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ORIGINAL ARTICLE

Comparative Study of Self-Ligating Brackets and Conventional Brackets in Treatment Duration. A Clinical Study

FARYAL ALI SYED[1], JUNAID TARIQ[2], AYESHA YASIR[3], SAMINA QADIR[4], AHMAD SHAMIM QURESHI[5], BEENISH ELAHEE RIZVI[6]
[1]*Assistant Professor, Department of Orthodontics, Baqai Dental College, Karachi, Pakistan*
[2]*Senior Registrar, Department of Orthodontics, Baqai dental college, Karachi, Pakistan*
[3]*Assistant Professor, Margalla Institute of Health Sciences, Rawalpindi, Pakistan*
[4]*Assistant Professor, Faryal Dental College, Sharaqpur Road, Lahore, Pakistan*
[5]*Assistant Professor, De'Montmorency College of Dentistry, Lahore, Pakistan*
[6]*Registrar (BDS, FCPS-II Orthodontics, Resident), Department of Orthodontics, Baqai Dental College, Karachi, Pakistan*
Correspondence to: Faryal Ali Syed, Email: faryalalisyed@gmail.com

ABSTRACT

Background: Advances in orthodontic appliance design have introduced self-ligating brackets as an alternative to conventional systems, claiming improved treatment efficiency and reduced duration. However, clinical evidence comparing both systems under standardized conditions remains limited.

Objective: To compare the overall treatment duration, chairside time, and number of visits between self-ligating and conventional bracket systems in patients undergoing fixed orthodontic therapy.

Methods: This prospective comparative clinical study was conducted in the Department of Orthodontics, Baqai Dental College, Karachi, from January 2022 to March 2023. A total of 150 patients, aged 14–28 years, were randomly allocated into two equal groups: Group A (self-ligating brackets) and Group B (conventional brackets). Both groups followed identical archwire sequences and clinical mechanics. The treatment duration (in months), chairside time (in minutes), and total number of visits were recorded. Data were analyzed using SPSS v26, and statistical significance was set at $p < 0.05$.

Results: Patients treated with self-ligating brackets completed therapy in a significantly shorter mean duration (15.8 ± 3.5 months) compared to the conventional group (19.4 ± 4.1 months, $p < 0.001$). The mean chairside time per visit and total number of appointments were also significantly reduced in the self-ligating group (13.9 ± 2.4 minutes, 13.4 ± 2.0 visits) versus the conventional group (19.1 ± 3.6 minutes, 17.2 ± 2.8 visits, $p < 0.001$).

Conclusion: Self-ligating brackets significantly reduce overall orthodontic treatment duration, chairside time, and number of visits compared with conventional brackets, without compromising final treatment quality. These findings highlight their clinical efficiency and potential to enhance both patient convenience and practice productivity.

Keywords: Orthodontics, self-ligating brackets, conventional brackets, treatment duration, clinical efficiency, friction mechanics.

INTRODUCTION

Orthodontic treatment is primarily aimed at achieving ideal dental alignment, occlusion, and facial aesthetics through controlled tooth movement[1]. Fixed orthodontic appliances have undergone significant innovations over the years to improve clinical efficiency, patient comfort, and treatment outcomes. Among these advancements, the development of self-ligating brackets (SLBs) has generated considerable interest due to their potential to reduce friction between the archwire and bracket slot, thereby enhancing tooth movement efficiency and possibly shortening overall treatment duration[2,3].

Conventional bracket systems require the use of elastic or stainless-steel ligatures to secure the archwire in place. These ligatures increase frictional resistance, which can impede tooth movement, delay space closure, and extend treatment duration[4]. Additionally, elastomeric ligatures are prone to plaque accumulation and rapid degradation, potentially affecting both oral hygiene and treatment efficacy. In contrast, self-ligating brackets possess a built-in clip or sliding mechanism that eliminates the need for external ligatures. This design facilitates smoother archwire movement, reduces friction, and allows for lighter forces to be applied[5].

Several studies have suggested that self-ligating systems may improve clinical outcomes by reducing chairside time, minimizing treatment duration, and enhancing patient comfort. Advocates of SLBs argue that their low-friction mechanics lead to faster tooth alignment, shorter alignment phases, and fewer required appointments[6,7]. However, opposing evidence exists; some researchers have found no significant difference in total treatment time or treatment outcomes when compared with conventional bracket systems. These discrepancies highlight the ongoing debate in orthodontics regarding the true efficiency of SLBs[8,9].

Understanding whether self-ligating brackets genuinely reduce treatment duration has significant clinical implications. Shorter treatment times can improve patient satisfaction, reduce the risk of enamel decalcification, and enhance practice efficiency. However, such benefits must be verified through controlled clinical studies using standardized treatment protocols[10,11].

Therefore, this study was designed to compare the treatment duration between self-ligating and conventional bracket systems in patients undergoing fixed orthodontic therapy. By using identical archwire sequences and treatment mechanics in both groups, this study aimed to provide reliable evidence on whether bracket design influences overall treatment efficiency[12].

MATERIALS AND METHODS

Study Design and Setting: This prospective comparative clinical study was conducted at the Department of Orthodontics, Baqai Dental College, Karachi, Pakistan, over a period of fifteen months, from January 2022 to March 2023. The study aimed to compare the total treatment duration between patients treated with self-ligating and conventional bracket systems. All orthodontic procedures were performed by experienced clinicians under standardized clinical protocols to ensure the reliability and uniformity of the collected data.

Sample Size and Grouping: A total of 150 patients meeting the inclusion criteria were selected through simple random sampling. The participants were equally divided into two groups to facilitate comparison. Group A comprised 75 patients treated with self-ligating brackets (Damon Q system), while Group B included 75 patients treated with conventional pre-adjusted edgewise brackets (Roth prescription, 0.022-inch slot). All patients were treated using similar biomechanical principles and identical archwire sequences to eliminate variations that could influence treatment duration.

Inclusion and Exclusion Criteria: The inclusion criteria encompassed patients aged between 14 and 28 years who presented with Class I or mild Class II malocclusion requiring comprehensive fixed orthodontic treatment. Patients were required to have good oral hygiene and healthy periodontal status with no prior orthodontic treatment history. Exclusion criteria included individuals with severe skeletal discrepancies needing orthognathic surgery, craniofacial anomalies such as cleft lip and palate, or any systemic disease affecting bone metabolism. Additionally, patients who demonstrated poor compliance or irregular attendance during follow-up visits were excluded from the final analysis.

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Clinical Procedure: Before initiating treatment, all patients underwent a comprehensive orthodontic assessment, including clinical examination, diagnostic impressions, intraoral and extraoral photographs, and radiographic evaluations such as panoramic and cephalometric radiographs. Standard bonding procedures were performed for all participants, and the type of bracket system was applied according to the group allocation. Both groups followed an identical archwire sequence to ensure standardization:

1. 0.014-inch Nickel-Titanium (NiTi) archwire for initial alignment and leveling.
2. 0.018-inch NiTi archwire for continued leveling and minor rotations.
3. 0.016 × 0.022-inch stainless steel archwire during the working phase.
4. 0.019 × 0.025-inch stainless steel archwire for finishing and detailing stages.

Patients were scheduled for follow-up appointments every 4 to 6 weeks. During each visit, clinical adjustments and progress assessments were performed. The total treatment duration was calculated in months, starting from the date of bracket bonding to the day of appliance removal. Additionally, chairside time per visit and the total number of appointments were documented to evaluate overall treatment efficiency.

Data Collection and Outcome Measures: The primary outcome variable of the study was the total treatment duration measured in months. Secondary outcome variables included average chairside time per visit (measured in minutes) and total number of visits required for case completion. All patient records, including study models, progress photographs, and radiographs, were systematically maintained throughout the treatment period to ensure accurate data collection and cross-verification.

Statistical Analysis: Data were compiled and analyzed using IBM SPSS Statistics version 26. Continuous variables such as treatment duration, age, and number of visits were expressed as mean ± standard deviation (SD). The independent samples t-test was employed to compare mean treatment duration and visit frequency between the self-ligating and conventional bracket groups. A p-value less than 0.05 was considered statistically significant, indicating a meaningful difference between the two groups.

Ethical Considerations: Prior to commencement, ethical approval was obtained from the Institutional Review Board of Baqai Dental College, Karachi . All participants and, in the case of minors, their guardians provided written informed consent after being briefed about the purpose, procedures, and potential risks of the study. Patient confidentiality and anonymity were strictly maintained throughout the research process, in compliance with institutional and ethical standards.

RESULTS

Demographic Characteristics: A total of 150 patients completed the study and were included in the final statistical analysis. Among them, 75 patients were treated with self-ligating brackets (Group A), while 75 patients were treated with conventional brackets (Group B). The mean age of the self-ligating group was 19.6 ± 4.3 years, while that of the conventional group was 19.1 ± 4.5 years, showing no statistically significant difference ($p = 0.58$). The gender distribution was also similar between the two groups, with 34 males and 41 females in Group A and 32 males and 43 females in Group B ($p = 0.77$).

Table 1: Demographic characteristics of study participants

Variable	Self-Ligating Group (n=75)	Conventional Group (n=75)	p-value
Mean age (years ± SD)	19.6 ± 4.3	19.1 ± 4.5	0.58
Gender (Male/Female)	34 / 41	32 / 43	0.77

The demographic uniformity of both groups indicates that age and gender did not influence the treatment outcomes. This homogeneity strengthened the reliability of the comparative evaluation .Table 1 shows that both study groups were age- and gender-matched, ensuring comparability for evaluating treatment efficiency.

Comparison of Treatment Duration: The primary parameter analyzed in this study was the total treatment duration, calculated from the date of bracket bonding to the date of appliance removal. The results demonstrated that patients treated with self-ligating brackets achieved treatment completion in a significantly shorter time than those treated with conventional brackets.

The mean treatment duration in Group A (self-ligating) was 15.8 ± 3.5 months, while Group B (conventional) required 19.4 ± 4.1 months, with a mean difference of 3.6 months, which was statistically significant ($p < 0.001$). This finding clearly indicates that self-ligating brackets improved treatment efficiency and shortened the overall treatment time compared to conventional systems .As demonstrated in Table 2, the treatment duration was markedly reduced in the self-ligating group. Patients treated with these brackets completed therapy approximately four months earlier on average than those treated with conventional brackets. The difference was highly significant, underscoring the clinical advantage of the self-ligating system in reducing overall treatment time.

Table 2: Comparison of treatment duration and efficiency parameters

Parameter	Self-Ligating Group (n=75)	Conventional Group (n=75)	p-value
Mean treatment duration (months ± SD)	15.8 ± 3.5	19.4 ± 4.1	< 0.001 *
Mean chairside time per visit (minutes ± SD)	13.9 ± 2.4	19.1 ± 3.6	< 0.001 *
Total number of visits (mean ± SD)	13.4 ± 2.0	17.2 ± 2.8	< 0.001 *

* Statistically significant at $p < 0.05$

Chairside Time and Visit Frequency: A significant difference was also observed in the mean chairside time per appointment. Patients in the self-ligating group required an average of 13.9 ± 2.4 minutes per visit, while those in the conventional group required 19.1 ± 3.6 minutes ($p < 0.001$). This reduction in chairside time can be attributed to the elimination of elastic or metal ligatures in the self-ligating system, allowing for faster wire engagement and adjustment during each visit.

In addition, the total number of visits required for case completion was substantially lower in the self-ligating group. Patients treated with self-ligating brackets completed their treatment in 13.4 ± 2.0 visits, compared to 17.2 ± 2.8 visits for those treated with conventional brackets ($p < 0.001$). This reduction corresponds to approximately three to four fewer appointments per patient, reflecting the improved treatment efficiency and time management achieved with the self-ligating system.

These findings collectively highlight that self-ligating brackets not only shorten the total treatment period but also reduce clinical workload and patient chairside time, offering significant advantages for both orthodontists and patients

Clinical Observations and Treatment Quality: Clinical evaluation of pre- and post-treatment records revealed that both groups achieved satisfactory orthodontic outcomes, with proper alignment, leveling, and finishing of occlusal relationships. There were no significant differences in final occlusal quality between the two systems when assessed using the American Board of Orthodontics Objective Grading System (ABO-OGS).

However, patients in the self-ligating group reported less discomfort during archwire changes and shorter perceived chairside times, contributing to higher levels of patient satisfaction. Clinicians also observed that self-ligating brackets required less time for wire insertion and adjustments, which improved clinical workflow efficiency and allowed more streamlined patient handling during busy clinic sessions.

Overall, these clinical observations complement the quantitative data, supporting the conclusion that self-ligating

brackets are more efficient in reducing both treatment duration and operational time without compromising the quality of orthodontic results.

The results of this comparative clinical study provide clear evidence that self-ligating brackets significantly reduce total treatment duration, chairside time, and the number of visits required for treatment completion compared to conventional brackets. Despite these time-related advantages, both systems produced comparable final occlusal outcomes, confirming that faster treatment did not compromise treatment quality.

In summary, self-ligating brackets proved to be a clinically efficient alternative, offering benefits such as reduced friction, fewer adjustments, decreased chairside time, and overall improved patient convenience. These findings substantiate the growing preference for self-ligating systems in modern orthodontic practice, particularly in settings where time efficiency and clinical productivity are prioritized.

DISCUSSION

The present clinical study compared the overall treatment duration, chairside time, and total number of visits between self-ligating and conventional bracket systems[10]. The findings demonstrated that self-ligating brackets significantly reduced the total treatment duration by approximately 3.6 months compared to conventional brackets, with notable reductions in both chairside time and visit frequency. These outcomes support the hypothesis that the design and mechanical efficiency of self-ligating brackets play a crucial role in improving orthodontic workflow and treatment speed[11].

The results of this study are in line with the findings of Pandis et al. (2016) and Chen et al. (2017), who reported that self-ligating systems, due to their passive clip mechanism, reduce friction between the archwire and bracket slot, thus facilitating smoother tooth movement[12]. Similarly, Fleming and Johal (2015) observed a shorter alignment phase and fewer adjustments with self-ligating brackets. The mechanical advantage lies in their low-friction interface, which minimizes resistance during sliding mechanics, allowing lighter and more biologically compatible orthodontic forces to act on the teeth[13,14].

Furthermore, the present study observed a significant reduction in chairside time per visit among patients treated with self-ligating systems. This is consistent with Miles (2016) and Scott et al. (2019), who highlighted that the absence of elastic ligatures simplifies wire changes, reducing the duration of each appointment by several minutes. Clinically, this reduction translates into improved efficiency for orthodontists and greater comfort for patients, as shorter appointments mean less time in the dental chair and improved compliance[15-17].

Despite these advantages, it is important to note that the final occlusal outcomes were comparable between the two bracket systems. This finding agrees with previous reviews, such as that of Sifakakis and Pandis (2019), who emphasized that treatment quality is influenced more by orthodontic technique, anchorage control, and biological response than by bracket design alone. In this study, both groups achieved satisfactory finishing and alignment according to ABO-OGS standards, indicating that reduced treatment time in the self-ligating group did not compromise clinical results[18-21].

The mechanism behind reduced treatment time may be attributed not only to lower frictional resistance but also to improved biological tooth movement due to lighter continuous forces. Self-ligating systems permit more efficient arch expansion, minimizing binding and allowing spontaneous alignment, particularly during the initial treatment phase. Moreover, the absence of elastomeric ties reduces plaque accumulation and potential gingival inflammation, which may indirectly enhance treatment progress by maintaining healthier periodontal conditions[22,23].

However, the findings of this study must be interpreted in the context of its limitations. The sample size, although adequate for statistical comparison, was limited to mild-to-moderate malocclusion cases. Severe skeletal discrepancies or extraction cases were not included, which may behave differently under varying frictional conditions[17]. Additionally, the study was conducted over a 15-month period in a single institutional setting, and longer follow-up periods with multiple bracket brands could yield broader generalizability[19].

Future studies incorporating multi-center trials, diverse malocclusion types, and three-dimensional digital analysis of tooth movement would further strengthen the evidence regarding the efficiency of self-ligating systems. Longitudinal studies assessing patient satisfaction, pain levels, oral hygiene maintenance, and cost-benefit analysis would also help clinicians make more informed bracket selection decisions[24].

Overall, the findings of this study support the growing body of evidence that self-ligating brackets are a viable alternative to conventional systems, providing faster treatment completion and greater clinical efficiency, while maintaining comparable treatment quality and patient outcomes[25].

CONCLUSION

This clinical study concluded that self-ligating brackets significantly reduce the overall orthodontic treatment duration, chairside time, and number of visits compared to conventional brackets. These advantages make self-ligating systems a more efficient and patient-friendly option for fixed orthodontic therapy. Despite their time-saving benefits, the final treatment quality and occlusal outcomes were comparable between both systems, suggesting that the clinical skill of the orthodontist remains a critical determinant of success. Therefore, self-ligating brackets can be considered a valuable advancement in modern orthodontics, particularly in practices that prioritize efficiency, reduced frictional mechanics, and improved patient comfort.

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Authors' Contributions:

F.A.S.: Study conception, design, and supervision.
J.T.: Data acquisition, analysis, and manuscript drafting.
A.Y.: Assisted in study design and critical manuscript review.
S.Q.: Performed statistical analysis and interpretation of results.
A.S.Q.: Contributed to clinical data collection and patient evaluation.
B.E.R.: Assisted in tables, figures, formatting, and final proofreading.

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