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A comparison between direct and indirect bonding techniques

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Abstract

Objective: The aim of the present study is to compare been direct and indirect bonding techniques in terms of: bracket placement accuracy, bond failure rate, total working time and chair side time, and oral hygiene status.

Methods: A systematic research to examine the articles relevant to this topic was conducted on PubMed databases, which is considered one of the largest databases for medical research. The key words used to conduct the research were; orthodontic bracket, bracket placement, and bracket bonding. While conducting the research, the year, language and type of publication were not restricted.

Results: In terms of bracket placement accuracy, the indirect bonding technique was significantly (P .001) more accurate than the direct technique for all teeth in both labial and lingual orthodontics. Also, indirect bonding is more accurate than direct bonding in terms of vertical, horizontal and angulation. Similarly, indirect bonding technique provides better bracket placement with regard to bracket height than direct bonding ($P < .05$). However, no statistically significant difference was found between these two techniques regarding angulation or mesiodistal position of brackets ($p=0.982$). Considering the total time length, indirect bonding was more time-consuming overall ($p < 0.001$), but the clinical phase was shorter than that required for direct bonding However, there was no statistically significant difference in treatment times between direct and indirect bonding techniques. Additionally, considering the bond failure between the two techniques, there was no difference in bond failure rates between direct and indirect bonding. Also in term of plaque accumulation, between direct and indirect bonding techniques, there was no difference.

Conclusion: orthodontic practitioners can safely use the indirect bonding technique due to its superiority over the direct bonding technique. However, high quality well

designed randomized controlled trials are needed before a conclusive recommendation could be made.

Keywords: Orthodontic bracket, bracket placement, and bracket bonding.

Introduction

The most widely used technique in orthodontic therapy nowadays is the straight wire technique, which was introduced by Andrews [1] in 1972. The basic concept behind the pre-adjusted system is that proper bracket position allows the teeth to be placed with a straight wire into an occlusal contact with a favorable mesiodistal inclination (tip) and faciolingual inclination (torque) [2]. All the information required to position a tooth in three planes is included in the brackets placed at the midpoint of the facial axis of the clinical crown, defined by facial axis point. Dellinger (1978); McLaughlin and Bennett (1995) have shown that the facial axis points between the teeth are not necessarily on the same plane. Therefore, this led to other recommendations for ideal bracket placement. In (1995), McLaughlin and Bennett advocated the positioning of brackets at a measured distance from the incisal edge, with different vertical positions recommended for different sized teeth. Moreover, they thought the use of a bracket placement chart with the use of a Dougherty gauge would dramatically reduce the bracket placement errors in the vertical dimension, with 50–60 percent reduction in the need to reposition brackets. Over the last 40 years, several changes have been made to Andrews' appliance [3,4] with improvements in preadjusted appliances, without the need of bending the arch-wire to achieve the ideal alignment and leveling, but the most important phase is still the bracket placement [1]. The pre-adjusted appliance has provided great benefit to orthodontics with a gradual progression towards finishing, rather than an abrupt stage of wire bending as in the standard edgewise technique (McLaughlin and Bennett, 2003). Good finishing begins at the commencement of treatment with positioning of the brackets. If the brackets are positioned correctly and the tip, torque, and in–out compensations built into the appliance are suited to the patient's dentition, only minimal wire bending will be required (McLaughlin and Bennett, 1991). Angle (1928) recommended that the ideal position to place the bracket should be at the centre of the labial surface of the tooth. Later, placement of the anterior bands at the junction of the middle and incisal thirds has been recommended (Balut et al., 1992). These authors suggest that with the Tweed and Begg techniques the brackets be placed by measuring the distance from the incisal edge for anterior teeth and from the cusp tip for posterior teeth. Regardless of which method is used for positioning brackets, there seems to be some margin of deviation from the ideal location and this is before operator error is taken into account. Unfortunately, even under the best of circumstances, the ideal bracket placement during initial bonding is often impossible because of the existing malocclusion, operator error, or tooth structure variation [4, 5, 6-10]. Horizontal, axis, vertical, and base are the most common bracket placement errors [2, 4, 6-9]. The 'eyeball' bracket position, described by Andrews, cannot be considered reliable and satisfying, as well as, the positioning with the help of a gauge [2, 11, and 12]. Because of bracket placement errors, orthodontists still spend considerable time in detailing to get the proper alignment of crowns and roots and leveling marginal ridges, particularly near the end of the treatment, to compensate them. Misplacement of orthodontic brackets could cause unwanted tooth movement, such as deviations in rotation, tipping, in/out, extrusion/intrusion, and torque [13]. Currently, no placement method, direct or indirect, can guarantee the correct execution of this delicate procedure [6, 7, 14-15].The aim of the present study is to

compare been direct and indirect bonding techniques in terms of: bracket placement accuracy, bond failure rate, total working time and chairside time, and oral hygiene status.

Inclusion and Exclusion Criteria

The number of articles that were found using the key words was huge (7,182), so a filter was used to exclude some of the articles. The articles were filtered to those that included the key words in the title, and there was a total of 255 articles. Then, a number of these articles were selected, based on their relevance and the availability of a full text, which included 90 articles. Finally, articles that were not indexed were excluded, and Thomson ISI Journal and SCOPUS websites were used to check the impact factor of the articles' journals. The final number of included articles after the exclusion process was 25 articles.

Results

Results of bracket placement accuracy: In a study done by Shpack et al [16], using 20 models of orthodontic subjects were selected. Subjects were divided into four groups according to the location of the bonded orthodontic appliance (labial/lingual) and technique of bonding (direct/indirect); labial direct (LbD), labial indirect (LbI), lingual direct (LgD), and lingual indirect. The indirect bonding technique was significantly (P .001) more accurate than the direct technique for all teeth in both labial and lingual orthodontics. Another study done by Agarwal et al [17], showed there was a statistical difference between mean bracket placement errors for direct and indirect methods. Indirect bonding is more accurate than direct bonding in terms of vertical, horizontal and angulation. Similarly, an in vitro study reported indirect bonding technique provides better bracket placement with regard to bracket height than direct bonding (P < .05). However, no statistically significant difference was found between these two techniques regarding angulation or mesiodistal position of brackets [18]. In contrast, a study done by Aguirre et al [19], found no statistically significant differences in vertical bracket placement between direct and indirect techniques. The only exceptions were the maxillary canines, where the indirect technique showed better results (P < 0.05) and the mandibular second premolars where the direct-bonded brackets were placed closer to ideal (P < 0.01). Likewise, a randomized clinical trial conducted by Hodge et al [20], reported there was no difference in the overall accuracy of bracket placement between direct and indirect bonding.

Results of bond failure

Regarding the bond failure, a study conducted by Thiyagarajah et al [27]; where 33 subjects fit their inclusion criteria and were divided into two groups with the difference between them in the location of the two-bonding technique among the four quadrants of the dentition. In other words, group 1 received the indirect technique in the upper right and lower left quadrants whereas the upper left and the lower right received the direct technique and vice versa for group 2. In terms of bond failure rate, there was no significant difference. Furthermore, in a study done by Menini et al [28]; where a total of 52 patients were divided into two groups according to the technique used. And it concluded that there was no significant difference between direct and indirect technique as well as between the upper and lower jaws. Another a study done by Bozelli et al [29]; where a total of 17 patients divided into two groups according to the technique used, and it showed no significant difference in bond failure frequency. Moreover, in a study done by Thomas Deahl et al [30]; where 772 patients used direct bonding technique and 596 patients used indirect bonding technique, with a total of 29,963 brackets examined. It

showed that there was no significant difference in the failure rate between direct and indirect bonding technique. On a meta-analysis study [31], there was no significant difference between direct and indirect bonding technique regarding the rate of bond failure. In a parallel, a randomized clinical trial study [32] where 30 patients were divided into two groups based on direct or indirect bonding technique. There was no significant difference between the two techniques in regard to bond failure. However, one study by Vijayakumar et al [33]; where 30 patients divided into two groups by using split-mouth study design. Group A were bonded with direct technique for maxillary right and mandibular left quadrants and indirect technique for maxillary left and mandibular right, whereas group B had direct technique for maxillary left and mandibular right and indirect for maxillary right and mandibular left. It showed that there was an overall more bond failure for the direct bonding technique, also posterior brackets exhibited more failure with the direct bonding technique.

Result of total working time and chairside time

A study done by Yildirim et al [21], showed indirect bonding was more time-consuming overall, but the clinical phase was shorter than that required for direct bonding. However, there was no statistically significant difference in treatment times between direct and indirect bonding techniques. Furthermore, a study conducted by Deahl et al [22], reported that the total visits per patient did not differ between direct and indirect bonding. Similarly, another study done by Bozelli et al [23], demonstrated that the total working time for indirect technique was significantly longer than that with direct technique. However, regarding the clinical phase, it revealed that the indirect technique was significantly less time-consuming than the direct one; which comes in agreement with other studies [24, 25, and 26].

Results of oral hygiene

In a study by Dalessandri et al [34], with a total of 30 patients were bonded using split-mouth approach; where indirect technique showed significant amount of plaque reduction around the brackets compared to the direct technique. However, a randomized clinical trial study [32]; where 30 patients divided into two groups based on direct or indirect bonding technique, showed similar rates of plaque accumulation.

Discussion

In terms of bracket placement accuracy: A study conducted by Shpack et al [16], summarized that all teeth in both labial and lingual orthodontics using indirect bonding technique was (twofold) more accurate than the direct technique. No statistical difference was found between the labial and lingual systems for each direct and indirect technique. In study done by Armestong et al [36], found that mean bracket placement errors for direct and indirect technique was significant, and indirect bonding was more accurate than direct bonding in following aspects: vertical, horizontal and in angulation, and the magnitudes of the findings are of clinical relevance. In addition, in a study conducted by Koo et al [38], the found that the mean error for bracket positioning in mesiodistal measurement was more accurate, on selected teeth, in the indirect bonding group than the direct bonding group. This might be due to better access and visibility offered by indirect bonding technique over the direct bonding technique.

In terms of bond failure

Thiyagarajahet al [27], reported that brackets were lost from 14 out of 553 teeth bonded, giving the totally bond failure rate of 14% for indirect bonding and 2.5% for the direct method. However, there were no statistically significant differences in bond failures between direct and indirect bonding. Moreover both studies by Yi GK et al

[43] and Pasquale et al. [41], concluded that there was no significant difference between the two techniques in terms of bond failures rates.

In terms of total working time and chair side time

A study of Yildirim et al [21], concluded that there was no difference in time consuming in terms of direct and indirect bonding techniques. Additionally a practice-based study done by Deahl [22], found no difference between the two techniques and the total treatment times and numbers of appointments was the same between the both techniques. In contrast, a study done by Bozelli et al [23], reported the total time spent with the indirect bonding technique was longer than that with the direct bonding approach. But, the time spent for positioning of the brackets in terms of laboratory and clinical insertion with the indirect bonding was equivalent to time with direct bonding; which justifies the advantages of the indirect bonding technique in comparison to the direct bonding procedure. However, in terms of the clinical steps, the direct bonding approach tooth less time than indirect bonding.

Summary and conclusion

The advantages of indirect bonding in comparison to direct bonding are numerous, and can be summarized as the following:

The indirect bonding technique was significantly more accurate than the direct

- Technique for all teeth in both labial and lingual orthodontics.
- Indirect bonding is more accurate than direct bonding in terms of vertical, horizontal and angulation.
- There was no difference in bond failure rates between direct and indirect bonding.
- The indirect bonding might require less chair side time but more total working time in comparison with the direct bonding technique.
- There was no difference in terms of plaque accumulation between direct and indirect bonding.

To conclude, orthodontic practitioners can safely use the indirect bonding technique due to its superiority over the direct bonding technique. However, high quality well designed randomized controlled trials are needed before a conclusive recommendation could be made.

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