ORIGINAL ARTICLE

COMPARISON OF DEBONDING TIME AND PAIN BETWEEN THREE DIFFERENT DEBONDING TECHNIQUES FOR STAINLESS STEEL BRACKETS

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ABSTRACT

The aim of this study was to compare the debonding time and pain or discomfort between conventional mechanical debonding with sonic and ultrasonic debonding of stainless steel brackets.

One hundred fifty brackets were debonded at the end of 2 years of comprehensive orthodontic treatment from 12 patients of both sexes of age range between 15-25 years using non probability sampling technique. Mechanical debonding of brackets was done with debonding plier using wing method. Ultrasonic and sonic scalers were used to debond the brackets engaging the bracket from incisal side. Debonding time in seconds and patient perception of pain on a scale of 0-4 was noted. One way ANOVA was used to compare these three techniques in terms of time efficiency and pain or discomfort at time of debonding.

Mechanical debonding was successful in all the cases while ultrasonic and sonic debonding failed to debond the brackets in 16% and 36% of the cases respectively. Mechanical wing method debonds brackets in 1.28±0.49 seconds, ultrasonic debonding in 42.53±20.25 while sonic method debonds brackets in 70.18±22.28 seconds. More pain was felt by mechanical debonding followed by sonic and ultrasonic debonding respectively. Difference in debonding time and pain were found statistically significant between these three different techniques.

It was concluded that that no single method is time efficient and at the same time least painful for the patient. Mechanical debonding was most time efficient while ultrasonic debonding was least painful.

Key Words: *Debonding time, Pain, Mechanical wing method, Ultrasonic deboning, Sonic debonding.*

INTRODUCTION

Fixed orthodontic brackets are temporary appliances which are attached to the teeth for certain period of time depending upon the severity of malocclusion and needed to be removed at the end of treatment. The removal process is either called debonding or debracketing. Debonding should be performed carefully and with the best available method. A careless debonding technique and approach can take longer debonding time[1], cause irreversible damage to outermost fluoride rich layer of enamel[2] and is usually more painful for the patient.[3]

Many different types of fixed orthodontic brackets are available in the market but stainless steel labial brackets are mostly used because of their low cost and clinical effectiveness.[4,5] Stainless steel brackets are usually bonded to teeth with composite adhesive systems which are based on the principle of enamel etching and microretention.[6]

Debonding of resin fixed stainless steel brackets is conventionally done mechanically with various different pliers.[7,8] Mechanical debonding of stainless steel brackets by using different pliers can be done with wing method and base method usually using a peel off force to debond the brackets.[9]

Ultrasonic scalers have been recommended for debonding of orthodontic brackets especially ceramic brackets.[1,10,11] The advantage of using ultrasonic scaler for debonding is that the same device can be used for adhesive remnant removal at the end of debonding. No study in literature is done on the use of sonic scalers for bracket debonding. Sonic scalers vibrate at a much

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Received for Publication: February 9, 2015
Revision Received: March 2, 2015
Revision Approved: March 5, 2015

slower speed than ultrasonic scalers and so generate less heat at its tip than the later.

Pain or discomfort during debonding can have a negative influence on the desire to undergo orthodontic treatment. In a survey conducted by Oliver and Knapman[12] it was documented that pain was one of the most discouraging feature to undergo orthodontic treatment as perceived by the patients and their parents. In conventional mechanical debonding techniques wing method of debonding causes 1.5 times less pain than base method.[9] Less mechanical forces are applied during ultrasonic and sonic scaling so there are also less chances of pain with these techniques.

The purpose of this study is to compare debonding time and pain or discomfort between conventional mechanical debonding with sonic and ultrasonic debonding of stainless steel brackets. This will help the clinician to choose best available technique that is time efficient and least painful for the patient.

METHODOLOGY

A total of one hundred fifty brackets were debonded at the end of 2 years of comprehensive orthodontic treatment from 12 patients of both sexes, of age range between 15-25 years at SMDC hospital and CMH Lahore Medical College, Institute of Dentistry between the years 2011 to 2013 using non probability sampling technique. Debonding procedure was explained to the patients and a written consent was taken from all patients or their parents before debonding. All the debonded brackets were from the same manufacturer having the same bracket width and mesh base design. All brackets were bonded with same luting composite cement (Transbond XT (3M Unitek, CA, USA)) at the start of treatment.

Patients were randomly divided into three groups. In each group 50 brackets were debonded. Usually a single technique was used in each patient. Brackets were debonded without the archwire in place. In mechanical debonding technique, a debonding plier was used with wing method of debonding applying squeezing force as described by Brosh (Fig 1).[9] A piezoelectric ultrasonic scalar (Woodpecker China) (Fig 2) was used for ultrasonic debonding while a four hole sonic scaler (NSK,-Japan) (Fig 3) was used for sonic debonding. In both ultrasonic and sonic debonding techniques a purchase point between enamel and bracket was created on the incisal side of brackets and rocking action of the scaler tip was given to debond the brackets.

Debonding time was recorded in seconds with stopwatch. Teeth on which ultrasonic and sonic technique failed to debond brackets for more than 2 minutes were excluded from the study. Such brackets were debonded with mechanical wing method but data was not included in the study.

Discomfort of pain was evaluated by asking the patient their level of sensitivity during debonding based on score of 0 to 4 as proposed by Normando.[3] The scale is given in Table 1.

RESULTS

The data acquired from the study was entered in SPSS version 20 for windows and analyzed. The three techniques namely mechanical wing method (MWM), ultrasonic debonding (USD) and sonic debonding (SD) was compared in terms of time efficiency and pain during debonding.

Descriptive analysis of total number of successful debonding was done (Table 2). With mechanical wing method all the brackets were successfully debonded in less than 2 minutes. So this technique was successful in 100% of the cases. Success rate of ultrasonic debonding was 84% while that of sonic debonding was 64%.

Descriptive analysis of time required to debond the brackets was done (Table 3). Mechanical wing method was most effective in terms of time efficiency to debond the brackets. The average time required by mechanical wing method using a debonding plier was 1.286±0.49 seconds. Ultrasonic debonding was time efficient next to mechanical wing method and took an average of 42.53±20.25 seconds. Sonic scalers took the longest time to debond a bracket which was on the average of 70±22.28 seconds.

A one way ANOVA test was used to compare debonding time of different techniques. The ANOVA test (Table 4) shows significant difference between debonding timing of different techniques ($F_{2, 123}$ = 1843.574, $p < .001$). In order to check for individual differences between groups post-hoc comparisons using the Dunnett's T3 was selected. The test indicated that the mean score for mechanical wing method (M = 1.28, SD = .49) was significantly different from ultrasonic debonding (M = 42.53, SD = 20.25). Mechanical wing method also differed significantly from sonic debonding (M = 70.188, SD = 22.28). Similarly the test indicated that the mean score for technique ultrasonic debonding was significantly different from sonic debonding. The mean differences were significant at the 0.001 level.

Descriptive analysis of pain during debonding (Table 5) show greater pain was experience in wing method of debonding as compared to sonic and ultrasonic debonding. Least pain on the average was felt by the patient in ultrasonic debonding. Intolerable pain (score 4) was felt by the patient in both mechanical wing method and ultrasonic debonding but not in sonic debonding. In sonic debonding the maximum pain that was felt was in tolerable range (score 3). A one way ANOVA test was used to compare pain during different debonding techniques (Table 6).

The ANOVA output suggests, the pain felt due to different techniques differs significantly ($F_{2, 123}$ = 6.209, $p < .05$). In order to check for individual differences between groups post-hoc comparisons using the Dunnett's T3 was selected. The test indicated that the mean score for pain during mechanical wing method debonding (M = 2.06, SD = 1.34) was significantly different from ultrasonic debonding (M = 1.26, SD = 1.32). Also significantly more pain was felt during mechanical wing method as compared to sonic debonding (M =

TABLE 1: SCALE FOR ASSESSMENT OF PAIN DURING DEBONDING

0	Total absence of pain
1	Mild discomfort with no pain associated
2	Mild pain
3	Considerable but tolerable pain
4	Intolerable pain

TABLE: 2 PERCENTAGE OF SUCCESSFUL DEBONDING

	Cases					
	Included		Excluded		Total	
	N	Percent	N	Percent	N	Percent
MWM	50	100.0%	0	0.0%	50	100.0%
USD	42	84.0%	8	16.0%	50	100.0%
ST	32	64.0%	18	36.0%	50	100.0%

TABLE 3: TIME REQUIRED TO DEBOND BRACKETS (SEC)

	MWM	USD	SD
Mean	1.286	42.536	70.188
N	50	42	32
Std. Deviation	.4907	20.2594	22.2891
Minimum	0.3	14.0	25.0
Maximum	2.3	98.0	114.0

TABLE 4: ANOVA RESULTS FOR TIME

(I) Debonding	(J) Debonding	Mean difference (I-J)	Sig.
MWM	US	-41.2497*	.000
MWM	S	-68.9015*	.000
US	S	-27.6518*	.000
F	184.574		
Sig	.000		

TABLE 5: PAIN DURING DEBONDING (SCORE OF 0-4)

	N	Mean	Std. Deviation	Minimum	Maximum
MWM	50	2.06	1.346	0	4
USD	42	1.26	1.326	0	4
SD	32	1.28	.813	0	3

TABLE 6: ANOVA RESULTS FOR PAIN

(I) Debonding	(J) Debonding	Mean difference (I-J)	Sig.
MWM	US	.798*	.016
MWM	SD	.779*	.005
USD	SD	-.798*	.016
F	6.209		
Sig	.003		

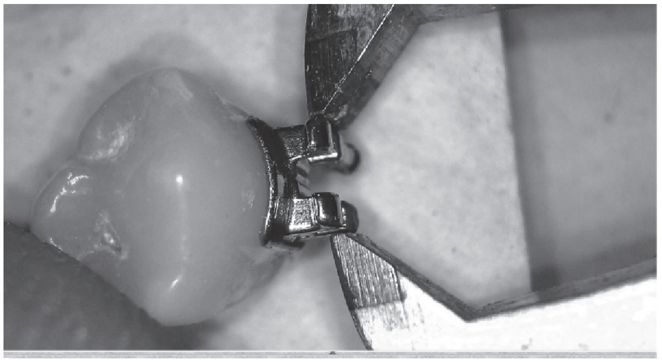

Fig 1: Debonding plier used with wing method

Fig 2: Ultrasonic scaler

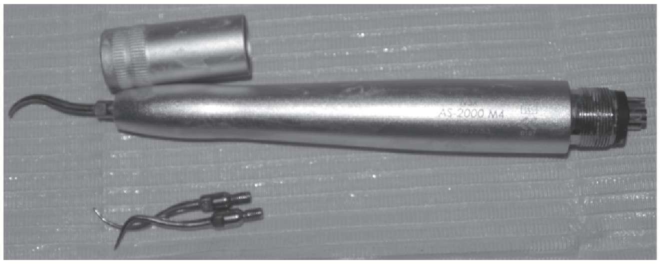

Fig 3: Sonic scaler

1.26, SD = .813). There was also statistical difference in pain score between ultrasonic debonding and sonic debonding. The mean differences were significant at the 0.05 level.

DISCUSSION

Debonding time reported in literature[1,13] for mechanical debonding is usually 1 second and for ultrasonic debonding is 16.6 seconds. These values are much smaller than debonding time for both these methods reported in this study. The main reason behind this is that Transbond XT was used for bonding orthodontic brackets. Sharma[14] in a study on comparison of shear bond strength of orthodontic brackets bonded with four different orthodontic adhesives showed that brackets bonded with Transbond XT have higher bond strength.

Transbond XT is a highly filled adhesive[15] with up to 80% filler contents.[16] Increased filler contents of the adhesive increases mechanical properties of material and bond strength of brackets.[17,18]

Ultrasonic debonding had previous been advocated for ceramic brackets removal with zero failure rate. In this study 16% of brackets failed to debond with ultrasonic debonding. This can well be coined with the use of highly filled adhesive for bracket bonding in this study. As sonic scalers have less vibration than ultrasonic one so 36% debonding failure with this scaler is not surprising. An important assumption that can be drawn is that sonic scalers can be successfully used for plaque removal in orthodontic patients if highly filled adhesive is used for bracket bonding and no rocking force to the bracket is given by the scaler tip.

Mechanical debonding though the most efficient technique for bracket debonding was also the most painful for the patient. In a finite-element study Katona[19] showed that less stress and so less tooth damage during debonding due to tension force as compared to peel off force. This explains why mechanical wing method which uses peel off force to debond the bracket is more painful for the patient than ultrasonic and sonic debonding which apply a tension force to the bracket after creating a purchase point under it. In addition to tension force, intrusive force was also applied to the bracket due to direction of ultrasonic and sonic scalers tips. Williams and Bishara[20] showed that patient can tolerate intrusive forces at time of debonding than forces in mesial, distal, facial, lingual, or an extrusive direction.

Surprisingly sonic debonding was on the average more painful for the patient than ultrasonic debonding though none of the sonic debonding cause's intolerable pain to the patient. This increased pain can be due to increase debonding time associated with sonic debonding.

Other variables that were not considered in this study but which can effect pain during debonding are mobility of the tooth at time of debonding ,tooth type, patient anxiousness at time of debonding and gender of the patient.[3,21-23]

CONCLUSION

From this study following conclusions can be made:

- No single method is time efficient and at the same time least painful for the patient.
- Mechanical debonding is most time efficient but also most painful for the patient.
- Ultrasonic debonding is least painful for the patient but also take longer debonding time. On some teeth ultrasonic debonding may fail to debond brackets so clinician must remain mentally prepared for that.
- Sonic debonding though does not cause intolerable pain to the patient but due to increase debonding time and greater failure rate, it cannot be recommended as a routine method for bracket debonding.

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