

The Duration of Bracket Detachment at Public Health Center Jakarta and Dental Hospital Universitas Indonesia**

Gina Maringka¹, Ellyza Herda^{2*}

1. Doctoral Program, Faculty of Dentistry, Universitas Indonesia.

2. Department of Dental Materials, Faculty of Dentistry, Universitas Indonesia.

Abstract

Up to date, there are no data about bracket detachment from the patients point of view. The aim of this study is to acquiring information regarding metal bracket used by patients undergo orthodontic treatment at Public Health Center in Jakarta and Dental Hospital Universitas Indonesia. The study conducted by survey using questionnaires from 250 patients at 10 Public Health Centers and 250 patients from Dental Hospital. Survey results were analyzed statistically by Chi-square test ($p < 0.05$). Bracket attachment failure analysis from 100 respondents from Public Health Center and Dental Hospital was carried out using Modified Adhesive Remnant Index. The adhesive remnant analyzed using Mann-Whitney Test ($p < 0.05$). Stereomicroscope, Scanning Electron Microscope and Energy Dispersive Spectroscopy were used to observe and analyze the form and composition of the bracket base.

Survey results showed that more than 90% respondents had experienced bracket detachment and around 60% respondents experienced the bracket detachment before the next appointment. The total bracket detachment vary from 1 bracket (50-57%), 2 brackets (around 36%) and particularly detached on the upper bicuspid region. The attachment failure on the detached bracket, in general, occurred on scale 1 and 2 Modified Adhesive Remnant Index. The form and composition of the bracket base used were varied.

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Introduction

Indonesia is a wide country with a big population where's many scattered throughout the islands so the Hierarchical Health Care System consist of Public Health Center and Hospital. Public Health Center is the foremost gateway to community health services aims to improve the public health of its area¹. It can be said that Public Health Center is the only one health services oriented to the community needs.

Recently, the needs of orthodontic treatment at Public Health Center has increased because more patients aware of their teeth position abnormality that affects their oral and dental also systemic health. According to Ministry of the Health Republic of Indonesia, in 1996 by Hoesin F (2007), malocclusion prevalence about 80% from total population and become one of the biggest oral and dental health problems compared with dental caries or periodontal disease². Realizing how many and serious problems arising from malocclusion make malocclusion should be treated immediately by orthodontic treatment.

The metal bracket is the most common bracket chosen from all types of bracket available, because of an economical factor and if the bracket detached for tooth surfaces may still be re-attached to reduce the treatment costs rather than using new bracket^{3,4}. During orthodontic treatment, bracket detachment sometimes occurs that will interfere the orthodontic treatment. Emin Kahyagil, et. al. (2006), found that one of every

*Corresponding author:

Dr. Ellyza Herda
Department of Dental Materials, Faculty of Dentistry,
Universitas Indonesia, Indonesia
E-mail: ellyza_herda@yahoo.com

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five brackets would detach⁵. According to Profitt, et. al. (2013), bracket detachment was caused by great force such as mastication force⁶. Wendl, et. al. (2011), said that the failure of the bracket base surface attachment and the adhesive material generally cause bracket detachment from the tooth surfaces⁷. Along with the technology advances, nowadays many brackets with a varied base to allow good mechanical retention for adhesive material attachment so the attachment failure is more due to the tooth surfaces and adhesive materials⁷⁻⁹.

Up to date, there are no data or study about bracket detachment from the patient's point of view regarding whether the bracket has detached, the time and location that the bracket was detached and how was the form of the attachment failure. That was the aims of this study through a survey to the patients of orthodontic treatment using the metal bracket. Aside from the patients factor, the composition and characterization of the metal bracket surface also have a big influence on the successful of orthodontic treatment. The composition of bracket materials influences the bracket structure, attribute and application, while the bracket surface characterization will affect the attachment strength to the tooth. The metal bracket may be used in orthodontic treatment if complied with particular requirements of its nature also its biocompatibilities. Each Public Health Center or Dental Hospital may use the metal bracket from the different factories with different bracket surface characterization that will influence the application and successful of orthodontic treatment which begins with the insertion of the metal bracket to the tooth. Therefore, this study took a photograph of the metal bracket used at Public Health Center in Jakarta and Dental Hospital Universitas Indonesia using Stereomicroscope and SEM-EDS test.

Materials and methods

Survey by Simple Random Sampling using Questionnaires (which has approved by Ethical Board from Research Ethics Commission of Dentistry Universitas Indonesia) was carried out from April 1, 2015 to August 31, 2015 to obtain the information from each 250 orthodontic patients at 10 Public Health Centers in Jakarta (in number code: 1 to 10) and Dental Hospital Universitas Indonesia regarding whether the

bracket has detached, when was the bracket detachment happened, how many bracket detached, and where region was often bracket detached. The respondents were chosen with inclusion criteria i.e. has had the metal bracket inserted, come for a routine orthodontic appointment, able to write and read the questions in Indonesian, and willing to participate in this study. The data was analyzed by SPSS version 17.0 (Statistical Package for Social Sciences, Chicago, USA) and the survey results were analyzed statistically by Chi-Square test ($p < 0.05$).

The attachment failures were observed from the remnant of the adhesive materials left on the metal bracket base and evaluated with Modified Adhesive Remnant Index by Artun and Bergland (1984), in 0-3 scale^{10,11}. Scale 3 given if all of the adhesive remnants still intact in the detached metal bracket surface base, scale 2 if there are more than 50% remnants of the adhesive materials while scaling 1 if only less than 50% adhesive materials left, and scale 0 if there are no more adhesive materials in the detached metal bracket surface. The adhesive remnant were analyzed statistically by Mann-Whitney Test ($p < 0.05$). The attachment failure analysis performed on each 100 patients from 10 Public Health Centers in Jakarta and Dental Hospital Universitas Indonesia. The photograph of the metal bracket surfaces base form and characterization from 10 Public Health Centers in Jakarta and Dental Hospital Universitas Indonesia performed using Stereomicroscope (Nikon SMZ800, Tokyo, Japan) and SEM-EDS (JEOL JSM-6510LA, Akishima, Japan)

Results

The Result was analyzed by SPSS version 17.0 (Statistical Package for Social Sciences, Chicago, USA). The data tabulations from the Questionnaires were shown in Table 1 - 3. The survey result on Table 1 showed that the orthodontic patients commonly was female either at Public Health Center or Dental Hospital about 80% and 49% respondents were ≥ 24 years old. Education background of the respondents mostly was high level around 67% and around 37% respondents worked as a private employee. Statistical analysis regarding the respondent's identity parameters with bracket detachment incidences either at Public Health Center or Dental Hospital were not a significant difference

($p < 0.05$). The respondents purpose of taking orthodontic treatment were mostly because of aesthetic factor (67%) as shown in Table 2. The respondents of this study evenly came to their routine orthodontic appointment every 3 or 4 weeks (about 88%).

No	Variable	Location		p		
		Public Health Center	Dental Hospital			
		Frequency	%	Frequency	%	
1	Age				0.347	
	1 – 13 years old	18	7.2	23		9.2
	14 – 18 years old	50	20	45		18
	19 - 23 years old	60	24	58		23.2
	≥ 24 years old	122	48.8	124	49.6	
2	Gender				0.265	
	Male	47	18.8	49		19.6
	Female	203	81.2	201	80.4	
3	Level of education				0.242	
	Low (Elementary School)	21	8.4	27		10.8
	Midle (Junior and High School)	72	28.8	55		22.0
	High (Bachelor)	157	62.8	168	67.2	
4	Job				0.777	
	Unemployed	49	19.6	53		21.2
	Civillian employee	16	6.4	20		8.0
	Private employee	93	37.2	90		36.0
	Businessman	16	6.4	14		5.6
	Professional	2	0.8	0		0
	Others	74	29.6	73		29.2

*Chi-Square Test, significant = $p < 0.05$

Table 1. Respondents Distribution at Public Health Center and Dental Hospital based on some identity parameters.

No	Variable	Location		p		
		Public Health Center	Dental Hospital			
		Frequency	%	Frequency	%	
1	The purpose of bracket insertion				0.105	
	Health factor	73	29.2	73		29.2
	Aesthetic factor	164	65.6	168		67.2
	Asked by parents/spouse	11	4.4	8		3.2
	Others	2	0.8	1		0.4
2	Routine orthodontic appointment				0.062	
	No because of laziness	5	2.0	5		2.0
	No because of out of town travel	22	8.8	31		12.4
	No because of other reasons	2	0.8	1		0.4
	Yes, every 3 weeks	109	43.6	113		45.2
	Yes, every 4 weeks	112	44.8	100	40.0	
3	Bracket detachment	245	98	240	96	0.354
4	Time of bracket detachment				0.077	
	First insertion	150	60.0	156		62.4
	Second routine	4	1.6	2		0.8
	Third routine	12	4.8	20		8.0
	...th routine orthodontic appointment	23	9.2	23	9.2	
5	Total of bracket detachment				0.155	
	0	8	3.2	4		1.6
	1	127	50.8	144		57.6
	2	91	36.4	90		36.0
	3	18	7.2	9		3.6
	4	6	2.4	3	1.2	
6	Region Tooth of bracket detachment				0.006	
	10	2	0.8	1		0.4
	6	2	0.8	1		0.4
	5	10	4.0	5		2.0
	12	14	5.6	12		4.8
	4	98	39.2	109		43.6
	13	30	12.0	42		16.8
	25	2	0.8	1		0.4
	27	3	1.2	1		0.4
	28	20	8.0	10		4.0
	21	22	8.8	30		12.0
	29	22	9.2	16		6.4
	20	16	6.4	18		7.2

Table 2. Bracket Insertion Data at Public Health Center and Dental Hospital.

*Chi-Square Test, significant = $p < 0.05$.

It's surprised that almost all respondents have had brackets detached (more than 90%) and around 60% it's happened before their first routine orthodontic appointment which was right after bracket insertion until the third weeks. The total of bracket detachment was mostly one (57%), and around 60% happened in the upper second bicuspid region. Statistical analysis showed that the region where's the bracket often detachment was significantly related with the bracket detachment incidence ($p < 0.05$).

No	Variable	Location		p	
		Public Health Center	Dental Hospital		
		Frequency	%	Frequency	%
1	Bracket discoloration				0.945
	Yes	197	78.8	203	
	No	53	21.2	47	18.8
2	Bracket deformation				0.091
	Yes	31	12.4	35	
	No	219	87.6	215	86.0
3	Bracket re-insertion				0.000
	Yes	226	90.4	225	
	No	24	9.6	25	10.0
4	On the same day				0.007
	Yes	200	80.0	210	
	No	50	20.0	40	16.0
5	Free of charge				0.002
	Yes	214	85.6	218	
	No	36	14.4	32	12.8
6	Objected replacement				0.529
	Yes	42	16.8	28	
	No	208	83.2	222	88.8
7	Objected to pay				0.805
	Yes	205	82.0	210	
	No	45	18.0	40	16.0

Table 3. Bracket detachment data at Public Health Center and Dental Hospital.

*Chi-Square Test, significant = $p < 0.05$.

No	Variable	Location		p		
		Public Health Center (n = 100)	Dental Hospital (n = 100)			
		Frequency	%	Frequency	%	
1	Scale				0.000	
	0	0	0	11		11
	1	21	21	33		33
	2	43	43	41		41
	3	36	36	15	15	

Table 4. Adhesive Remnant Index.

*Mann-Whitney Test, significant= $p < 0.05$, Mean Rank PHC 117,31 and Hospital 83,69.

From Table 3 showed that according to the respondent observation, the detached bracket had the color changed after cleansing process (around 81%) with no deformation (87%). Most respondents wanted to re-insert the bracket at that same day of routine control (84%) with no objection of replacing the detached bracket with the new one (88%) but objected if it was charged (84%). Statistical analysis showed a significant difference in bracket re-insertion at the same day and without additional charge.

The result of attachment failure analysis was

shown in Table 4 that shows that the detached bracket generally was on scale 1 of Modified ARI, 21% at Public Health Center and 33% at Dental Hospital and scale 2 about 40% both at Public Health Center and Dental Hospital. Scale 3 was found quite high (36%) at Public Health Center. Statistical analysis regarding the Modified ARI was a significant difference between Public Health Center and Dental Hospital.

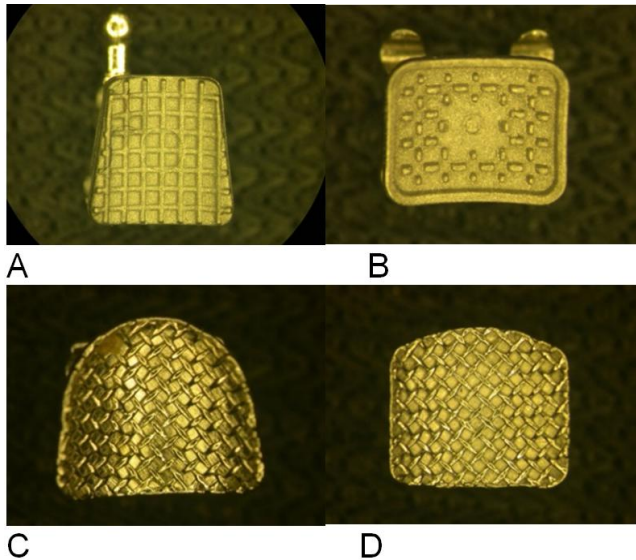


Figure 1. The photograph of the metal bracket base used in Group A,B,C and D with 20 times magnification.

The photograph of the metal bracket base used at 10 Public Health Center in Jakarta and Dental Hospital using Stereomicroscope were shown in Figure 1. According to the Stereomicroscope shown in Figure 1, denote that the metal bracket used at 10 Public Health Center Jakarta and Dental Hospital basically may be divided into four groups (in Alphabet code A,B,C,D). The grouping was based on the similarity of the metal bracket base forms. Group A is the metal bracket from Public Health Center 1, 2, and 3, Group B is the metal bracket from Public Health Center 4, 5 and Dental Hospital, Group C is the metal bracket from Public Health Center 6, 7, and 8, and Group D is the metal bracket from Public Health Center 9 and 10.

The analysis results of elements composition of the surface of metal bracket base from 10 Public Health Centers in Jakarta and Dental Hospital using SEM-EDS were found that the highest compositions of the Group A are Cobalt and Chromium. Group B, C, D, and

Dental Hospital have Iron and Chromium as its highest elements on the surface base with varied compositions. All of the alloys on the metal bracket used by 10 Public Health Centers and Dental Hospital have Chromium ranging from 15.5 to 26.18%. Nickel found in group B, C, D, and Dental Hospital. Other elements found are Molybdenum, Mangan, Silicon, and Aluminium in varied quantity.

Discussion

Table 1 shows the age of the respondents generally over of twenty-four years in which they were studying or already working. According to the previous experiences, most orthodontic patients are female, the result shows most respondents were female (81%) which naturally are concerned about the aesthetic especially in dental appearance¹²⁻¹⁵. Table 2 shows that the main purpose of respondents orthodontic treatment is due to the aesthetic factor followed the health factor. This proves the result of Table 1 which female pay more attention to the aesthetic factor. Most of the respondents were responsible for periodically routine control in three until four weeks. The fact nearly all respondents had bracket detached (about 90%), which occurred in the period before the first control and the respondent admitted as unfamiliar with bracket in the mouth. They were hard to adapt to this condition, especially when eating. This is supported by the theory that the bracket detached due to pressure when mastication occurs⁶. Generally, bracket detaches amounted to one or two with the regions that most often occurs in upper bicuspid region. Some research found that the bond failure which means the bracket detached usually on premolar (bicuspid)¹⁶. This could happen because it is behind that play a role in the process of mastication or this region is the last bracket were before the molar band fitted on molar. According to the observations of the respondent (Table 3), the detached bracket was discoloration which combustion residue resulting from the Flaming, the cleaning method of a detached bracket used by both Public Health Center and Dental Hospital⁹. This discoloration makes the respondent uncomfortable so they do not mind if replaced with new bracket but want for free. Generally, detached bracket re-insertion at the time of routine control. Modified ARI were shown

on Table 4 which the detached bracket generally on scale 1 (20 - 33%) and scale 2 (40%) which means that the bracket detachments occurred on the adhesive material as a binding medium between the tooth and bracket¹⁶⁻¹⁸. Scale 1 and 2 means half the adhesive material on tooth and bracket base means the bond failure is the cohesive failure. Generally, the bond failure is a combination of adhesive failure and cohesive failure or Mixed failure¹⁶⁻¹⁸. Cohesive failure could happen perhaps the orthodontist have done well in the bracket insertion procedure. Table 4 shows there were 36% in Scale 3 means all adhesive material on the bracket base, no adhesive remnant on the tooth. According to the bracket bonding procedure, if the profilaksis procedure was not done well so it would interfere the attachment between tooth and base metal, the tooth is not quite dry or oral environment has not good support by suction or cotton roll so it has contamination by saliva or cheek and lips¹⁹. This situation would make the bonding between the tooth and the adhesive material incompletely. Scale 0 means all adhesive material on the tooth, no adhesive material on bracket base means the retention form of mesh is not quite good, perhaps there is a premature contact or by stress concentration on the bracket base which in the form of weld spot or damaged mesh^{17,20}. Based on the results of Stereomicroscope, there were variations in the metal bracket were used by the Public Health Centers. The variations in terms of shape and size of the bracket base were one of the factors which influenced the success of the bracket insertion on the enamel surface besides the other factor is the adhesive and surface treatment of the email. There were only two Public Health Centers have the shape and size of the mesh same as those used at the Dental Hospital. The metal bracket used by the Dental Hospital is Dyna-Lock (3M,USA) which has specifications and made of Stainless Steel metal alloys. While it is difficult to know the shape of packaging, specifications and manufacturer metal bracket that were used by all Public Health Center because the material has prepared already. The test results of SEM-EDS shows metal bracket used in Group 1 from Public Health Center has main elements were Co and Cr which means metal bracket is made of Co-Cr alloy metals^{21,22}. Metal bracket from another Public Health Center made of Stainless Steel metal alloys. Co-Cr alloys in dentistry is a base metal

alloys commonly used for the manufacture of removable partial denture framework and metal ceramic restorations and is not indicated for the manufacture of metal bracket²². Metal alloys used for metal bracket generally are Stainless Steel type 316 Austenitic Steel containing 16-18% Cr, 10-14% Ni, 2-3% Mo and <0.03% C^{21,22}. Metal bracket for orthodontic treatment should have the standards and the composition listed on the packaging and specifications including important properties associated with its function.

Conclusions

The purpose of orthodontic treatment at Public Health Center in Jakarta and Dental Hospital Universitas Indonesia is mostly because of aesthetic factor which majority respondents are female and more than 90% respondents have had experienced bracket detachment and it's happened before their first routine control which is right after bracket insertion until the third weeks. The bracket detachment show the attachment failure that generally due to the cohesiveness of the adhesive materials which on scale 1 and scale 2 Modified ARI.

Despite of many choices of bracket, we have to be more selective in choosing, according to its standards including the compositions and specifications that should be mentioned in its packaging. The composition of bracket materials influences the bracket structure, attribute and application, while the bracket surface characteristic will affect the attachment strength to the tooth.

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Declaration of Interest

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