Official Dental Journal of Suez Canal University
DENTAL SCIENCE Updates
Print ISSN 2636-3836
Online ISSN 2636-3844
www.dsujournals.ekb.eg
DSU — Vol. 5, No. 1, March (2024) — PP. 69:75

# EFFECT OF UPPER FIRST PREMOLARS EXTRACTION DURING ORTHODONTIC TREATMENT ON DISTRIBUTION OF BITE FORCE

**Rim Fathalla[1], Hanady Mohamed Samih[2], Ahmed Abdel Fattah Ramadan[3]**

*DOI: 10.21608/dsu.2024.195241.1162*
*Manuscript ID: DSU-2302-1162*

***KEYWORDS***

*Bite force, extraction, occlusion, orthodontic treatment, T-scan.*

• E-mail address:
Email: rimfathalla87@gmail.com

1. Assistant lecturer of Orthodontics, Department of Orthodontics, Faculty of Dentistry, Suez Canal University.
2. Associate Professor of Orthodontics, Department of Orthodontics, Faculty of Dentistry, Suez Canal University.
3. Professor of Orthodontics, Department of Orthodontics, Faculty of Dentistry, Suez Canal University.

## *ABSTRACT*

**Introduction:** Improving masticatory and postural function is one of the primary goals of orthodontic treatment. The assessment of the patient's occlusion throughout the treatment permits the orthodontist to improve the functional occlusion through interventional tooth movements when necessary, rendering the overall treatment to be more efficient and decreasing the patient's discomfort. **Aim:** An in-vivo cross-sectional study to evaluate the effect of upper first premolars extraction during orthodontic treatment on bite force distribution. **Methods:** Ten patients (mean age=16.13±2.17 years), who would be treated orthodontically with upper first premolars extraction to treat their upper anterior teeth proclination, were selected for this study. The T-scan III system was utilized to measure the occlusal bite force of the patients before and after treatment, and the findings were compared. **Results:** There was a statistically significant increase in the occlusal bite force's mean in the arch's anterior segment from 5.96% (±6.57) to 14.48% (±8.81) after the orthodontic treatment. A non-statistically significant increase in the occlusal bite force in the posterior right segment of the arch from 36.94% (±15.60) to 42.36 % (±11.14) was found after the treatment. The occlusal bite force in the posterior left segment of the arch decreased insignificantly from 56.45% (±15.72) to 40.15% (±13.59). It was found that there was an increase in the distribution of occlusal bite force on the right side and a subsequent decrease on the left side after treatment. There was an even distribution of bite force on both sides of the arch by the end of the treatment. **Conclusions:** Extraction of upper first premolar teeth does not negatively impact the functional aspect of occlusion. The T-scan III system is a key diagnostic tool utilized during orthodontic treatment to monitor occlusal changes.

## INTRODUCTION

Improving masticatory and postural function is one of the primary goals of orthodontic treatment. This, in turn, makes it possible to achieve functional comfort. Because treating complex malocclusions with fixed appliances requires the orthodontist to adjust dental contacts to achieve a new position of equilibrium, an evaluation of the quality of the final occlusion of the cases that have been treated must be performed. This evaluation must consider how well the patient can chew and how stable the teeth are [(1)].

The occlusal changes in post-orthodontic patients are associated with more TMD signs/symptoms than in non-orthodontic patients, as shown in some studies. This was attributed to the prolonged disclusion time

following the orthodontic treatment. It was found that orthodontic treatment created fewer working interferences. And as the group function occlusion was reported to be more prevalent in the post-orthodontic patients, combined with non-working contacts, this increased the prevalence of TMD. [2]

Considering this comes to the importance of the functional occlusal relationships that follow tooth movement either during or after the orthodontic treatment. The assessment of the patient's occlusion throughout the treatment and after debonding permits the orthodontist to improve the functional occlusion through interventional tooth movements when necessary. Thus, rendering the overall treatment to be more efficient and decreasing the patient's discomfort, and optimizing occlusal settling[3].

Nowadays, the occlusal forces and occlusal contact data may be readily assessed throughout the arches in real-time, dynamically, and in various clinical scenarios by employing computerized instruments like the T-scan system [4].

So, this study aimed to assess how the distribution of bite force would change if premolars were removed during orthodontic therapy. The hypothesis was that the extraction of premolar teeth during orthodontic treatment has not any effect on the distribution of bite force at the end of the therapy.

## PATIENTS AND METHODS

### Study sample:

Ethical approval (registration number: 2018/105) was obtained from the Research Ethical Committee (REC) of the Faculty of Dentistry, Suez Canal University. The number of samples needed for the study was determined with the help of G* power version 3.9.1.6.[5]. It was established that a sample size of at least ten patients was required to detect an effect size of 0.88 with a power of 0.8 at a significance level of 0.05. This was the conclusion reached by the researchers. Ten patients seeking orthodontic treatment at the Department of Orthodontics, Faculty of Dentistry, Suez Canal University, were selected for this study. They fulfilled the following criteria to be eligible for participation in the study: age group from 14 to 25 years, a full complement of permanent teeth (except third molars), no previous orthodontic/orthopedic/orthognathic surgical treatment, no history of trauma, no obvious/gross facial asymmetry, and the case analysis indicated the need for extraction of upper first premolars to relieve the malocclusion problem. Despite these factors, the patient required the extraction of the upper first premolars to alleviate the malocclusion problem. The objectives and methodology were explained to all participants, and written consent was obtained.

### T-scan occlusion recording:

1. The T-scan III (from Tekscan Inc., Boston, MA, USA) was used to measure the occlusal bite force.
2. The patient was sitting in an upright position without any kind of head support, and the Frankfurt horizontal plane was primarily parallel to the ground.
3. Every patient was instructed to bite down on the sensor, positioned between the arches and in the exact middle of the space between the incisors. When the patient chews on the sensor, the data is processed and shown visually on the computer screen in two or three dimensions, depending on which dimension the patient bit[6].
4. All the patients were repeatedly trained to bite on the sensor at maximum intercuspation (MIP). For every patient, the occlusal bite force

was recorded during centric occlusion. The subject was recruited to clench their teeth three times on the sensor while checking for proper device placement and mandibular centering. 5) The data on the force is shown as a percentage concerning the total loading, divided for each recording into two distinct sectors: right and left (Fig 1).

**T-scan occlusion analysis:**

All the patients were analyzed with the T-Scan system to get their values for these parameters (Fig. 1):

1. Force distribution in the patient's arch at maximum intercuspation.
2. Levels of occlusal force are exerted on the mouth's right and left sides at maximal intercuspation.
3. The disparity in the percentage of force distributed on the right and left sides of the arch at its highest intercuspation.

The study was done using the mean occlusal bite force derived from the three collected recordings of bite force. The patients were given treatment that consisted of extracting their two upper first premolars with fixed appliances to achieve optimal occlusion with the therapeutic objectives satisfied. Using the same methodology described earlier, another set of T-scan data was obtained for each participant immediately after removing the fixed appliance at the end of the orthodontic treatment.

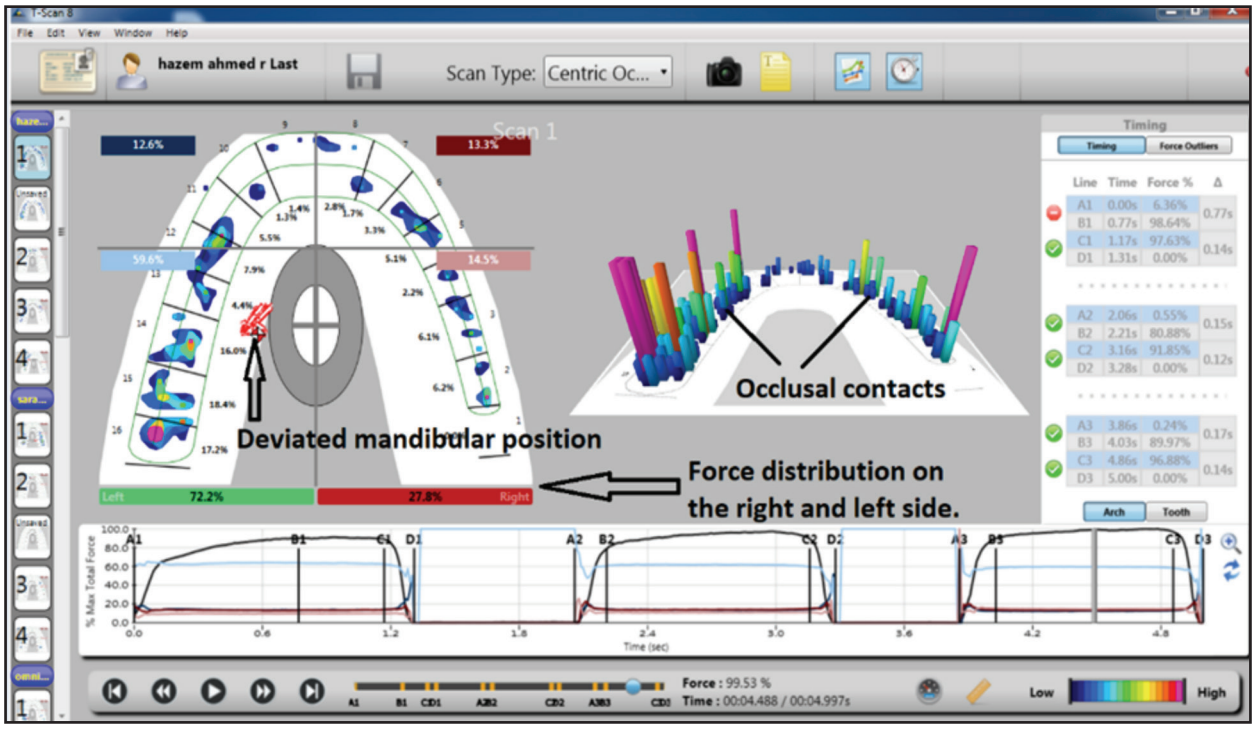


Fig. (1) Shows a screen photo obtained from a T-scan of a patient undergoing orthodontic treatment, displaying the 2D, 3D, and force Vs time graphs in the quadrant during centric occlusion. The timing table was taken before treatment. It displays the distribution of biting force inside and on both sides of the arch. Columns in pink denote a high level of force, while colored blue denotes a low level of power.

**Statistical analysis:**

The data obtained before and after therapy were collected, and then the appropriate statistical test was utilized to analyze. All data are given by mean ± standard deviation (SD). The normality of quantitative variables was checked by the Shapiro-Wilk test, bar charts and descriptive. Quantitative variables (DBF, BF percentage in both R & L side at MIP) were not normally distributed and presented using Mean and Standard deviation. All data were presented in percentages. Records of before and after orthodontic treatment were compared utilizing the Wilcoxon Sign Rank test. Statistical analysis of data was carried out using SPSS v. 23 for the Windows package (IBM Corp., Armonk, NY). Every test had two tails. Significance was tested at the level of P=0.05.

## RESULTS

There was a statistically significant increase (P value = 0.028) in the mean of the occlusal bite force in the anterior portion of the arch from 5.96% to 14.48% after the orthodontic treatment, as shown in table (1). This rise occurred after the end of the orthodontic treatment. On the other hand, following the completion of the orthodontic treatment, there was an increase in the occlusal bite force in the posterior right segment that was not statistically significant. This rise was from 36.94% to 42.36%. The occlusal biting force in the left posterior part of the arch decreased from 56.45% of its initial value to 40.15% of its previous value.

Table (2) describes the relative (percentage) distribution of occlusal forces on the left and right sides during centric occlusion recorded before and after the orthodontic treatment. Before treatment, the bite force was concentrated more on the left side (60.24%), while after treatment, the bite force was evenly distributed on both sides. No statistically significant difference was found.

**Table 1.** *Comparison of the distribution of biting force in centric occlusion between the anterior, posterior right, and left posterior portions before and after orthodontic treatment.*

| | | | **Study sample (n=10)** |
|---|---|---|---|
| Anterior | Before | Mean (SD) | 5.96 (6.57) |
| | After | Mean (SD) | 14.48 (8.81) |
| | | **P value** | **0.028*** |
| Posterior Right | Before | Mean (SD) | 36.94 (15.60) |
| | After | Mean (SD) | 42.36 (11.14) |
| | | **P value** | 0.345 |
| Posterior Left | Before | Mean (SD) | 56.45 (15.72) |
| | After | Mean (SD) | 40.15 (13.59) |
| | | **P value** | 0.173 |

**Statistically significant difference at p-value ≤0.05*

**Table 2.** *Comparison of the relative distribution of occlusal forces on the right and left side of the dental arch during centric occlusion and the difference in percentage force distribution between the right and left sides taken pre- and post-orthodontic treatment.*

| | | | **Study sample (n=10)** |
|---|---|---|---|
| Right | Before | Mean (SD) | 39.76 (15.00) |
| | After | Mean (SD) | 50.59 (10.57) |
| | | **P value** | 0.173 |
| Left | Before | Mean (SD) | 60.24 (15.00) |
| | After | Mean (SD) | 49.41 (10.57) |
| | | **P value** | 0.173 |
| Right - left | Before | Mean (SD) | -20.48 (29.99) |
| | After | Mean (SD) | 1.18 (21.14) |
| | | **P value** | 0.173 |

## DISCUSSION

The functional and occlusal alterations resulting from the removal of premolar teeth during orthodontic therapy have not been exhaustively addressed in the published research. Evaluation of the morphological occlusal relationship of the teeth clinically after treatment or through the study models is inadequate since a case with clinically satisfied occlusion could be functionally imbalanced while having clinically satisfied occlusion [7]. That is why it is essential to evaluate the occlusion statically and functionally [8].

### Occlusal bite force assessment methods and T-scan III:

The T-scan III system was used in the current study to assess the distribution of the occlusal bite force. This was done because previous studies [9, 10] have shown the importance of T-scan III as a dynamic occlusal indicator in orthodontics.

### The distribution of occlusal bite force on teeth:

In this study, we found that more forces were concentrated in the posterior regions than the anterior regions, either pre-treatment or post-treatment. This is due to the larger occlusal table of molars and wider occlusal contacts. This finding agreed with the studies of **Agbaje et al.** [11] and **Alkan et al.** [12]. Our study showed an increase in the mean of the occlusal bite force in the anterior segment of the arch. This might be attributed to the fact that most of the patients, who were treated by the extraction of upper first premolars teeth, had skeletal Class II malocclusion, with proclined upper anterior teeth, and had no incisal stops. So, after orthodontic treatment and correction of overjet and overbite, more contact between the anterior teeth were restored. This finding agreed with **An et al.** [13]. In addition, once the orthodontic treatment had been completed, there was a little but insignificant rise in the occlusal bite force on the posterior right side of the mouth. This conclusion agreed with what Yoon et al.[4] discovered, who found that the occlusal biting force reduced when assessed immediately after debonding utilizing the dental prescale method. From the results of our research, we found that only the mean occlusal bite force on the posterior left side decreased.

### The relative distribution of occlusal forces on both sides of the dental arch during centric occlusion:

Our study showed that the left side had more force than the right side before treatment. This agreed with **Gomes et al.** [15], who confirmed that chewing side preference was reported in all the study subjects with different craniofacial vertical dimensions. After the orthodontic treatment, it was discovered that there was a non-statistically significant increase in the distribution of occlusal bite force on the right side. A non-statistically significant decrease followed this in the relative distribution of the occlusal bite force on the left side. Both findings were observed after the treatment. Thus, eventually leading to an even distribution of bite force on both sides. This latter finding agreed with **Seth et al.** [8] and **Qadeer et al.** [6].

### The difference in percentage force distribution between the right and left sides of the arch at maximum intercuspation:

The current research demonstrated a significant difference between the right and left percentage forces observed at maximal intercuspation before the start of the orthodontic treatment. However, there was a non-significant decrease in the mean difference in percentage force distribution between the right and left sides of the arch after the orthodontic

treatment, indicating a more even distribution of the occlusal bite force by the time the orthodontic treatment was complete. As a result, this contributes to the achievement of a more balanced functional occlusion. This is found to agree with **Qadeer et al.**[6].

**Premolars extraction and functional occlusion:**

The current study found no statistically significant differences between the distribution of occlusal bite force in the patients before and after they underwent extraction of their two upper first premolar teeth as a part of their orthodontic treatment, except the anterior segment of the arch. This demonstrates that there is no correlation between the extraction of the premolars and the occlusal function. This was confirmed by **Choi et al.** [16], who concluded in their study that premolar extraction did not induce any decline in the functional aspect of occlusion. This result agreed with **Yoon et al.** [14]. The latter research found a tendency for the occlusal function to recover after two years to the pre-treatment level in a group with two premolars extracted.

## CONCLUSIONS

From this study, it was concluded that:

1. Before and after orthodontic treatment, the occlusal biting forces are more focused on the posterior teeth than on the front teeth.
2. The orthodontic treatment aids in the even distribution of bite force on both sides of the arch by the end of the treatment in both patients' groups, thus achieving functional occlusal balance.
3. The removal of premolar teeth does not have a negative impact on the functional aspect of occlusion in patients who have had their upper first premolars extracted, as there was no statistically significant difference in the distribution of bite force records that were taken prior to and after orthodontic treatment for the patients in this study.
4. The T-scan III system is a key diagnostic tool used to monitor the occlusal changes during the whole orthodontic treatment.

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