

# Bracket Failure among Orthodontic Patients in Ghana

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## Abstract

**Background:** This study was carried out to investigate the most common sites of bracket failure during orthodontic treatment and the factors causing them. The effects of gender and age were also assessed.

**Method:** A total of 70 patients (38 females and 32 males) with a mean age of 20.2 years undergoing fixed orthodontic treatment at the University of Ghana Dental School who had reported with bracket failures were selected to participate in this study. The number, site and date of bond failures were recorded over a period of five months. Data was captured using the SPSS 16. T-test and ANOVA were used to compare means. Chi-square was used to compare proportions.

**Results:** 168 orthodontic bracket failures were recorded for the period of six months. 111(66%) bracket failures occurred in the lower arch while 57(34%) occurred in the upper arch. 120(71%) failures occurred in the posterior regions while 48(29%) occurred in the anterior regions. 54% reported that eating was the cause of bracket failure. Brushing caused the highest number of mean bracket failures per patient. The lower left second premolar recorded the highest number of failures followed by the lower right second premolar.

**Conclusion:** The left lower second premolar recorded the highest number of bracket failures followed by the lower right second premolar. The major cause of the bracket breakages according to the patients was eating while tooth brushing caused the highest number of mean bracket failures per patient

**Keywords:** Bracket failure, Ghana, Orthodontic treatment

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## Introduction

Since the advent of the acid etching technique by Buonocore<sup>1</sup> and the bonding of orthodontic brackets to teeth by Newman<sup>2</sup>, the practice of orthodontics has been revolutionized with faster times for bonding brackets to teeth, however bracket failure is a commonly encountered complication during routine orthodontic treatment with between 0.5 to 55.8 per cent of bond failures<sup>3,4,5,6,7</sup>. As the bonding procedure is technique-sensitive, even slight salivary contamination or lack of improper composite-primer application can lead to weaker bond strength between enamel and bracket<sup>8-9</sup>. Other causes are excessive mechanical forces, occlusal interferences and hard sticky diet during treatment<sup>10</sup>. Increased frictional forces encountered with heavy-

gauge stainless steel wires during sliding mechanics have also been implicated in bracket failure during treatment<sup>11</sup>. Frequent bracket failure causes delay in treatment time, enamel damage, lack of patient cooperation and improper finishing<sup>8</sup>. Most recently investigators have studied the bond strength of different composites on various bracket materials<sup>8,11,12</sup>.

Bonding failures can represent a significant increase in treatment time, additional costs in materials and personnel and unexpected additional visits by the patient. A study by Haegeretal<sup>13</sup> found that patients with loose brackets averaged 2.8 more months in treatment and 1.5 more visits.

A 2011 study by Singh et al.<sup>14</sup> was conducted to determine the rate and cause of bracket failure in specialist practice. The study found out that the lower right first molar was the most commonly offending tooth (26%), followed by the lower right second premolar (22%) and then the lower right lateral incisor (11%) The study also found that the most common reason for failure of a bracket was eating (44.4%). Fidgeting with the brace was also a major reason for bracket failure (7.4%)<sup>14</sup>. Another study by Graham et al<sup>15</sup> showed that the bracket failure was most often attributed to eating (62.35%), 16.47% and 9.41% by trauma.

An audit on orthodontic casualties conducted by Sayers et al.<sup>16</sup> reported that the commonest single treatment carried out was repair of debonded brackets and the teeth commonly associated with bracket failure were the incisor teeth in the maxillary arch, with the premolar or molar teeth, in the mandibular arch.

Sunna and Rock<sup>17</sup> evaluated the clinical performance of different types of orthodontic brackets and adhesives and revealed that significantly more brackets failed on the left side of the mouth than on the right and more premolar brackets failed than incisor ones. No significant differences were detected between failure rates for the upper and lower arches. The purpose of the present study was to investigate the cause of bracket failure in the Ghanaian patient and its relationship to age and gender

## Methods

This research was a cross sectional study conducted within a six month period in the Department of Orthodontics and Paedodontics at the University Of Ghana Dental School (UGDS). A total of 70 patients (32 male, 38 female; 13-43years of age) undergoing orthodontic treatment by means of fixed appliances who reported with broken brackets were sampled for this study. Inclusion criteria for this study were patients treated using orthodontic brackets from the same manufacturer, brackets bonded by two consultant orthodontists using the same criteria for bonding, the same orthodontic composite, and light curing machine. Enamel surfaces presenting with caries, fillings, gingival hyperplasia or congenital enamel defects were excluded from the study.

Ethical approval was obtained from the ethical committee of the university of Ghana medical school

The purpose of the study was explained to every patient and patient's guardians. Verbal consent was reached before the start of the study. A questionnaire was prepared to obtain necessary information. The questionnaire was a closed type except for two

open type questions, which were designed to allow the patients to express their ideas on certain issues.

All teeth up to the first molars in both arches were included in the study. The molars in this case were cemented with bands using band cement from the same manufacturer.

The data collected was entered in Microsoft Access and analysis done with Statistical Package for Social Sciences (SPSS). The data is presented using graphs, charts and tables. Continuous data was summarized as means and standard deviations but categorical data was summarized by frequencies and percentages. T-test and ANOVA were used to compare means. Chi-square was used to compare proportions. Significant test was set at  $\alpha=0.05$ .

## Results

Seventy patients entered the study with a mean age of 20.2 years. Female patients formed a greater percentage (54%) of the respondents for the study compared to males (46%). A total of 168 failures of the orthodontic brackets and bands were recorded.

111 bracket failures occurred in the lower arch and 57 in the upper arch. A greater number of the breakages (95) representing 57% occurred on the left side of the jaws. Majority of the failures occurred in the posterior region of the jaws. The third quadrant recorded the highest number of failures (61) followed by the fourth quadrant (50) (Figure 1).

The tooth that recorded the highest number of failures was the mandibular left second premolar (24) followed by the mandibular right second premolar (21) (Figure 2). The left central incisor was the most commonly involved tooth in the maxillary arch (9).

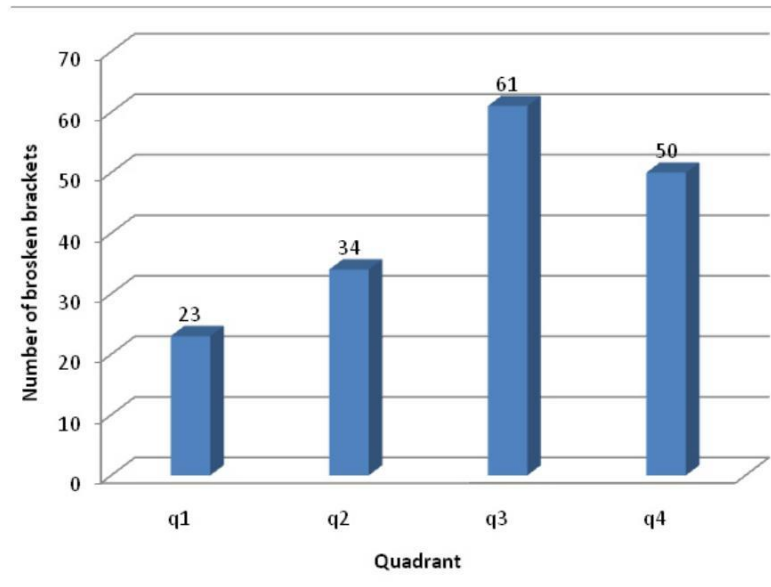
Even though more patients reported Eating as the major cause of bracket failure followed by Unknown reasons, (Table I). brushing resulted in the higher number of mean broken brackets per patient (Figure 3).

Males recorded a higher number of bracket failure but this was not significant ( $P=0.073$ ) (Table II).

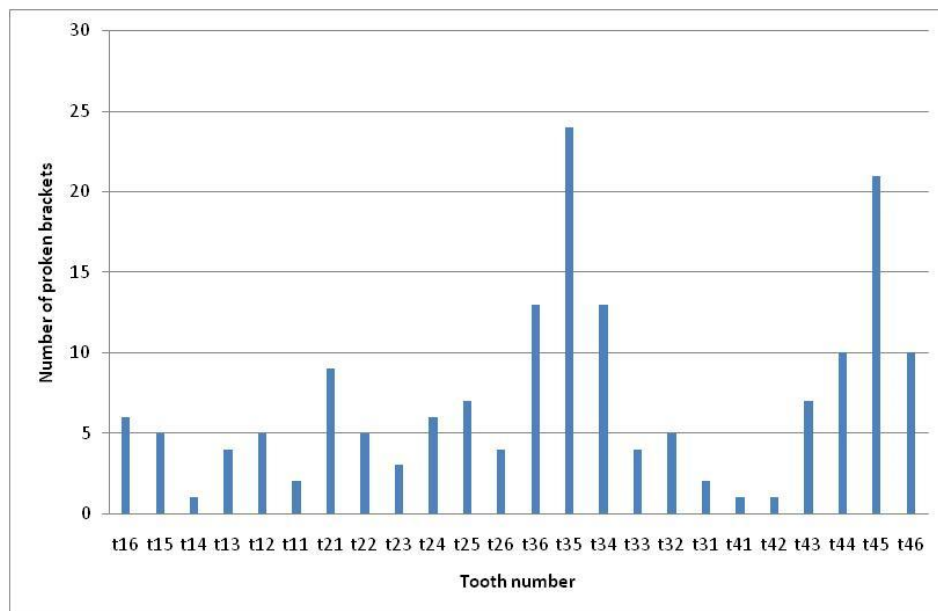
Nearly a quarter of the failures occurred during the first year of the treatment with the majority of them (14.5%) occurring during the first six

months. One third of the breakages occurred during the second year of the treatment.

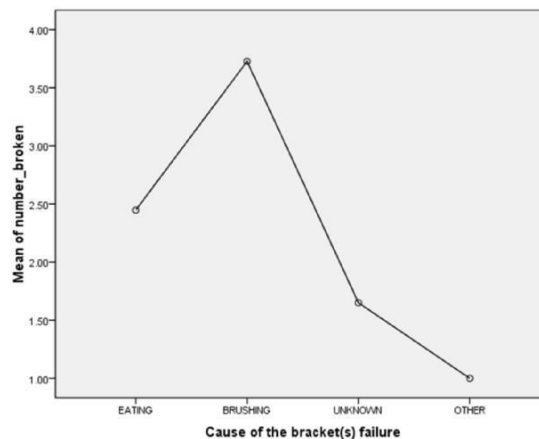
**Figure 1: Distribution of number of the broken brackets among quadrants of the jaws**



**Figure 2: Number of failures per tooth**



**Figure 3: Relationship between the mean number of broken brackets and causes of the brackets' failure**



**Table I: Relationship between the causes of the brackets' failure number of patients reporting them**

|          | N  | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean |             | Minimum | Maximum |
|----------|----|------|----------------|------------|----------------------------------|-------------|---------|---------|
|          |    |      |                |            | Lower Bound                      | Upper Bound |         |         |
| EATING   | 38 | 2.45 | 1.81           | .29        | 1.85                             | 3.04        | 1.00    | 8.00    |
| BRUSHING | 11 | 3.73 | 2.83           | .85        | 1.83                             | 5.63        | 1.00    | 10.00   |
| UNKNOWN  | 20 | 1.65 | .88            | .20        | 1.243                            | 2.06        | 1.00    | 4.00    |
| OTHER    | 1  | 1.00 | .              | .          | .                                | .           | 1.00    | 1.00    |
| Total    | 70 | 2.40 | 1.90           | .27        | 1.95                             | 2.85        | 1.00    | 10.00   |

**Table 2: Relationship between Gender and the number of broken brackets.**

|        | N  | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean |             | Minimum | Maximum |
|--------|----|------|----------------|------------|----------------------------------|-------------|---------|---------|
|        |    |      |                |            | Lower Bound                      | Upper Bound |         |         |
| MALE   | 32 | 2.84 | 2.27           | .40        | 2.02                             | 3.66        | 1.00    | 10.00   |
| FEMALE | 38 | 2.03 | 1.44           | .23        | 1.55                             | 2.50        | 1.00    | 6.00    |
| Total  | 70 | 2.40 | 1.90           | .23        | 1.95                             | 2.85        | 1.00    | 10.00   |

**Discussion**

Failure rates for orthodontic brackets in vivo range from 0.5 to 16 percent<sup>18</sup>; the average reported clinical bracket failure of all orthodontic bonds is approximately 6%<sup>17 19</sup>. It is well known that in vivo studies, socioeconomic and dental status of patients and malocclusion classification could influence the outcomes. Additionally,

masticatory forces varying with facial type, culturally influenced dietary habits, and gender differences could also affect the results<sup>20</sup>.

The position of the bracket in the dental arch had an influence on the failure of the brackets. Nearly three-quarters of the total brackets breakages occurred in the posterior region of the jaws. This is in agreement with studies by

Mavropoulos et al.<sup>21</sup> who observed that the bracket failure rate for posterior teeth was three times higher than the failure rate for anterior teeth. This study showed that majority of bracket failures occurred in the lower jaw, which is in contrast with clinical studies conducted by Mavropoulos et al.,<sup>21</sup> and Pandis et al.,<sup>22</sup> whose study showed that tooth location (i.e. upper or lower Jaw) did not influence failure rates. The high incidence of bracket failures in the posterior teeth could be associated with a number of factors such as poor moisture control<sup>23</sup> and the heavier occlusal forces exerted on the posterior teeth during eating<sup>14,24</sup>. The larger amount of aprismatic enamel on premolars has been shown to affect their micromechanical bond strength<sup>25,26,27</sup> which may explain why the premolars showed the highest number of breakage.

The most common reason for failure of a bracket was claimed to be eating (54.2%). Similar findings were observed in a study by Singh et al.,<sup>14</sup> where (44.4%) of the breakages were attributed to eating. A possible explanation for this could be the diet of the average Ghanaian, which is coarse and crunchy.

This study showed that brushing caused higher number of mean bracket failures per patient. Haesman<sup>22</sup> showed in his research that in patients wearing fixed appliances 'good brushers' used significantly greater brushing pressures than 'poor brushers' and some of larger forces recorded in that study were potentially traumatic. We are however of the opinion that in some cases tooth brushing only serves to expose previously broken brackets and may not be the primary cause of bracket failure.

Although some studies<sup>18,29</sup> have shown that bracket failure depended on gender, the gender of the patients did not influence the number of the broken brackets obtained in the present study, to any significance, corroborating the results of previous clinical reports by White<sup>30</sup>, Hitmi et al.,<sup>31</sup> and Karamouzous et al.,<sup>32</sup>

Association between age of the patients and the number of the broken brackets showed a

decreasing number of the broken brackets with age. Similar findings were observed in a study by Sukhia et al.,<sup>33</sup> where the lower age groups demonstrated greater bracket failures as compared to the older age groups in both sexes. This could be explained by the fact that with age patients tend to be more compliant, cooperative with a doctor's recommendations and careful in following the oral hygiene instructions.

### **Limitations of this study**

The following Limitations were identified:

- The small sample size and the restriction of the study to one health centre only, which limited the generalization of the results.
- The fact that Some of the patients were not aware what caused the bracket failures.

### **Conclusion**

Out of 70 patients sampled, a total of 168 orthodontic bracket failures were recorded in the above study.

- The study showed that the lower left second premolar recorded the highest number of bracket failure followed by the lower right second premolar.
- The most offending tooth in the maxillary arch was the left central incisor.
- Brushing caused a higher number of broken brackets per patient.
- A greater number of patients reported eating as the cause of bracket failure
- Gender did not have any influence on the cause of bracket failure
- The older the patient, the higher the survival rate for the orthodontic brackets

### **Contributors**

Dunaeva N, was responsible for the study design, acquisition, analysis and interpreting the data and writing of the study

Amoah KG, was responsible for the concept, study design, acquisition, analysis, interpreting the data and writing the study

Newman-Nartey M was responsible for study design, acquisition, analysis and editing

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