) c: 12/18	"split-mouth" with randomization	518	Stainless steel	?	Indirect vs direct bonding	50 (9.6)	6	As above
Bazargani et al. 2016 ²⁷	a: 49 b: 14.4 (1.8) c: 29/20	single-operator, crossmouth, randomized controlled trial (RCT).	908	Metal	?	Primer vs. non-primer	39 (4.2)	18	No difference between both groups, except in younger children the primer setting yielded better results
Roelofs et al. 2017 ¹	a: 153 b: 16.6 (10.7) c: 60/93	retrospective survey	3336	Metal and tubes	?	Atropine premedication vs. control	83 (2.5)	18	No significant differences between both techniques.

prospective cohort,³⁶ one retrospective survey,¹ and two studies did not report about the study design.^{4,34} Trials originated from the Netherland,¹ Brazil,^{4,34} India,^{20,38} Turkey,^{21,31,37} Switzerland,²² Italy,^{23,24,30} Sweden,²⁷ Greece,³² Spain,³³ Egypt,³⁵ and Korea³⁶. The number of patients ranged from 19 to 153 with the mean age from 10.5 to 38.7 years. The male to female ratio was 353:495. In most of the included studies, patients were distributed as class I, II, and III malocclusion,^{4,20,23,24,30-32,34,36} and stainless steel brackets were used.^{20,21,23,24,30,32,33,38} In all the studies, the number of brackets used ranged from 361 to 3336. Four studies compared the halogen light technique with the other adhesive systems on brackets detachment after orthodontic bonding,^{20,24,30,32} while three studies compared direct versus indirect bonding techniques in relation to brackets detachment during orthodontic treatment.^{22,23,38}

Methodological Quality: Nine included studies^{20,22-24,27,30-32,34} had CMS score of 70% or above and six studies^{4,21-23,33,35,37} had CMS score of 60%. Only two studies^{1,38} had CMS score of 50%. Two of the studies provided the justification for sample size and provided information about drop outs from the study.^{22,27} None of the included studies reported the clinical importance of the results (Table-II). Risk of bias is presented as a graph in Figure 2. Almost all the included studies had a high risk of bias,^{1,4,20-24,30-38} while only one study had an unclear risk of bias.²⁷

Incidence of Orthodontic Brackets Detachment: The incidence of orthodontic brackets detachment ranged from 0.6 to 28.3% in the selected studies. The follow-up period after bonding of brackets ranged from 6 months to 22 months. The details are provided in Table-I. A 6-months detachment incidence was given in seven included studies (0.6% to 28.3%).^{4,22,31,33-35,38} One study reported 9-months incidence of 4.2%.³⁴ Four studies reported 12-months incidence (3.1% to 5.7%).^{24,30,35,36} Two studies reported 15-months incidence (4.3% to 7.5%).^{20,23} Three studies reported 18-months incidence (2.5% to 4.2%).^{1,21,27} Only one study reported a 22-months incidence (2.6%).³⁷

DISCUSSION

As per our knowledge, this is the first systematic review on the incidence of brackets detachment during orthodontic treatment. An increase in incidence of bracket failure is expected with increase in the follow-up period. However, this was not evident from the results of the current review. Only one study reported very high incidence of brackets detachment (28.3%),²² while others reported rela-

Table II: Methodological quality assessment of included studies based on Coleman Methodology Scoring.²⁸

Study	Criteria												Score	Scores (%)
	1	2	3	4	5	6	7	8	9	10	11	12		
Sfondrini et al. 2004 ³⁰	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Cacciafesta et al. 2004 ²⁴	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Krishnaswamy et al. 2007 ²⁰	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Elekdag-Turk et al. 2008 ³¹	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Koupis et al. 2008 ³²	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Varlik et al. 2009 ²¹	Yes	Yes	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
Campoy et al. 2010 ³³	Yes	Yes	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
ROMANO et al. 2012 ⁴	Yes	No	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
ROMANO et al. 2012b ³⁴	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Hammad et al. 2013 ³⁵	Yes	Yes	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
Bovali et al. 2014 ²²	Yes	Yes	No	Yes	N/A	Yes	N/A	Yes	Yes	No	Yes	Yes	8/10	80
Jung 2014 ³⁷	Yes	No	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
Menini et al. 2014 ²³	Yes	Yes	Yes	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	7/10	70
Ozer et al. 2014 ³⁷	Yes	Yes	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	6/10	60
Vijayakumar et al. 2014 ³⁸	Yes	No	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	5/10	50
Bazargani et al. 2016 ²⁷	Yes	Yes	Yes	Yes	N/A	Yes	N/A	Yes	Yes	No	Yes	Yes	9/10	90
Roelofs et al. 2017 ¹	Yes	No	No	No	N/A	Yes	N/A	Yes	Yes	No	No	Yes	5/10	50

N/A: Not applicable.

tively low incident (0.6% to 9.6%).^{1,4,20,21,23,24,27,30-38} The finding could be attributed to several factors. Firstly, the type of adhesive resin used for bracket bonding could affect the bracket survival. Varlike et al.²¹ concluded that highly filled light-cured sealant can be used as a preventive measure without affecting the bonding properties of metal brackets. Similarly, Romano et al.⁴ reported less number of bracket failure following the application of Transbond XT (TXT) composite or Transbond Plus Color Change (TPCC). Furthermore, Hammad et al.³⁵ have recommended using amorphous calcium phosphate-containing adhesive to minimize risk of bracket failure. Secondly, direct and indirect bonding technique

could be another reason for different rates of bracket detachment during orthodontic treatment. Indirect bonding technique is significantly faster than direct bonding, however, both techniques have shown similar risks of brackets bonding failure^{22,23,38}

Out of the seventeen studies included in this review, eight studies^{1,4,21,33,35-38} had low CMS score ($\leq 60\%$), which indicates low methodological quality. Various items were not met by most of the included studies, therefore, future studies investigating incidence of brackets detachment after orthodontic treatment considering these items are recommended. The lack of information about the sample size estimation and dropouts could

	Sfondrini et al. 2004	Cacciafesta et al. 2004	Krishnaswamy et al. 2007	Elekdag-Turk et al. 2008	Koupis et al. 2008	Varlik et al. 2009	Campoy et al. 2010	ROMANO et al. 2012	ROMANO et al. 2012b	Hammad et al. 2013	Bovali et al. 2014	Jung 2014	Menini et al. 2014	Ozer et al. 2014	Vijayakumar et al. 2014	Bazargani et al. 2016	Roelofs et al. 2017	
Random sequence generation (selection bias)	+	+	+	-	+	+	-	-	-	+	+	-	-	-	+	+	-	
Allocation concealment (selection bias)	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+	-	
Blinding of participants and personnel (performance bias)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	?	-	
Blinding of outcome assessment (detection bias): self-reported outcomes	-	-	-	-	-	-	-	-	-	-	+	-	?	-	-	?	-	
Blinding of outcome assessment (detection bias): objective outcomes	-	-	-	-	-	-	-	-	-	-	+	-	?	-	-	?	-	
Incomplete outcome data: attrition bias	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Selective reporting (reporting bias)	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	
Other bias	+	+	+	?	+	+	?	?	?	+	+	?	?	?	+	+	?	
+ Low risk of bias	?	Unclear risk of bias					- High risk of bias											

Fig.1: Risk of bias summary: Authors’ judgments about each risk of bias item for each included study.

limit the validity of the results. Additionally, a lack of information about the patient’s description could also limit the generalizability of results.

Of the seventeen studies included in this review, almost all the included studies had a high risk of bias,^{1,4,20-24,30-38} while only one study had an unclear risk of bias.²⁷ Several items including allocation concealment and blinding of participants, personnel and outcome assessor were not met by most of the included studies. A previous study has reported the importance of blinding to reduce the performance and detection bias.³⁹

Limitations: It was heterogeneity among the studies as related to patients’ selection criteria, treatment techniques, outcome criteria, and length of follow-up, indicating lack of sufficient body of literature available on this topic. The present review did not assess the factors associated with brackets detachment during orthodontic treatment. Nevertheless, the present review has provided new evidence-based information on incidence of bracket failure during orthodontic treatment. Orthodontists need to adopt all the possible measures to prevent bracket failure during treatment with fixed orthodontic appliances.

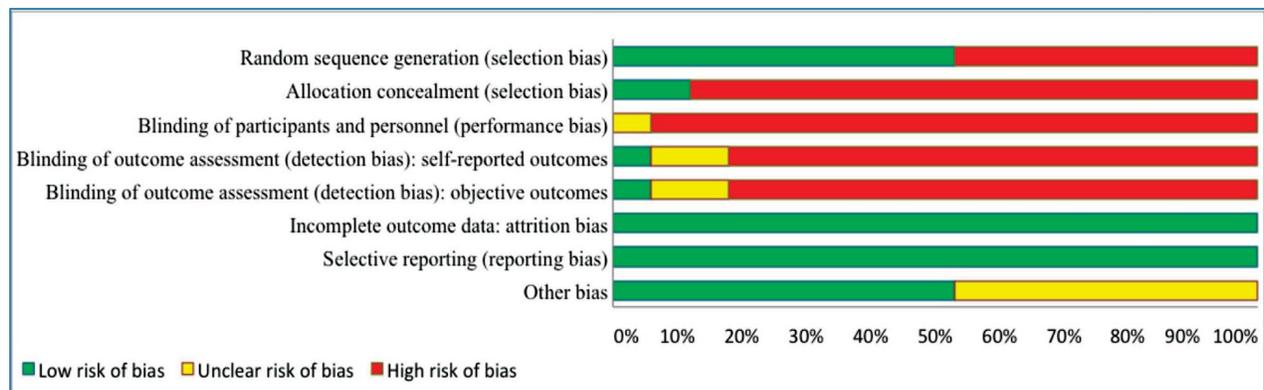


Fig.2: Risks of bias; review authors’ judgments about each risk of bias item presented as percentages across all included studies.

CONCLUSIONS

The present review indicates a high incidence of brackets detachment during orthodontic treatment. However, more high quality studies with larger samples are recommended to improve the evidence on the prevalence and incidence of brackets detachment during orthodontic treatment.

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