Educational Administration: Theory and Practice
2024, 30(4), 7466-7477
ISSN: 2148-2403
https://kuey.net/

Research Article

Comparative Evaluation Between Different Manual And Ultrasonic Orthodontic Bracket Debonding Methods In Terms Of Adhesive Remnants, Pain Perception And Incidence Of Bracket Distortion– An In-Vivo Study

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Citation: Dr. Romilkumar Shah et al. (2024), Comparative Evaluation Between Different Manual And Ultrasonic Orthodontic Bracket Debonding Methods In Terms Of Adhesive Remnants, Pain Perception And Incidence Of Bracket Distortion– An In-Vivo Study, *Educational Administration: Theory And Practice, 30(4),* 7466-7477, Doi: 10.53555/kuey.v30i4.2592

ARTICLE INFO

ABSTRACT

Aim: To evaluate and Compare different Manual and Ultrasonic Orthodontic bracket debonding Methods in terms of Adhesive Remnants, Pain Perception and Incidence of bracket Distortion

Material and Method: A sample size of 50 patients (>18 years) having fixed orthodontic treatment for both upper and lower arches having MBT prescription 0.022-inch metal brackets and ready for orthodontic bracket debonding were selected according to inclusion and exclusion criteria. In each patient four Quadrants of oral cavity were randomly distributed amongst four methods Method -I: Wing Method Debonding, Method -II: Base method Debonding, Method -III: Scaler-tip angulation at 45° and Method –IV: Scaler-tip angulation at 0° by using lottery method.

Results: In AIR Index, Median Value of Wing Method is 2.4, which is highest followed by the median value of Scaler-tip angulation at 45° is 1.4 and Scaler-tip angulation at 0° is 1.4 which is Same followed by the Base method whose median value is 0.4 which is lowest. In Bracket Failure Score, Median Value of Base Method is 4.5, which is highest followed by the median value of Wing Method which is 4. Median value of Scaler-tip angulation at 0° and Scaler-tip angulation at 45° is same which is 1. In Visual Analogue Scale, Median Value of Wing Method and Base Method is 5 which is same and Median value of Scaler-tip angulation at 0° and Scaler-tip angulation at 45° is same which is 2.

Conclusion: Base Method showed lowest AIR score indicating less Adhesive remnants on enamel surface after Orthodontics Bracket debonding. Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed less incidence of bracket distortion compared to wing method and base method. Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed reduced pain level compared to Wing Method and Base Method

Key words: Manual Debonding, Ultrasonic Debonding, Adhesive Remnant Index, Bracket Distortion, Pain Perception.

1. INTRODUCTION

The methods of direct bonding and acid etching, which were initially reported in 1955 and 1965 by Buonocore [1] and Newman [2], respectively, were significant advancements in the field of orthodontics. Once orthodontic treatments with fixed appliances are completed, the bonded brackets and remaining adhesive must be removed. However, when the bracket debonding process is inadequate, the enamel is damaged, resulting in cracks and fractures on the enamel surface which further leads to tooth sensitivity and raises the risk of cavities and pulp inflammation [3].

Previous research has described several ways for removing brackets, including manual procedures, chemical solvents, ultrasonic scalars and lasers. The Manual approach by using debonding plies is the most commonly employed in clinical practice. The most effective approach for debonding orthodontic brackets is to use sharp-edged pliers to generate a bilateral force at the bracket base-adhesive interface.

Ultrasonic scalars are utilized in professional oral hygiene procedures to remove plaque from the bracket base, which might impact the enamel-bracket interface [4]. Ultrasonic vibration at high power is used to remove dental posts, crowns, and bridges, and can also debond orthodontic brackets. [5] This action is due to the propagation of vibrations from the ultrasonic instrument to the orthodontic bracket.
The adhesive remnant index is a significant parameter for assessing the enamel damage risk induced by debonding [6]. Bonding failure can occur at the enamel-adhesive contact, the bracket-adhesive interface, or in the adhesive, each with its own set of advantages and disadvantages.
Despite recent advances in dentistry, the most prevalent complaint of many patients is pain or discomfort following many types of dental treatments, including orthodontic therapy [7]. Pain is a subjective feeling that varies from patient to patient and is conveyed to varied degrees during the active treatment phase as well as the removal of the fixed appliance [8]. Patients feel diverse degrees of discomfort in various clinical scenarios, such as placement of separators, orthodontic implants placement, arch wires activations, banding and debonding procedure. Orthodontic pain is frequently characterized by feelings of pressure, tension, tooth soreness, and pain itself [9]. These perceptions may be attributable to changes in blood flow in the periodontal ligament and are associated with the presence of prostaglandins, neuropeptides such as substance P, cytokines, and other inflammatory mediators [10]. Williams and Bishara [8] found that patient discomfort during debonding is mostly determined by tooth mobility and force direction. Both of these issues should be considered while removing the bracket. Thus, reducing or minimizing discomfort during orthodontic bracket debonding is just as important as preventing enamel damage.
After orthodontic bracket debonding, the same bracket can be reused after bracket reconditioning, which has obvious cost benefits. Therefore, one should utilize orthodontic bracket debonding procedure that preserves full bracket structure intact.
So, in order to obtain the finest possible Orthodontic Bracket Debonding procedure among popular clinical debonding methods in terms of adhesive remains, pain perception, and bracket distortion becomes need of an hour.

Need of the Study

After appraising the literature till 13th July, 2022 from PubMed, Google Scholar and Research Gate there were no in-Vivo studies found comparing two different methods of Manual technique [Wing Method and Base Method] and two different methods of Ultrasonic technique [Scaler-tip angulation at 45° and Scaler -tip angulation at 0°] in terms of Adhesive remnants, Pain perception and incidence of bracket Distortion during debonding Orthodontic bracket. Adhesive remnants, pain perception and incidence of bracket Distortion in debonding procedure is still a poorly documented issue in orthodontics Hence, to derive the best technique among Manual and Ultrasonic methods in terms of Adhesive remnants, Pain perception and incidence of bracket Distortion with best possible results becomes a need of the hour.

Aim & Objectives

Aim: To evaluate and Compare different Manual and Ultrasonic Orthodontic bracket debonding Methods in terms of Adhesive Remnants, Pain Perception and Incidence of bracket Distortion

Objectives:

1. To evaluate the Adhesive Remnants, Pain Perception and incidence of Bracket Distortion following Orthodontic Bracket debonding by Manual Wing Method
2. To evaluate the Adhesive Remnants, Pain Perception and incidence of Bracket Distortion following Orthodontic Bracket debonding by Manual Base Method
3. To evaluate the Adhesive Remnants, Pain Perception and incidence of Bracket Distortion following Orthodontic Bracket debonding by Ultrasonic Method with 45°Scaler-tip angulation.
4. To evaluate the Adhesive Remnants, Pain Perception and incidence of Bracket Distortion following Orthodontic Bracket debonding by Ultrasonic Method with 0° Scaler-tip angulation.
5. To compare Manual Wing Method, Manual Base Method, Ultrasonic Method with 45° Scaler-tip angulation and Ultrasonic Method with 0° Scaler-tip angulation in terms of Adhesive Remnants, Pain Perception and incidence of Bracket Distortion

2. MATERIALS AND METHODS

I. Study design: -

Place of the Study: Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital, Sumandeep Vidyapeeth Deemed to be University.

II. Source of Sample: Patients of the department of Orthodontics and Dentofacial Orthopaedics concluded their Fixed Orthodontic Mechanotherapy having metal Braces and are ready for orthodontic bracket debonding.

III. Sample Description:
Sample size was calculated from studies conducted by Alessandri Bonetti G et al [13] and Brosh T et al [16], considering 20% difference between 4 Methods, with SD 1.35, minimum 49 samples required to achieve 95% confidence with 80% power.

$$n = p(1-p)\left(\frac{z_{1-\alpha/2} + z_{1-\beta}}{p - p_0}\right)^2$$

= $0.5(1-0.5)\ (1-0.05/2 + 1-0.20/0.5-0.3)^2 = 49$

Where, p = 0.5 p0 = 0.3 Alpha = 0.05 Beta = 0.20
The calculated sample size is 49 So,
the final sample size for this study was 50

IV. Time Scale of the Study: Study started after obtaining SVIEC approval and was completed within 6 months from the date of approval.

V. Selection Criteria:
1. Inclusion Criteria:
I. Patients having fixed orthodontic treatment with bonded all incisors, canines and premolars in both the arches with MBT prescription 0.022-inch metal brackets.

2. Exclusion Criteria:
I. Patient with Orthodontic Treatment in Single Arch
II. Patients with loose or absence of one or more brackets.
III. Patients with any Developmental Craniofacial Anomalies
IV. Patients with any missing teeth except Molars
V. Presence of any prosthesis, heavily restored teeth, and root canal treated teeth
VI. Patients with any active periodontal problem.
VII. Patients with history of medicine intake periodically or in the last 24 hours, particularly pain modifying drug

A. Equipment and Material used for the study: -
1. Orthodontic Debonding Pliers (GDC)
2. Ultrasonic Scaler (Woodpecker)
- Rated input- 24V
- Frequency- 50Hz/60Hz
3. Qpets UV light torch: 395 nm

Methodology: -
After obtaining Ethical approval from Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC), the study was conducted in the Department of Orthodontics and Dentofacial Orthopaedics, K. M. Shah Dental College & Hospital. The participants were selected as per the inclusion criteria. The selected participants were introduced to the aims, objectives and methodology of the study. If the participants agree to participate in the study, a signed written Informed Consent was obtained from them.

Orthodontic Bonding for all the patient was done using 3M Unitek Transbond XT and at time of Orthodontic Debonding appointment, for every patient four Quadrants of oral cavity were randomly distributed amongst four methods (Method -I: Wing Method Debonding, Method -II: Base method Debonding, Method -III: Scaler-tip angulation at 45° and Method –IV: Scaler-tip angulation at 0°) by using lottery method.

Group-I: Wing Method Debonding [11]: Jaws of the debonding plier were aligned horizontally over bracket in occluso-gingival direction over the tie wings. Debonding occurs when the handles are squeezed and the bracket is pulled away from the tooth surface (Fig 1-2).

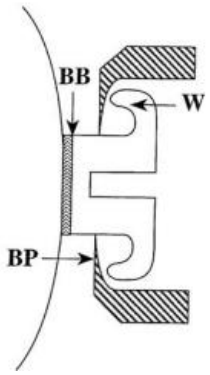

Fig 1: Diagrammatic representation of Wing Method [11]

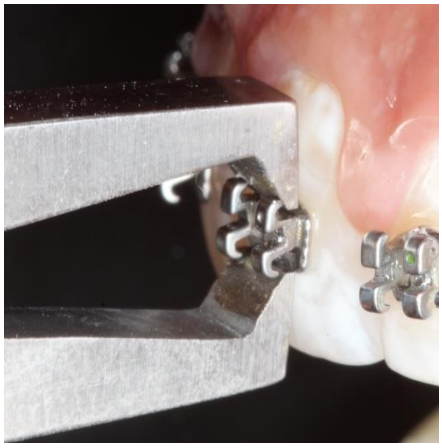

Fig 2: Photographic representation of wing Method

(BB= Bracket Base, W= Bracket Wing, BP= Blades of Plier)

Group -II: Base Method [11]: Sharp edges of the debonding plier were placed at adhesive layer between the bracket and the enamel surface aligned horizontally over bracket in occluso-gingival direction. Application of force produce a wedging effect which leads to debonding of bracket (Fig 3-4).

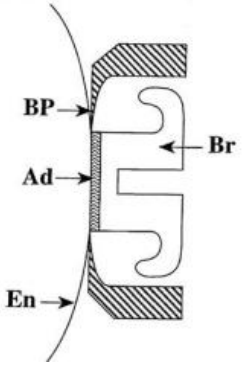

Fig 3: Diagrammatic representation of Base Method [11]

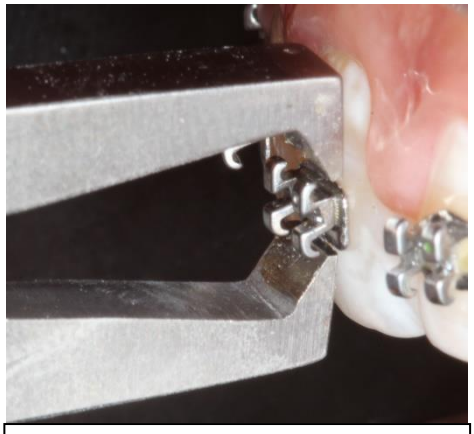

Fig 4: Photographic representation of Base Method

(BP= Blades of Plier, Br= Bracket, Ad= Adhesive Layer, En= Enamel Surface)

Method -III: Scaler-tip angulation at 45° [12]: Ultrasonic Scaler tip with full power were applied as close as possible to the bracket-tooth interface for 12 seconds (i.e. 3 seconds on each of the mesial, distal, occlusal and gingival aspects) with sweeping motion in each direction with Scaler tip angulated at 45° (Fig 5-6)

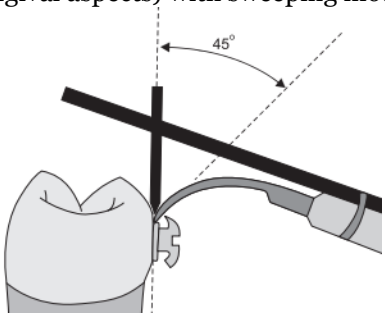

Fig 5: Diagrammatic representation of Scaler-tip angulation at 45° [12]

Fig 6: Photographic representation of Scaler-tip angulation at 45°

Method -IV: Scaler-tip angulation at 0º [12]: Ultrasonic Scaler tip with full power was applied as close as possible to the bracket-tooth interface for 12 seconds (i.e. 3 seconds on each of the mesial, distal, occlusal and gingival aspects) with sweeping motion in each direction with Scaler tip angulated at 0º (Fig 6-7).

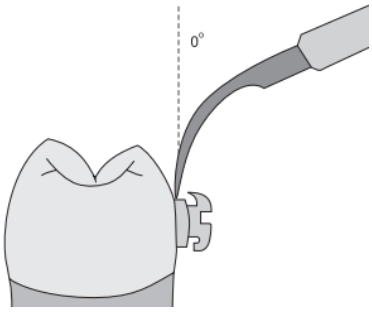

Fig 7: Diagrammatic representation of Scaler-tip angulation at 0º [12]

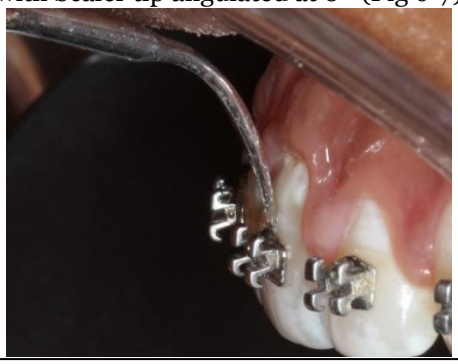

Fig 8: Photographic representation of Scaler-tip angulation at 0º

After Orthodontic Bracket Debonding, for each patient in all four quadrants, Adhesive remnants was evaluated by Adhesive Remnants Index (ARI) using UV light (Fig 9)

ARI Index:
0 = No Adhesive resin left on enamel surface
1 = Less than 50% Adhesive resin on enamel surface
2 = More than 50% Adhesive resin on enamel surface
3 = 100 % of Adhesive resin left on enamel surface with a distinct bracket base impression.

After recording ARI score for each tooth (from central incisor to second premolar) for each quadrant, quadrant wise average ARI score was taken that represents the score of the respective method.

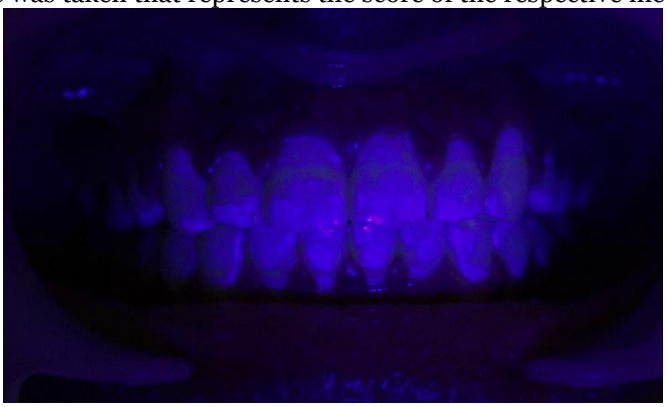

Fig 9: UV light use to check Adhesive Remnants Index

Pain Perception by Patient was evaluated using Visual Analogue Scale (VAS). A 10-cm VAS was used wherein score 0 means “no pain” and increasing scores from 0 to 10 represents pain increase. For recording the scores, patients were asked to tick on the scale according to the intensity of pain felt by them after each bracket was deboned (Fig 10).

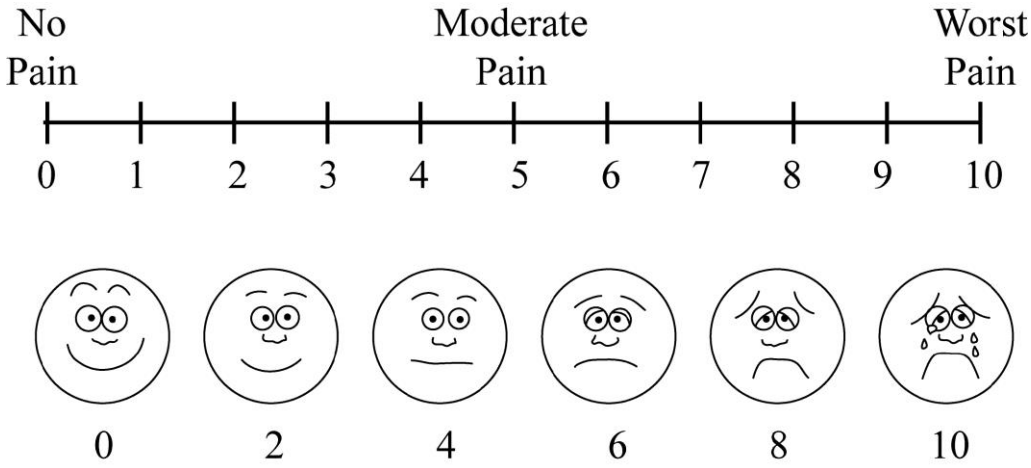

Fig 10: Visual Analogue Scale (VAS)

Bracket failure (Fig 11-12) was scored on a scale of 0 to 1, were
0 = Brackets showing no sign of visible distortion
1= Brackets showing visible distortion
After recording quadrant wise incidence of Bracket failure (from central incisor to second premolar), summative score for each quadrant was the score of the respective method.

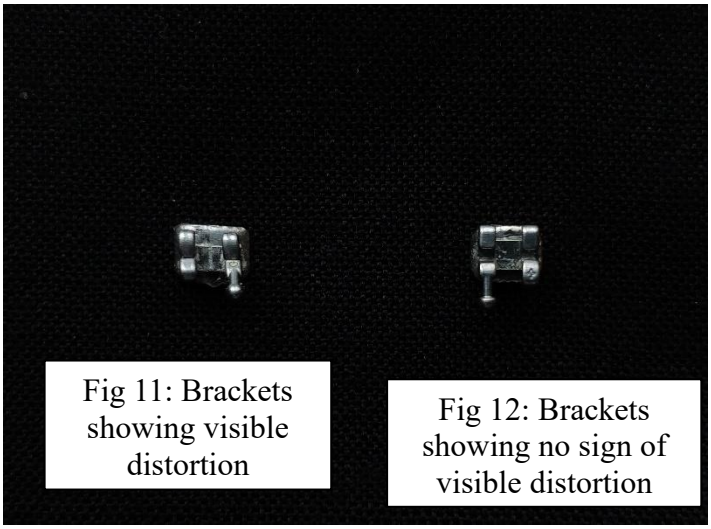

Fig 11: Brackets showing visible distortion

Fig 12: Brackets showing no sign of visible distortion

All the collected data was further subjected to suitable statistical analysis

3. RESULTS

Table 1: Demographic data

AGE	N	Mean ± SD	Median (IQR)	Range
	50	22.26 ± 3.9	22.5(19,25.25)	15 - 30

All the four Methods i.e. Method -I: Wing Method Debonding, Method -II: Base method Debonding, Method -III: Scaler-tip angulation at 45° and Method –IV: Scaler-tip angulation at 0° were compared with each other in each of this Indices using Friedmans Test
In AIR Index, Median Value of Wing Method is 2.4, which is highest followed by the median value of Scaler-tip angulation at 45° is 1.4 and Scaler-tip angulation at 0° is 1.4 which is Same followed by the Base method whose median value is 0.4 which is lowest. This Comparison of Four Method is statistically significant with the p value of 0.001 (Table 2) (Fig 13).

Table 2: AIR Index Comparison between Four Methods

Index	Method	N	Mean ± SD	Median (IQR)	Range	Mean Rank	Chi square test	p value
Air Index	Wing Method	50	2.36 ± 0.12	2.4(2.2,2.4)	2.2 - 2.6	4	118.824	<0.001
	Base Method	50	0.54 ± 0.38	0.4(0.4,0.6)	0.2 - 1.6	1.2		
	Scaler tip angulation at 45 Degree	50	1.32 ± 0.28	1.4(1.2,1.4)	0.6 - 1.6	2.42		
	Scaler tip angulation at 0 Degree	50	1.38 ± 0.14	1.4(1.2,1.4)	1.2 - 1.6	2.38		

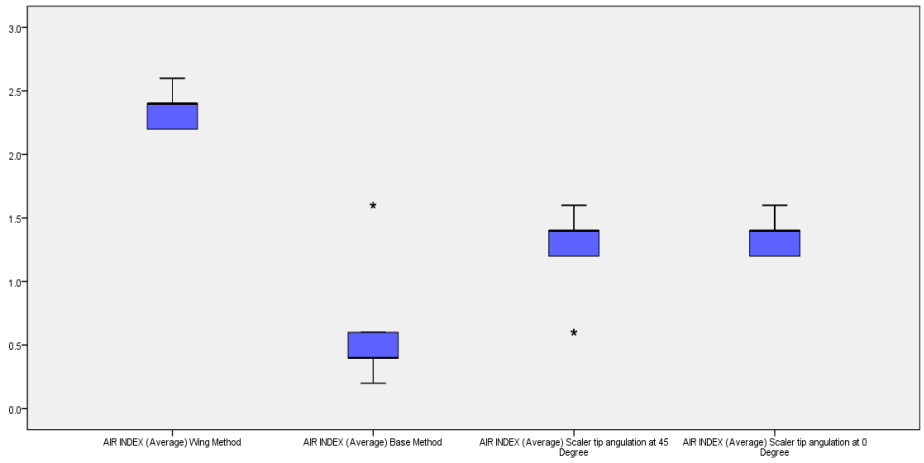

Fig 13: AIR Index Comparison between Four Methods

Posthoc Test For subgroup analysis was used in which The Base Method and Scaler tip angulated at 0, Base Method and Scaler tip angulated 45 and Base method and wing method is significant, Scaler tip angulated 0 and Wing Method and Scaler tip angulated 45 and wing Method are Significant but the Scaler tip angulated 0 and Scaler tip angulated 45 is not significant (Table 3) (Fig 14).

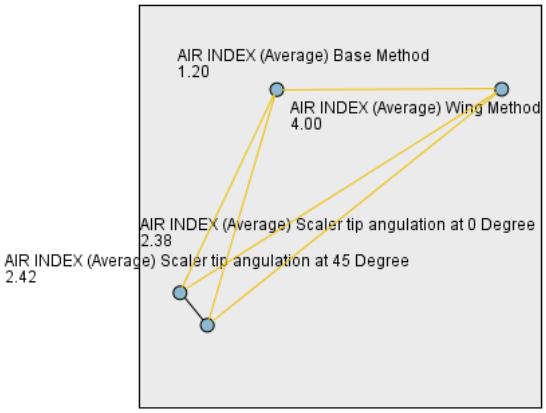

Fig 14: AIR Index Pairwise Comparison

Table 3: AIR Index Subgroup Comparison

Sample1-Sample2	Test Statistics	Std. Error	Std. Test Statistics	Sig.	Adj.Sig.
AIR INDEX Base Method- AIR INDEX Scaler tip Angulated at 0°	-1.180	.258	-4.570	.000	.000
AIR INDEX Base Method- AIR INDEX Scaler tip Angulated at 45°	-1.220	.258	-4.725	.000	.000
AIR INDEX Base Method- AIR INDEX Wing Method	2.800	.258	10.844	.000	.000
AIR INDEX Scaler tip Angulated at 0°- AIR INDEX Scaler tip Angulated at 45°	.040	.258	.155	.877	1.000
AIR INDEX Scaler tip Angulated at 0°- AIR INDEX Wing Method	1.620	.258	6.274	.000	.000
AIR INDEX Scaler tip Angulated at 45°- AIR INDEX Wing Method	1.580	.258	6.119	.000	.000

In Bracket Failure Score, Median Value of Base Method is 4.5, which is highest followed by the median value of Wing Method which is 4. Median value of Scaler-tip angulation at 0° and Scaler-tip angulation at 45° is same which is 1. This Comparison of Four Method is statistically significant with the p value of 0.001 (Table 4) (Fig 15).

Table 4: Bracket Failure Score Comparison between Four Methods

Score	Method	N	Mean ± SD	Median (IQR)	Range	Mean Rank	Chi square test	p value
BRACKET FAILURE SCORE	Wing Method	50	3.8 ± 1.48	4(3,5)	0 - 5	3.3	102.586	**<0.001**
	Base Method	50	3.9 ± 1.53	4.5(3,5)	0 - 5	3.4		
	Scaler tip angulation at 45 Degree	50	1.1 ± 0.71	1(1,2)	0 - 2	1.85		
	Scaler tip angulation at 0 Degree	50	0.7 ± 0.65	1(0,1)	0 - 2	1.45		

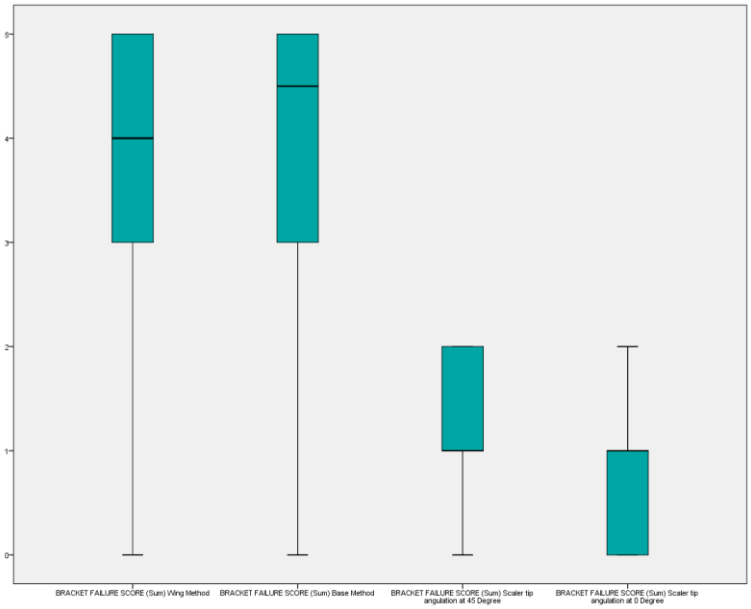

Fig 15: Bracket Failure Score Comparison between Four Methods

Posthoc Test For subgroup analysis was used in which Scaler tip angulated 0 and Wing Method, Scaler tip angulated 0 and Base Method, Scaler tip angulated 45 and Wing Method, Scaler tip angulated 45 and Base

Method are Significant but the Scaler tip angulated 0 and Scaler tip angulated 45 and Wing Method and Base Method are not significant (Table 5) (Fig 16)

Table 5: Bracket Failure Subgroup Comparison

Sample1-Sample2	Test Statistics	Std. Error	Std. Test Statistics	Sig.	Adj.Sig.
BRACKET FAILURE SCORE Scaler tip Angulated at 0°- BRACKET FAILURE SCORE Scaler tip Angulated at 45°	.400	.258	1.549	.121	.728
BRACKET FAILURE SCORE Scaler tip Angulated at 0°- BRACKET FAILURE SCORE Wing Method	1.850	.258	7.165	.000	.000
BRACKET FAILURE SCORE Scaler tip Angulated at 0°- BRACKET FAILURE SCORE Base Method	1.950	.258	7.552	.000	.000
BRACKET FAILURE SCORE Scaler tip Angulated at 45°- BRACKET FAILURE SCORE Wing Method	1.450	.258	5.616	.000	.000
BRACKET FAILURE SCORE Scaler tip Angulated at 45°- BRACKET FAILURE SCORE Base Method	1.550	.258	6.003	.000	.000
BRACKET FAILURE SCORE Wing Method- BRACKET FAILURE SCORE Base Method	-.100	.258	-.387	.699	1.000

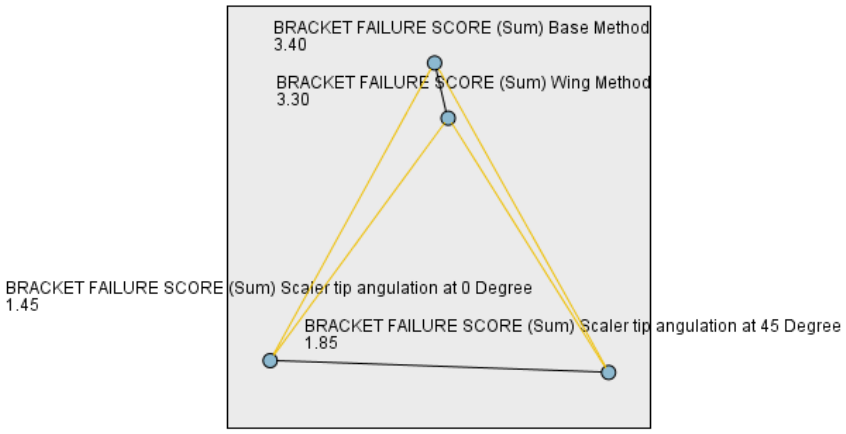

Fig 16: Bracket Failure Score Pairwise Comparison

In Visual Analogue Scale, Median Value of Wing Method and Base Method is 5 which is same and Median value of Scaler-tip angulation at 0° and Scaler-tip angulation at 45° is same which is 2. This Comparison of Four Method is statistically significant with the p value of 0.001 (Table 6) (Fig 17).

Table 6: Visual Analogue Scale Comparison between Four Methods

Scale	Method	N	Mean ± SD	Median (IQR)	Range	Mean Rank	Chi square test	p value
VISUAL ANALOGUE SCALE	Wing Method	50	4.88 ± 1.85	5(4,6.25)	1 - 8	3.45	126.715	**<0.001**
	Base Method	50	4.84 ± 1.79	5(4,6)	1 - 7	3.4		
	Scaler tip angulation at 45 Degree	50	2.4 ± 1.32	2(1,3)	1 - 6	1.66		
	Scaler tip angulation at 0 Degree	50	2.22 ± 1.28	2(1,3)	1 - 5	1.49		

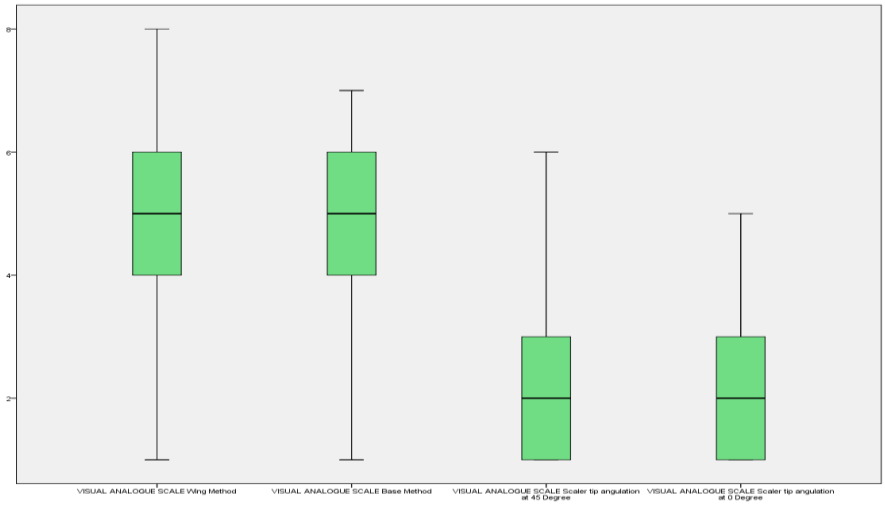

Fig 17: Visual Analogue Scale Comparison between Four Methods

Posthoc Test For subgroup analysis was used in which Scaler tip angulated 0 and Wing Method, Scaler tip angulated 0 and Base Method, Scaler tip angulated 45 and Wing Method, Scaler tip angulated 45 and Base Method are Significant but the Scaler tip angulated 0 and Scaler tip angulated 45 and Wing Method and Base Method are not significant (Table 7) (Fig 18).

Table 7: Visual Analogue Scale Subgroup Comparison

Sample1-Sample2	Test Statistics	Std. Error	Std. Test Statistics	Sig.	Adj.Sig.
VISUAL ANALOGUE SCALE Scaler tip Angulated at 0˚- VISUAL ANALOGUE SCALE Scaler tip Angulated at 45˚	.170	.258	.658	.121	.728
VISUAL ANALOGUE SCALE Scaler tip Angulated at 0˚- VISUAL ANALOGUE SCALE Base Method	1.910	.258	7.397	.000	.000
VISUAL ANALOGUE SCALE Scaler tip Angulated at 0˚- VISUAL ANALOGUE SCALE Wing Method	1.960	.258	7.591	.000	.000
VISUAL ANALOGUE SCALE Scaler tip Angulated at 45˚- VISUAL ANALOGUE SCALE Base Method	1.740	.258	6.739	.000	.000
VISUAL ANALOGUE SCALE Scaler tip Angulated at 45˚- VISUAL ANALOGUE SCALE Wing Method	1.790	.258	6.933	.000	.000
VISUAL ANALOGUE SCALE Base Method - VISUAL ANALOGUE SCALE Wing Method	.050	.258	.194	.699	1.000

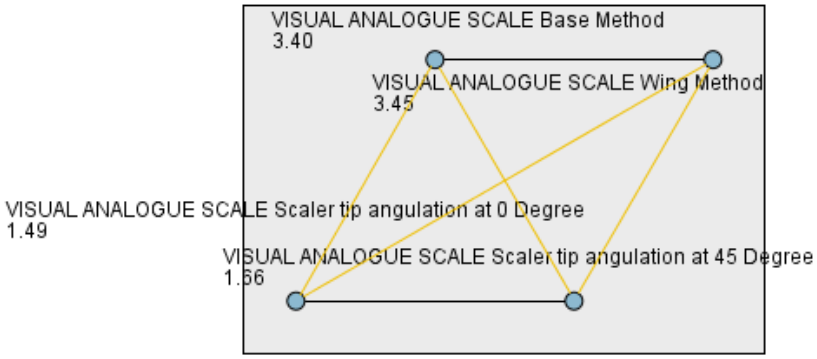

Fig 18: Visual Analogue Scale Pairwise Comparison

4. DISCUSSION

In this study, Four Orthodontic bracket debonding methods were used for Comparative Evaluation in terms of Adhesive Remnants, Pain Perception and Incidence of Bracket Distortion. In AIR Index, Result shows Significant difference in comparing 4 methods in which Base Method showed Lowest AIR Index whereas Wing Method showed Highest AIR Index. In Bracket Failure Score, Base Method showed Highest score followed by Wing Method whereas Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed same score. In Visual Analogue Scale, Wing Method and Base Method showed highest score and Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed lowest score.

According to a study by **Tamar Brosh et al**. [11] the Base Method required a 1.5-fold higher debonding force and strength than the Wing Method. Despite this difference in debonding force, the AIR Scores for both methods were the same. In contrast, the Wing Method showed the highest AIR Index and the Base Method the lowest AIR Index in the current study. According to study conducted by **Argiro Kechagia et al** [13]**,** Different bracket base and adhesive may result in different ARI scores, which can affect the enamel surface during debonding. In study conducted by **Giulio Alessandri Bonetti et al** [12] effects of ultrasonic instrumentation with different scaler-tip angulations (control group, no treatment; 45° -angulation group, ultrasonic instrumentation with a scaler-tip angulation of 45°; 0° -angulation group, ultrasonic instrumentation with a scaler-tip angulation of 0°) on the shear bond strength (SBS) and bond failure mode of metallic orthodontic brackets were evaluated. The result showed that the mean Shear Bond Strength value of the control group was significantly higher than that of the 45° -angulation and 0° -angulation groups. The AIR Score showed non-significant difference. 62.5% of the 45°-angulation group and 66.67% of the control and 0°-angulation groups showed adhesive remnants on the enamel surface. In present study Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed similar AIR score.

A study by **R. G. Oliver et al.** [14] examined the impacts of three distinct techniques (Method A: Using pliers, squeeze the mesial and distal wings of an edgewise twin bracket together. The pliers are used gingivally and occlusally to remove solid brackets. Method B: Using the debonding pliers or ligature cutters with the blades positioned at the enamel-composite or composite-bracket contact, a shear force is applied. Method C: Applying LODI. Through the use of a wire loop looped around the tie wing of an edgewise bracket, this instrument applies a tensile force on the bracket.) of bracket removal on the dimensions of the arch wire slot of the edgewise brackets were examined. It was seen that Gross distortion and microscopic distortion were found for all three methods. All methods produced approximately equal levels of distortion at microscopic level. In present study, the wing method and base method by using debonding plier showed distortion of brackets during debonding.

Janani Jayapal et al [15] conducted a split mouth study to evaluate the pain perception during debonding using low-level vibrational therapy and conventional debonding technique. Study concluded that Low-level vibratory therapy prior to debonding procedure reduces pain level significantly. In present study it is seen that Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed lower VAS Score than compared to Wing Method and Base Method.

5. CONCLUSION

- Base Method showed lowest AIR score indicating less Adhesive remnants on enamel surface after Orthodontics Bracket debonding followed by Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed same score and AIR Score of Wing Method was highest.
- Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed less incidence of bracket distortion compared to wing method and base method
- Scaler-tip angulation at 0° and Scaler-tip angulation at 45° showed reduced pain level compared to Wing Method and Base Method

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