BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 12

DOI:10.58240/1829006X-2025.21.12-232

ORIGINAL RESEARCH

COMPARATIVE ASSESSMENT OF THE EFFICACY OF TWO TECHNIQUES OF INDIRECT BRACKET POSITIONING ON TREATMENT OUTCOME IN EXTRACTION CASES OF CLASS I MALOCCLUSION

Wessam M. Abdelrazek[1], Hanady M. Samih[1], Waleed R. El Nagar[1]

[1]Department of Orthodontics, Faculty of Dentistry, Suez Canal University

Corresponding author: Wessam M. Abdelrazek **Email:** wessam.abdelrazek@hotmail.com **Mobile:** +201006245885

Received: Nov 29. 2025; **Accepted:** Dec 27. 2025; **Published:** Dec. 30, 2025

Abstract

Background: Accurate bracket positioning is crucial in orthodontics to achieve desired tooth movement. Two primary techniques exist: direct bonding, where brackets are attached directly to teeth, and indirect bonding, which utilizes a transfer tray. There is limited evidence comparing the clinical efficacy of conventional indirect bonding (CIB) versus digital indirect bonding (DIB), particularly in Class I malocclusion cases requiring extraction treatments.

Aim: To compare the efficacy of CIB and DIB in patients with Class I malocclusion undergoing extraction orthodontic treatment.

Methods: In a randomized controlled trial, 28 patients with Class I malocclusion scheduled for extraction orthodontic treatment were randomly assigned to either the CIB or DIB group. Both groups underwent initial impressions to create plaster models. In the CIB group, brackets were positioned on the plaster models and transferred to the teeth using a vacuum-formed transfer tray. In the DIB group, plaster models were scanned to create 3D digital models, and brackets were positioned and transferred using a 3D-printed tray. Baseline assessments included the discrepancy index, and treatment outcomes were evaluated using the Objective Grading System (OGS).

Results: The CIB and DIB groups were comparable in terms of median age (20 vs. 21, P=1.000) and gender distribution (71.4% vs. 57.1% male, P=0.695). Baseline discrepancy index scores were similar between groups (22 vs. 30, P=0.653). There was no significant difference in median total OGS scores between the CIB and DIB groups (14 vs. 12, P=1.000).

Conclusion: Both conventional and digital indirect bonding techniques are effective for bracket positioning in the extraction orthodontic treatment of patients with Class I malocclusion**.**

Keywords: extraction orthodontic treatment, Class I malocclusion, indirect bracket positioning, conventional indirect bonding, digital indirect bonding

INTRODUCTION

Orthodontics aims to achieve optimal functional occlusion, facial harmony, and long-term stability while enhancing aesthetics and supporting overall oral health; this is achieved through positioning the teeth into the best functional balance.

To reach that, Orthodontists continually look for new products and procedures that can simplify their practice, increase clinical effectiveness, and improve patient experience. By far the most commonly used appliance in fixed orthodontic treatment is the orthodontic brackets1.

From the advent of pre-adjusted edgewise appliances, researchers and clinicians have focused on improving the efficiency of aligning malpositioned teeth with minimal wire bending. Pre-adjusted edgewise appliances have provided orthodontists the ability to achieve a gradual progression towards finishing, rather than an abrupt stage of wire bending as in the standard edgewise technique[2].

The use of pre-adjusted bracket systems is based on the concept that ideal bracket placement will correct tooth positions in all the three planes of space during treatment with placement of straight archwires. As regards efficient finishing, ideal bracket placement from the onset of treatment should be the goal for every practicing orthodontist[3].

There are numerous techniques regarding the bonding of the brackets, including direct and indirect bonding techniques. Indirect bonding method became very popular after it was first described by Silverman and Cohen in 1972[4].

There are various techniques of indirect bonding, according to bracket base preparation (standard or customized), transfer mask type (single jigs or full arch) and transfer tray material (acrylic resin, silicone, thermo-printed material)[5-7].

In terms of utilization, Gorelick reported that only 17 percent of orthodontists used indirect bonding in their practice. Although the technique of indirect bonding has become more accepted in recent years due to advances in materials and development of new techniques, the majority of orthodontists still utilize the direct bonding method[8].

The uncertainties inherent in the transfer could present a problem for clinicians using the indirect method because bracket positioning has a direct influence on both the magnitude and direction of tooth movement. Improperly positioned brackets lead to inefficiencies in initial bracket leveling, alignment and, ultimately, longer treatment times. This is especially true when the clinician assumes that each bracket has been transferred precisely as originally placed on the stone or digital models. When the clinician later recognizes malpositioned brackets, they must either be repositioned or archwire adjustments need to be made, which often negate the efficiencies gained by bonding indirectly at the onset of treatment [7-9].

The evolution of imaging techniques has opened new horizons for both diagnosis and treatment. Recent imaging techniques have allowed complete visualization of the tissues in 3 dimensions[10]. Cone-beam computed tomography (CBCT) has proven to have great diagnostic value, with the ability to produce accurate images of the patient's soft and hard tissues [10–12].

Recently, computer-aided design and computer- aided manufacturing (CAD/CAM) systems have been used for indirect bonding. This process involves designing a virtual model in a CAD/CAM program to produce a transfer jig. The CAD/CAM transfer jig facilitates bonding of the bracket to the target tooth[13-15]. For instance, 3-dimensional (3-D) modeling of the maxilla and the mandible has been used for the ideal setup and the rapid production of prototype transfer jigs. These would, subsequently, be involved in the transfer of brackets with individualized custom resin bases.

Over the years, several in-vitro and in-vivo studies have compared direct and indirect bonding techniques.

To the best of our knowledge, no studies compared the digitally positioned brackets to the conventionally manual indirect bonding technique. Thus, it seems important to compare the effect of digital and conventional indirect bonding techniques on the outcome of orthodontic treatment. Studying the clinical variables, which are affected by these different bonding techniques in orthodontic treatment, might help clinicians choose the best method for bracket bonding.

The present work will therefore aim to compare efficiency of bracket positioning in extraction orthodontic treatment of Class I malocclusion patients with two techniques of indirect bonding.

METHODS

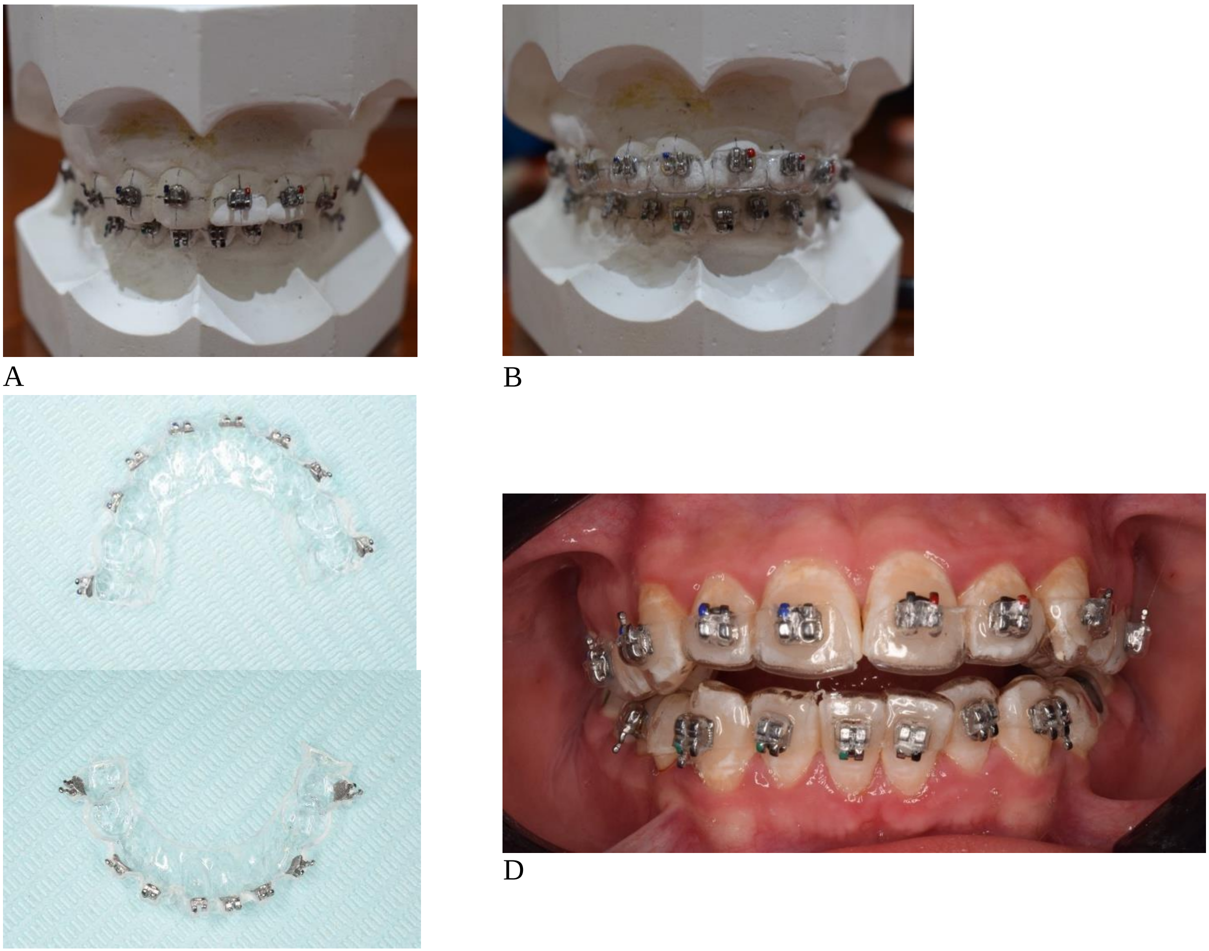
This was an interventional prospective randomized controlled study. A total of 28 patients with Class I malocclusion who were scheduled for extraction orthodontic treatment were included. The patients were randomly assigned to receive either CIB or DIB.

Before commencing the study, the approval of the Research Ethics Committee (REC) of the faculty of Dentistry, Suez Canal University was obtained, and a written informed consent was signed by all the included subjects.

No prior studies have compared OGS outcomes between these specific digital and conventional indirect bonding techniques. Therefore, an a priori sample size calculation was conducted using variability estimates from a previous study evaluating OGS scores [16]. Based on a standard deviation of approximately 2.5, a significance level (α) of 0.05, and a power of 80%, it was determined that 14 subjects per group (28 total) were required to detect a clinically significant difference.

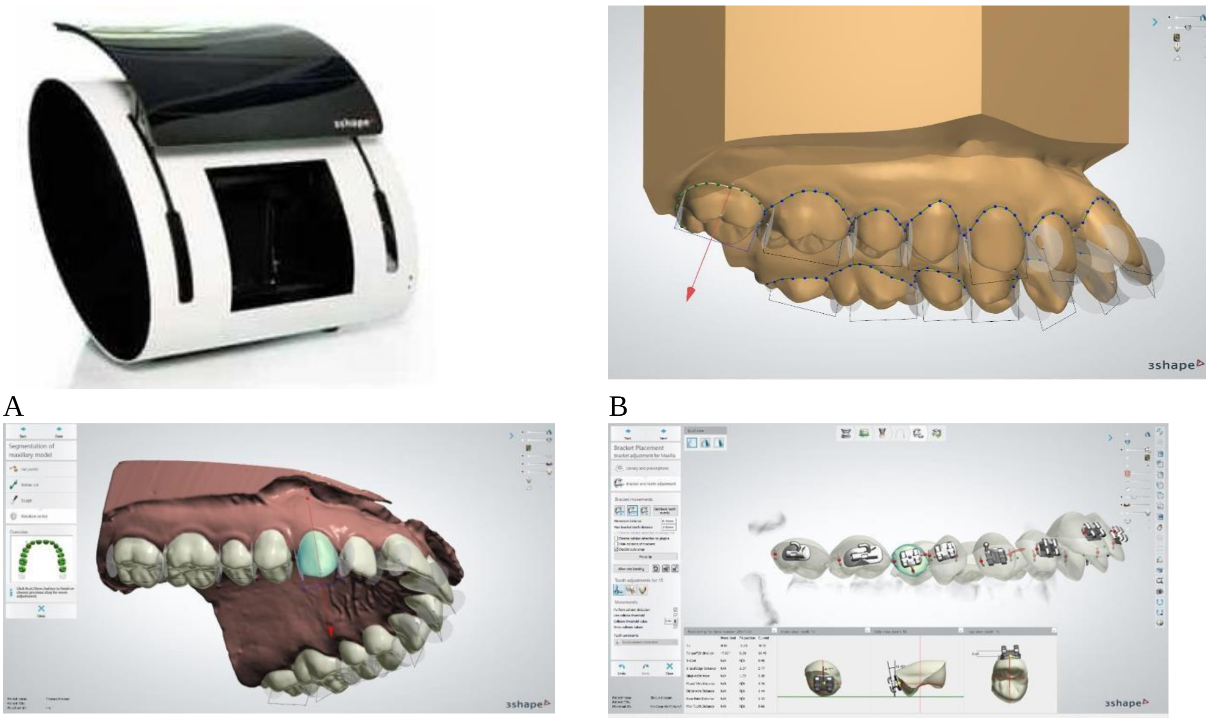
Patients were included in the study if they fulfilled the following criteria: age between 18 and 40 years, with permanent dentition (excluding third molars), bilateral Angle's Class I molar relationships, without skeletal discrepancy or history of previous orthodontic treatment.

Impressions of the patient's teeth were obtained and used to create plaster models in both groups. In the CIB group, the brackets were then positioned on the plaster models and transferred to the patient's teeth using 1 mm vacuum formed transfer tray as shown in **Figure 1**. In the DIB group, digital scans of the plaster models were scanned using a laboratory scanner 3Shape R500 to create 3D digital models. The brackets were then positioned virtually on the 3D models using 3Shape OrthoAnalyzer, and transferred to the patient's teeth using a 3D-printed transfer tray with biocompatible resin, as shown in **Figure 2**. Treatment outcomes were assessed using the Objective Grading System (OGS) on post-bonding dental casts. The assessed OGS parameters included alignment, marginal ridges, buccolingual inclination, occlusal contacts, occlusal relationships, overjet, interproximal contacts, and root angulation[17].



A B C D

Figure 1. Conventional indirect bonding technique: positioning of the brackets on dental cast according to positioning guidelines; B, transfer tray formation; C, transfer tray; D, intra-oral view of indirect bonding.



A B C D

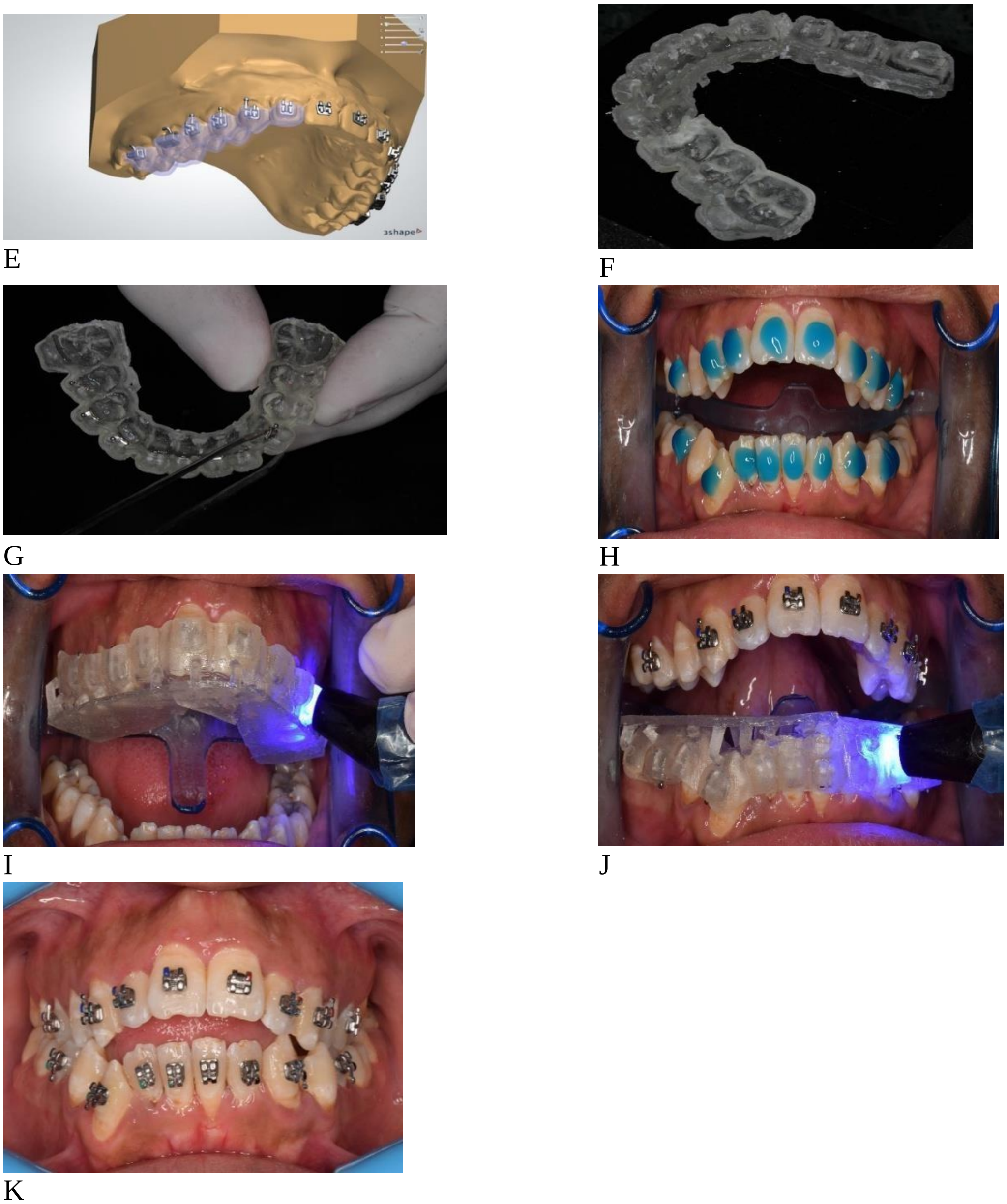


Figure 2. Digital indirect bonding technique: A, Lab scanner 3Shape R500; 3Shape OrthoAnalyzer software defining the gingival margins (B), long axes (C); D, bracket adjustment on software; E, Constructed virtual transfer tray ready for printing; F, transfer tray; G, loading the brackets; H, intra-oral teeth etching; transfer trays installed in patient’s upper (I) and lower (J) arches; K, intra-oral brackets after removal of trays.

Fixed appliances consisted of 0.022-inch slot brackets with an MBT prescription (Rocky Mountain Orthodontics, Denver, CO, USA). To minimize bias, all patients were bonded by a single operator to ensure consistency, the OGS scores were evaluated by an independent examiner blinded to the group allocation. Data were analyzed using the IBM SPSS Statistics for Macintosh, Version 26.0 (IBM Corp, Armonk, NY, USA). Qualitative data were presented as frequency and percentage, while qualitative data were presented as median and interquartile range (IQR). The non-parametric Mann-Whitney U test (Wilcoxon rank-sum test) was used to compare the distributions of the studied variable between the conventional and digital groups. The association between categorical variables was assessed using the chi-square test. The Fisher’s exact test was used if any of the observed or expected values is less than 5. A two-sided P (probability) value less than 0.05 was considered significant in all analyses.

RESULTS

The results of this study highlight the comparative effectiveness of CIB) and DIB techniques in orthodontic treatment, specifically focusing on key treatment outcomes assessed using the OGS.

Demographic and Baseline Characteristics

The study included 28 patients diagnosed with Class I malocclusion, randomly assigned to either the CIB or DIB group. The demographic characteristics were well-balanced between the two groups, with median ages of 20 years (CIB) and 21 years (DIB), showing no statistically significant difference (P=1.000). Gender distribution was also comparable, with males comprising 71.4% of the CIB group and 57.1% of the DIB group (P=0.695). Baseline discrepancy index scores, which reflect the initial complexity of malocclusion, were similar between the groups, with median scores of 22 for CIB and 30 for DIB (P=0.653) **(Table 1)**.

Table 1. Comparison of baseline and outcome characteristics between the studied groups

	Conventional	Digital	P
Males*	10 (71.4)	8 (57.1)	0.695
Age	20 (3.5)	21 (4)	1.000
Discrepancy index	22 (5.5)	30 (15.5)	0.653
OGS			
Alignment	2 (1.5)	2 (1.5)	0.462
Marginal ridge	2 (2.5)	2 (1)	1.000
Buccolingual inclination	2 (1.5)	2 (1)	0.192
Occlusal contacts	3 (2)	2 (0)	0.266
Occlusal relationship	0 (1)	0 (0.5)	1.000
Overjet	2 (1.5)	2 (2)	1.000
Interproximal contacts	0 (1)	0 (0.5)	1.000
Root angulation	1 (1)	2 (1)	0.266
Total OGS	14 (6.5)	12 (3)	1.000

*Data are presented as number and (percentage), while other data are median and (interquartile range).

Objective Grading System (OGS) Scores

The primary outcome measure, the total OGS score, was used to evaluate the effectiveness of both bonding techniques in achieving desirable orthodontic results. The median total OGS score was 14 for the CIB group and 12 for the DIB group, with no statistically significant difference observed between the two (P=1.000) **(Table 1, Figure 3)**. This suggests that both techniques are equally effective in achieving high-quality orthodontic outcomes.

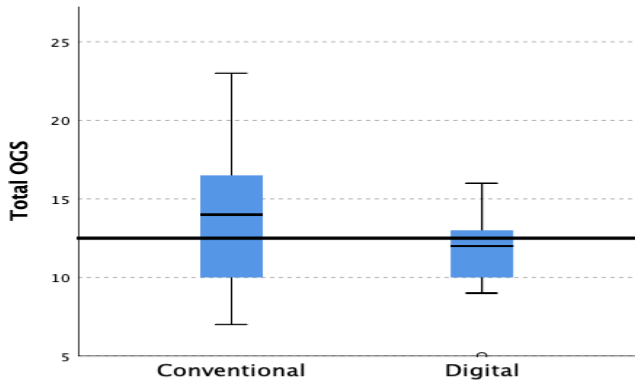


Figure 3. Total OGS in conventional and digital indirect bonding group

Component Analysis of OGS Scores

To gain deeper insights into the performance of CIB and DIB, we analyzed the individual components of the OGS as detailed in **Table 2**. The following sections discuss the results for each component.

Table 2. Outcome assessment of orthodontic treatment in the studied groups using the Objective Grading System

	Conventional	Digital	P
Alignment	2 (1.5)	2 (1.5)	0.462
Marginal ridge	2 (2.5)	2 (1)	1.000
Buccolingual inclination	2 (1.5)	2 (1)	0.192
Occlusal contacts	3 (2)	2 (0)	0.266
Occlusal relationship	0 (1)	0 (0.5)	1.000
Overjet	2 (1.5)	2 (2)	1.000
Interproximal contacts	0 (1)	0 (0.5)	1.000
Root angulation	1 (1)	2 (1)	0.266
Total OGS	14 (6.5)	12 (3)	1.000

Data are median and (interquartile range).

1. **Alignment**: Both groups achieved similar outcomes in terms of alignment, with median scores of 2 for both CIB and DIB groups (P=0.462).
2. **Marginal Ridge**: Both techniques demonstrated similar effectiveness regarding the marginal ridge scores were also comparable, with median values of 2 for both groups (P=1.000).
3. **Buccolingual Inclination**: Buccolingual inclination, which assesses the angular position of the teeth in the buccolingual direction, showed no significant difference between the groups, with median scores of 2 for both (P=0.192).
4. **Occlusal Contacts**: The occlusal contact scores, which evaluate the precision of tooth contacts in the occlusal plane, were slightly better in the DIB group (median score of 2) compared to the CIB group (median score of 3), though this difference was not statistically significant (P=0.266).
5. **Occlusal Relationship**: Both groups achieved near-perfect occlusal relationships, with median scores of 0 in both groups (P=1.000).
6. **Overjet**: The overjet, which measures the horizontal overlap of the front teeth, showed identical outcomes in both groups, with median scores of 2 (P=1.000).
7. **Interproximal Contacts**: The integrity of interproximal contacts was well-maintained in both groups, with median scores of 0, indicating no gaps or discrepancies between teeth (P=1.000).
8. **Root Angulation**: Lastly, the root angulation scores, which assess the positioning of the tooth roots, were similar between the groups, with a median score of 1 for CIB and 2 for DIB (P=0.266).

DISCUSSION

Currently, the accuracy of bracket bonding is a key and difficult component to achieve successful and efficient orthodontic treatment outcomes. To achieve more exact and precise bracket insertion, the indirect bonding process has been devised. Indirect bonding has been researched over time to strengthen the bonding of fixed orthodontic equipment[18].

The indirect bonding procedure was developed to achieve more exact and precise bracket insertion. Over time, indirect bonding has been studied to improve the accuracy of the bonding of fixed orthodontic appliance[18].

Digital technology has, as is widely known, invaded all elements of orthodontics, including diagnostic tools, treatment planning, appliance production, and 3D printing; Botsford et al. asserted that intraoral scanning-based software and virtual 3D occlusal records in biting registration provided clinically adequate precision when obtaining contact size and location[19].

Furthermore, developments in digital technology have enabled the combination of tomographic scan data with digital models to visualize tooth roots in scanned casts and enable correct bracket location[20]. Digital process combining intraoral scanners and CAD-CAM software enabled virtual setup, printing of 3D models, and digital transfer trays for indirect bonding[21,22].

To our knowledge, no studies have directly compared digitally positioned indirect bonding to conventional manual bonding. Examining the clinical outcomes of these techniques could guide clinicians in choosing the best bracket bonding method.

Regarding demographic data, there was comparable data between both groups for gender and age. All patients in each group were treated by the same operator using the same kind of brackets and the same treatment protocol.

Wessam M. Abdelrazek, Hanady M. Samih, Waleed R. El Nagar Comparative Assessment of the Efficacy of Two Techniques of Indirect Bracket Positioning on Treatment Outcome in Extraction Cases of Class I Malocclusion.Bulletin of Stomatology and Maxillofacial Surgery. 2025;21(12) 232-239
doi:10.58240/1829006X-2025.21.12-232

This allowed us to maintain consistency while determining the effects of these bonding methods in orthodontic treatment.

Both techniques have demonstrated their effectiveness in achieving desirable clinical outcomes, as evidenced by comparable OGS scores across key parameters such as alignment, marginal ridges, and occlusal relationships. According to the ABO's standard, a total OGS score of less than 20 points indicated a successful orthodontic treatment[17]. In this study, the median OGS scores were 14 for the CIB group and 12 for the DIB group, with no statistically significant difference ($P > 0.05$), both comfortably below the threshold of 20. This is consistent with the findings of Yıldırım and Saglam-Aydinatay, who compared direct and indirect bonding techniques in non-extraction orthodontic treatment for Class I malocclusion patients, reporting median OGS scores of 14 for indirect bonding and 17 for direct bonding[23].

Based on our data and the findings of Yıldırım and Saglam-Aydinatay[23], successful clinical outcomes were achieved with both techniques. However, patients who underwent indirect bonding had lower total OGS scores due to lower marginal ridge scores, which were linked to better treatment outcomes. In our study, there was no statistically significant difference in marginal ridge scores between the two indirect techniques, with both groups having a median score of 2. This aligns with the findings of Soares Ueno et al., who reported no significant difference between conventional and digital indirect bonding techniques regarding marginal ridge scores, with both methods scoring 1.4[24]. This is also consistent with Yıldırım and Saglam-Aydinatay[23], where the indirect bonding group also had a marginal ridge score of 2.

This suggests that the indirect bonding technique is more effective in leveling the marginal ridges, which is crucial for achieving proper occlusal contacts and maintaining a flat bone level between adjacent teeth in periodontally healthy patients[17]. The low marginal ridge scores observed in both techniques in our study may indicate better vertical positioning of brackets with the indirect bonding technique. The vertical height of brackets is key to determining marginal ridge levels and contact points, and correct vertical positioning promotes appropriate occlusal contacts[2].

In line with our study findings, Brown et al. compared the clinical effectiveness and efficiency of CAD/CAM customized orthodontic appliances with direct and indirect bonded stock brackets [25]. The study included three treatment groups: group 1 with direct-bonded self-ligating appliances, group 2 with indirect-bonded self-ligating appliances, and group 3 with CAD/CAM indirect-bonded self-ligating appliances. The study found no statistically significant differences in the discrepancy index or ABO Cast-Radiograph Evaluation across the groups.

Theoretically, indirect bonding could reduce the need for compensatory archwire bends and repositioning of brackets by increasing accuracy in bracket positioning.

The comparable outcomes across multiple OGS components suggest that both CIB and DIB are versatile and reliable options. For practices with access to advanced digital tools, DIB offers advantages in integration with other digital workflows, potentially enhancing precision, overall treatment efficiency and patient experience.

While the findings of this study are robust, it is important to acknowledge certain limitations. The single-center design and relatively small sample size may limit the generalizability of the results. However, the strict selection criteria (extraction cases only) and standardization (single operator) reduced confounding variables.

Future research should focus on multi-center trials with larger cohorts to validate these findings and explore the long-term outcomes of CIB and DIB techniques.

Additionally, exploring patient-centered outcomes, such as comfort, satisfaction, and overall treatment experience, could provide valuable insights into the practical benefits of digital orthodontics. Investigating the cost-effectiveness of digital versus conventional methods would also be beneficial for clinicians considering the adoption of new technologies.

CONCLUSION

In summary, both conventional and digital indirect bonding are effective in achieving accurate bracket positioning and desirable orthodontic outcomes in extraction cases of Class I malocclusion.

DECLARATIOM

Conflict of Interest
None to declare.
Funding
None to declare.

REFERENCES

1. Murakami T, Kawanabe N, Kataoka T, Hoshijima M, Komori H, Fujisawa A, Kamioka H: A Single-center, Open-label, Randomized Controlled Clinical Trial to Evaluate the Efficacy and Safety of the Indirect Bonding Technique. Acta Med Okayama. 2016, 70:413–6. 10.18926/AMO/54604

2. McLaughlin RP, Bennett JC: Finishing with the preadjusted orthodontic appliance. Semin Orthod. 2003, 9:165–83. 10.1016/S1073-8746(03)00034-3
3. Shpack N, Geron S, Floris I, Davidovitch M, Brosh T, Vardimon AD: Bracket placement in lingual vs labial systems and direct vs indirect bonding. Angle Orthod. 2007, 77:509–17. 10.2319/0003-3219(2007)077%5B0509:BPILVL%5D2.0.CO;2
4. Silverman E, Cohen M, Gianelly AA, Dietz VS: A universal direct bonding system for both metal and plastic brackets. Am J Orthod. 1972, 62:236–44. 10.1016/s0002-9416(72)90264-3
5. Zachrisson BU, Brobakken BO: Clinical comparison of direct versus indirect bonding with different bracket types and adhesives. Am J Orthod. 1978, 74:62–78. 10.1016/0002-9416(78)90046-5
6. Dalessandri D, Dalessandri M, Bonetti S, Visconti L, Paganelli C: Effectiveness of an indirect bonding technique in reducing plaque accumulation around braces. Angle Orthod. 2012, 82:313–8. 10.2319/041811-273.1
7. Aguirre MJ, King GJ, Waldron JM: Assessment of bracket placement and bond strength when comparing direct bonding to indirect bonding techniques. Am J Orthod. 1982, 82:269–76. 10.1016/0002-9416(82)90461-4
8. Gorelick L, Masunaga GM, Thomas RG, Zachrisson BU: Round table: bonding. Part 3. J Clin Orthod JCO. 1978, 12:825–37, 840–2.
9. Kalange JT: Indirect bonding: a comprehensive review of the advantages. World J Orthod. 2004, 5:301–7.
10. El-Zanaty HM, El-Beialy AR, Abou El-Ezz AM, Attia KH, El-Bialy AR, Mostafa YA: Three-dimensional dental measurements: An alternative to plaster models. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2010, 137:259–65. 10.1016/j.ajodo.2008.04.030
11. Tong H, Enciso R, Van Elslande D, Major PW, Sameshima GT: A new method to measure mesiodistal angulation and faciolingual inclination of each whole tooth with volumetric cone-beam computed tomography images. Am J Orthod Dentofacial Orthop. 2012, 142:133–43. 10.1016/j.ajodo.2011.12.027
12. Cevidanes LHS, Styner MA, Proffit WR: Image analysis and superimposition of 3-dimensional cone-beam computed tomography models. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2006, 129:611–8. 10.1016/j.ajodo.2005.12.008
13. Redmond WJ, Redmond MJ, Redmond WR: The OrthoCAD bracket placement solution. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2004, 125:645–6.
14. Garino F, Garino GB: Computer-aided interactive indirect bonding.ProgOrthod.2005,6:214–23.
15. Mayhew MJ: Computer-aided bracket placement for indirect bonding. J Clin Orthod JCO. 2005, 39:653–60.
16. Jain M, Varghese J, Mascarenhas R, Mogra S, Shetty S, Dhakar N: Assessment of clinical outcomes of Roth and MBT bracket prescription using the American Board of Orthodontics Objective Grading System. Contemp Clin Dent. 2013, 4:307–12. 10.4103/0976-237X.118352
17. Casko JS, Vaden JL, Kokich VG, et al.: Objective grading system for dental casts and panoramic radiographs. American Board of Orthodontics. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 1998, 114:589–99. 10.1016/s0889-5406(98)70179-9
18. Eissa T, Rifai W, El-Shal M, Ibrahim M: Dependability Of A Digital Indirect Bonding Approach Using E-models And Two Transfer Trays. Egypt Orthod J. 2022, 62:94–112. 10.21608/eos.2022.146611.1051
19. Botsford KP, Frazier MC, Ghoneima AAM, Utreja A, Bhamidipalli SS, Stewart KT: Precision of the virtual occlusal record. Angle Orthod. 2019, 89:751–7. 10.2319/092018-684.1
20. Israel M, Kusnoto B, Evans CA, Begole E: A comparison of traditional and computer-aided bracket placement methods. Angle Orthod. 2011, 81:828–35. 10.2319/072110-425.1
21. Camardella LT, Rothier EKC, Vilella OV, Ongkosuwito EM, Breuning KH: Virtual setup: application in orthodontic practice. J Orofac Orthop Fortschritte Kieferorthopadie OrganOfficial J Dtsch Ges Kieferorthopadie. 2016, 77:409–19.
22. Müller-Hartwich R, Jost-Brinkmann P-G, Schubert K: Precision of implementing virtual setups for orthodontic treatment using CAD/CAM-fabricated custom archwires. J Orofac Orthop Fortschritte Kieferorthopädie. 2016, 77:1–8.
23. Yıldırım K, Saglam-Aydinatay B: Comparative assessment of treatment efficacy and adverse effects during nonextraction orthodontic treatment of Class I malocclusion patients with direct and indirect bonding: A parallel randomized clinical trial. Am J Orthod Dentofacial Orthop. 2018, 154:26-34.e1. 10.1016/j.ajodo.2017.12.009
24. Soares Ueno EP, De Carvalho TCADSG, Kanashiro LK, Ursi W, Chilvarquer I, Neto JR, De Paiva JB: Evaluation of the accuracy of digital indirect bonding vs. conventional systems: a randomized clinical trial. Angle Orthod. 2025, 95:3–11. 10.2319/030624-179.1
25. Brown MW, Koroluk L, Ko C-C, Zhang K, Chen M, Nguyen T: Effectiveness and efficiency of a CAD/CAM orthodontic bracket system. Am J Orthod Dentofacial Orthop. 2015, 148:1067–74.

Wessam M. Abdelrazek, Hanady M. Samih, Waleed R. El Nagar Comparative Assessment of the Efficacy of Two Techniques of Indirect Bracket Positioning on Treatment Outcome in Extraction Cases of Class I Malocclusion . Bulletin of Stomatology and Maxillofacial Surgery. 2025;21(12)232-239 doi:10.58240/1829006X-2025.21.12-232