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Original Research Article

Vibratory stimulation in non-growing patients and its effect on the orthodontic tooth movement

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ABSTRACT

Background: Objectives of the study were to determine the impact of vibratory stimulation in non-growing patients on the orthodontic tooth movement rate and to differentiate the orthodontic tooth movement rate in both experimental and control sides.
Methods: 30 non-growing patients were selected for a split-mouth study with fixed appliance therapy orthodontic treatment undergoing bilateral first premolar extractions in maxillary arch. Type 1 active tiebacks were used to perform single canine retraction in all the patients. Vibratory stimulation was provided for 15 minutes daily with the help of Oral-B battery powered toothbrushes of 125 Hz frequency. Measurement was taken with calibrated digital vernier caliper clinically and OPG were taken at regular time intervals using grid method for the tooth movement calculation.
Results: P value obtained by statistical calculation shows non-significant results in both experimental and control sides in non-growing patients.
Conclusions: Cyclic loading in non-growing patients with fixed orthodontic appliance shows no change in orthodontic tooth movement in experimental and control group.

Keywords: Cyclic loading, Vibrations, Vibratory stimulation, Orthodontic tooth movement, split-mouth study

INTRODUCTION

Orthodontic treatment is a lengthy procedure and takes approximately two years for completion. As treatment proceeds with time, patient's satisfaction becomes the main concern of the clinician.[1]

During this treatment span all biological processes in close vicinity may impact and have deleterious effects in some cases. Patient's periodontal disease, dental caries and root resorption may get deteriorated with prolonged treatment time. The repercussions can be improved by decreasing the orthodontic treatment time and it is beneficial for both patient and the clinician.[2]

Orthodontic tooth movement occur as a result of alveolar resorption on one side and deposition on the other side in bony socket.[3] Till date, various techniques have been introduced to fast-track the orthodontic tooth movement. These methods include pharmacological therapies, surgical cortectomies, mechanical vibrations and distraction techniques.[4] Studies were done to investigate the effects of vibration on bone metabolism at cellular level and showed the deteriorated efficacy and response

of high frequency vibration on osteocytes that may impede osteoclast formation.[5,6]

El-Bailey, in the study performed on non-growing skeletal class-II patients showed enhanced tooth movement with the use of high frequency vibrations along with the use of aligners.[7]

There are various compelling evidences that gave the idea of using mechanical vibrations for enhancing bone formation and thus can be used for accelerating orthodontic tooth movement.

This study aims to evaluate the effectiveness of vibratory stimulation on the tooth movement in non-growing patients and to assess and compare the effect of vibration in experimental and control group in non-growing patients.

METHODS

This study involves a parallel-arm and a split-mouth clinical trial. The projected study was performed in the department of orthodontics and dentofacial orthopedics, Saraswati dental college, Lucknow from January 2017 to December 2018. Convenience sampling method was used to collect the data. Thirty non-growing subjects (age 18 years to 28 years) were selected from the patients undergoing bilateral maxillary first premolar extractions orthodontic treatment in the department with patient's written consent and with certain inclusion and exclusion criteria.

Inclusion criteria included patients undergoing fixed orthodontic treatment with bilateral maxillary first premolar extractions with good periodontal condition and having complete permanent dentition. Exclusion criteria includes patients with impacted canines, poor oral hygiene, having any systemic disease or taking analgesics priorly. Split mouth study was done with right side of maxillary arch in all patients allocated as experimental side and left side allocated as control side.

The 0.022" slot preadjusted edgewise brackets were used in all the patients and maximum anchorage were used for individual canine retraction. 0.019"x0.025" SS arch wires ligated in maxillary arches and type 1 active tiebacks (Figure 1) with 150 gm force (standardized with Dontrix gauge) were given on both experimental and control sides. Battery powered toothbrushes of 125 Hz vibrations (Figure 2) were provided to the patients to place on the lingual side of canines (as labial side has bracket attachment) for 10 minutes daily for 3 months. Digital vernier caliper (Figure 3) was used clinically for measuring the amount of tooth movement on T_0 (at the start of retraction), T_1 (at first month) and T_2 (at third month). Measurements were done from canine cusp tip to 2nd premolar cusp tip at mentioned time intervals and result obtained.

Figure 1: Active tiebacks (Type 1) given for canine retraction.

Figure 2: Battery powered toothbrush.

Figure 3: Tooth movement measured with digital vernier caliper.

Statistical analysis

The data was entered into MS-excel spread sheets and analysis was carried out using statistical package for social sciences (SPSS) version 20. Mean and standard deviation was calculated. Comparison was made using the paired t test and results obtained. $P \leq 0.05$ was considered statistically significant.

RESULTS

The monthly rate of canine retraction as measured from canine to second premolar between experimental and control side (T0-T1) shows no significant difference (p=0.25) between the experimental side (2.38±0.20 mm) (Table 1 and Figure 4) as compared to control side (2.32±0.2 mm).

Table 1: Comparative values of tooth movement between experimental and control sides for time interval To-T1.

Sides	Movement (mm) (Mean ± SD)
Experimental side	2.38±0.2
Control side	2.32±0.2
P value[1]	0.25*

[1]Paired t test, *non-significant

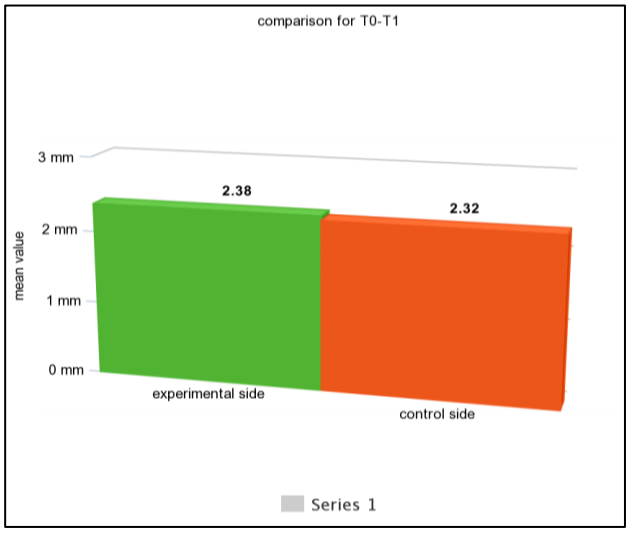

Figure 4: Comparative values of tooth movement between experimental and control sides for time interval To-T1.

Similarly, comparison of tooth movement was obtained between experimental and control side from T0-T2 which again shows no significant difference (p=0.45) (Table 2 and Figure 5) between experimental side (3.80±0.40 mm) and control side (3.65±1.0 mm). The results revealed that the rate of orthodontic tooth movement between experimental side and control side shows no significant difference at the time period T0-T1 and T0-T2 when measured from 13-15, 23-25 in non- growing patients.

Table 2: Comparative values of tooth movement between experimental and control sides for time interval To-T2.

Sides	Movement (mm) (Mean ± SD)
Experimental side	3.80±0.40
Control side	3.65±1.0
P value[1]	0.45*

[1]Paired t test, *non-significant.

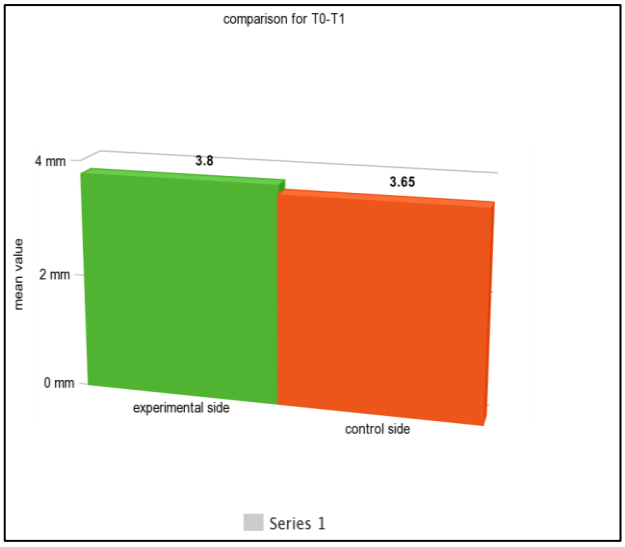

Figure 5: Comparative values of tooth movement between experimental and control sides for time interval To-T2.

DISCUSSION

Vibrational forces has been proven to be the non-invasive, painless procedure for fasten the orthodontic tooth movement in various studies. Many studies show the positive results and proved the efficacy of vibrational forces for accelerating orthodontic tooth movement. Studies done by Al Sayagh et al and Pavlin et al shows positive impact of vibrations on orthodontic tooth movement which is in contrast of this study.[4,8] But the growing or non- growing patients were not considered in these studies. Study done by Bowman showed no influence of vibration on to the rate of tooth movement.[9] Uribe et al in a review article discussed that more evidence studies have not been able to show an accelerator effect of vibrational forces which is in evidence of the projected study.[10]

In the projected study, vibrational frequency of 125 Hz frequency is used in accordance with the Alikhani et al.[11] Who in his study mentioned the strong influence of high-frequency vibration onorthodontic tooth movement.

Battery powered toothbrushes (125 Hz) were provided to the patients for vibratory forces which is in correlation with the study performed by Yimlaz et al and Leethanakul et al that also used battery powered toothbrushes to predict the rate of orthodontic tooth movement.[12,13] Commercialized devices Acceledent™ and OrthoAccel are also available in markets for providing cyclic loading in during orthodontic treatment but battery powered devices are cost-effective and be in budget for most of the patients hence, used in the present study. In the proposed study, canine retraction was done with active ligatures with 150g of force which is also in accordance with the study by Liao et al.[14] The sliding mechanics produced a translatory canine movement with

a negligible component of tipping. This extremely low force ensured that the patient did not have any discomfort.

The projected study involved non-growing patients with age 18-28 years which is in accordance with the study done by Azeem et al and El-Baily and depicts the result of vibrational force in non-growing patients.[7,15]

Measurements done in projected study i.e. the comparison of monthly rate of tooth movement from T0-T1 time interval shows movement of 2.38±0.2 mm in experimental side as compared to control side which shows movement of 2.32±0.2 mm. The p value obtained for the mentioned time interval shows non-significant results (p=0.25) depicts that there is not much difference of tooth movement with the use of vibrational force. This study is in accordance with the study done by Woodhouse et al that in his study showed no significant increase in rate of initial tooth movement or reduced time duration to achieve final alignment when they used vibrational force in conjunction with a preadjusted edgewise fixed appliance.[16]

Similarly, the comparison of the monthly rate of canine retraction measured at T0-T2 from canine to 2nd premolar between experimental and control side. The mean value at experimental side was found to be 3.80 mm with standard deviation of 0.40 mm and at control side was 3.65 mm with standard deviation of 1.0 mm. The p value was calculated which revealed unsignificant results (p=0.45) that depicts that the vibrational force shows no significant increase in fasten orthodontic tooth movement.

These results echoed the findings of various studies by Woodhouse et al, Miles et al, Miles et al and Azeem et al as these studies proved that vibrations did not enhance the rate of tooth movement.[15-18]

Limitations of the study were small sample size. Also. this study was done for a short span of time. Orthodontic Tooth movement requires more time to obtain the desired results. Moreover, the study was done using 125 Hz Frequency only and with 15 mins time duration. Further studies with different frequency and long span of time are required to show variable results.

CONCLUSIONS

The present studyshows no favorable impact of vibrational force provided by battery powered toothbrush 0f 125 Hz frequency (10 minutes daily for 3 months) on the rate of orthodontic tooth movement in non-growing patients.

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