PRELIMINARY STUDY FOR THE EFFECT OF BUCCAL SHELF MINISCREW RETRACTION TECHNIQUES ON BONE REMODELING OF MANDIBULAR ALVEOLAR RIDGE OF ANTERIOR TEETH

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Abstract

The purpose of this study was to evaluate the effect of two different mandibular En Masse retraction techniques using mandibular buccal shelf miniscrews. Twenty patients with skeletal Class I or mild skeletal Class II relationship and severe crowding in the lower arch more than 7 mm requiring orthodontic treatment with upper anterior en masse retraction in the extraction space of first premolars were selected then 10 patients will be allocated to each group. The CBCT were analyzed for differences between pre-treatment and post-treatment variables that included skeletal and dental relationships. Results were statistically analyzed by IBM SPSS version 28. There were no significant differences in bone resorption of the labial bone and its height after performing both techniques of En masse retraction (P values<0.001). the bone remodeling process is required for tooth displacement.

Keywords: En Masse, Bone remodeling, orthodontic retraction

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1. INTRODUCTION

Improving the appearance of the smile is one of the main reasons that encourage patients to seek orthodontic treatment, successful treatment results in patient satisfaction which cannot be achieved without understanding the components of an aesthetically attractive smile. Proper diagnosis for angle class I extraction cases that require either first or second premolar extraction isn't an easy mission and so they are called borderline cases, while Edward Angle emphasises on non-extraction technique on the other hand Charles Tweed was one of the first orthodontists who follow extraction philosophy which till now considered the most popular choice to solve bimaxillary protrusion and crowding [1], [2].

Following levelling and alignment, the most challenging process during orthodontic treatment starts which is space closure which needs the understanding of biomechanical principles to avoid undesirable side effects. Friction and frictionless mechanics are both still used now but friction mechanics or sliding mechanics are more attractive because of their simplicity while the braces slide on the orthodontic archwire, coil springs or elastics are used to close the space. Space closure in sliding mechanics can be managed either by using two-step techniques where the canine is retracted first and followed by retraction of anterior teeth which consume time with lesser effect on the anchor units or en-masse retraction where anterior teeth are retracted as one unit depending on well knowing about the centre of resistance of the anterior segment. Retraction of anterior teeth in extraction cases routinely comes with some difficulties due to bowing of the main archwire with loss of anchorage, at this point the importance of anchorage and achievement of success in clinical orthodontics depends mainly on anchorage control either by conventional extraoral headgears or facemasks or by intraoral appliances like TPA, Nance appliance or lingual arches but neither

intraoral nor extraoral anchorage reinforcement appliances can provide absolute anchorage. Nowadays miniscrews can provide absolute anchorage without patient compliance and with a wide range of various tooth movements in different directions that are impossible with traditional orthodontic mechanics [3]

One of the best sites for miniscrews insertion is the mandibular buccal shelf (MBS) due to adequate bone quality that improves the stability of the miniscrew against heavy forces that en-masse retraction exerts when used to correct skeletal malocclusions, protrusion, and severe crowding cases, miniscrews will be placed at the extending external oblique ridge opposing the distobuccal cusp of the lower sex and the mesiobuccal cusp of the lower seven [4].The technique of retraction depending on TADs might have an

impact on the dentoalveolar complex. The study of the effects of different retraction techniques in combination with MBS seems to be a point of worthy investigation. Accordingly, this study will be conducted to highlight this aim

2. MATERIALS AND METHODS

Study design

A randomized control clinical trial with parallel groups was carried out to evaluate the effect of the three-dimensional evaluation of two different mandibular en masse retraction techniques using mandibular buccal shelf miniscrews.

The techniques used were divided into two groups, (Group 1) where retraction at the level of the main archwire where the power chain extended continuously starting from minscrew at one side engaging the lower anterior teeth fro left canine to the other canine then attached to the miniscrew at the opposing side vs hook retraction with retraction force at the level of the centre of resistance of lower anterior segments (Group 2)

Ethical regulations:

This study was approved by the Research Ethics Committee of the Faculty of Dentistry, Minia University (ID number 176/2018).

Patients were informed about the aim and detailed procedure of the study, and if they were interested in participating, verbal ascent and written informed consent was obtained, which was laid down by the Research Ethics Committee, Faculty of Dentistry, Minia University.

Sample size calculation

The sample size calculation was performed using G.power 3.1.9.2 (Universitat Kiel, Germany). It was calculated as N ≥7 in each group based on the following considerations: 0.05 α error and 95% power of the study to demonstrate a mean difference in root retraction as an indicator of bone movement (our primary outcome) of (-3.55 ± 0.80) with the longer ARH of 9 mm vs (-2.15 ± 0.38) with that of 3 mm according to previous studies [37]. Three cases were added to each group to compensate for any possible dropout. Therefore, 10 patients will be allocated to each group.

Patient's selection:

Forty-seven patients were assessed for eligibility, 18 patients did not meet the criteria and 9 refused to participate in the study. The remaining 20 adolescent patients aged 14-25 years old of any sex with skeletal Class I or mild skeletal Class II relationship and, severe crowding in the lower arch more than 7 mm were randomly allocated into two groups: 10 patients in each. All patients were followed-up and analyzed statistically.

All included patients fulfilled the following eligibility criteria.

Inclusion criteria

1.patients with an age range between 14 to 25 years, with no gender predilection

2.Need for extraction of at least Lower first premolars as a part of the orthodontic treatment plan.

3.Need for maximum or absolute Mandibular posterior anchorage.

4.Symmetrical Mandibular arch with minimal midline deviation (2mm or less)

5.Good oral hygiene and gingival condition with no loss of epithelial attachment.

Exclusion criteria

1.Bad oral hygiene with signs of gingival inflammation.

2.Radiographic evidence of bone loss.

3.Radiographic evidence of root resorption in the maxillary anterior region.

4.History of previous orthodontic or orthopaedic treatment.

5.Medically compromised patients with any systemic disease affecting the rate of tooth movement or bone metabolism.

6.Pregnant or lactating females to exclude hormonal influence on the rate of tooth movement or bone metabolism.

7.Patients receiving pharmacological agents that affect the rate of orthodontic tooth movements such as corticosteroids and analgesics.

Randomization

Twenty patients were included in this study to compensate for dropouts during the study. Patients were equally distributed into 2 groups according to the technique of retraction main arch wire retraction technique referred to as (group 1) vs hook retraction technique referred to as (group 2) (10 patients in each group).

Randomization has been done using an excel sheet through the Excel RAND function to assign every patient number in Both retraction techniques through the following steps. Microsoft Excel sheet was created and used for the randomization process. Then, in the 1st column, numbers from 1 to 20 were written, representing the 20 patients included in this study. In the 2nd column, groups 1& group 2 were equally assigned 10 numbers each. The first ten samples for group 1 were referred to as (C), and the next ten for group 2 were referred to as (H). In the 3rd column, a randomization formula had been added, which is between 0-1. A function called "RAND" had been inserted in the 1st row of the 3rd column. Accordingly, Excel has added a random number to the cell. Random numbers had been added to the entire column. After that, a filter was added to columns 2 and column 3 as we wanted to randomize column 2. Then column 3 content has been sorted from smallest to largest from the filter function to randomize it. Finally, all the contents in column 2 were randomized, and all patient numbers were randomized to either H or C groups.

During the recruitment of patients, every patient was allocated to a group according to his number in the excel sheet without concern for the dropouts.

Materials:

1. Brackets mini master roth.018 American orthodontics.
2. DB TUBR IFIT ROTH 0.18
3. American orthodontics niti & stainless-steel archwires.
4. Long crimpable hook.
5. Orthodontic miniscrew 12 * 2 mm.
6. Elastomeric chain.

Methods.

The patients were fitted with straight wire braces 0.018 inches with Roth

prescriptions All patients underwent extraction of upper first premolars and lower first premolars according to their treatment plan. Some patients required

extraction of mandibular premolars to level the curve of Spee or to relieve crowding.

Initial alignment and levelling were performed with the wire sequence 0.012,0.014, 0.016-inch nickel titanium wires followed by 0.018-inch stainless steel wires, followed by 0.016 x 0.022-inch nickel titanium wires and 0.016 x 0.022-inch stainless steel wires. The regular appointment interval was every 4-5 weeks. Emergency visits were scheduled in case of broken brackets or buccal tubes. The first phase of levelling and alignment ranged between 5 to 6 months.

After initial levelling and alignment, 0.017x 0.025-inch stainless steel wires were fitted for at least 4 weeks to ensure the passivity of the archwire.

At this point the patients were prepared for placing the buccal shelf miniscrews size 12 mm length and 2 mm diameter, localising the target area opposing to the midpoint between the lower 6 distal roots and lower 7 mesial roots.[5] The area was disinfected with betadine swab. Anesthetization with topical anasthesia and few drops of infiltration injection around the target of insertion to avoid sloughing of soft tissue, the screw is handled and first applied in 45°.

After 4 turns slight and slowly changing the direction of insertion to nearly parallel to ensure passing toward the external oblique ridge and avoid roots as the screws are self-drilling smooth tapping to avoid strain on the neck of the screw.After placing both screws the patients were directed to make a CBCT to check for screws position, and to estimate level of bone labially and relation to cementoenamel junction at the lower anterior area before starting the retraction stage.Cone beam computed tomography (Scanora 3D, medium FOV 75 X 100 with voxel size 0.2 mm) [39]were taken at two-time intervals for the whole sample:

T1: Before the onset of en-masse retraction.

T2: After the completion of en-masse retraction and complete space closure.From the labial side, A linear measure was taken from the cementoenamel junction point to the highest level of labial bone

According to the randomization patients were divided into their groups, for group 2 a crimpable hook was placed at the target area between the lower lateral and canine as the centre or resistance for the lower anterior segment. For optimum retraction, a force gauge was used to adjust the exerting force by the elastomeric chain used for both groups After 6 months of retraction and complete space closure for all patients in both groups the second CBCTs were taken to measure the changes that happened at the bone height labially and and compared to those that were taken before retraction.

3. RESULTS

Statistical analysis

Statistical analysis was done by IBM SPSS version 28. Quantitative parametric data were presented as mean and standard deviation (SD) and were analysed by unpaired student t-test. Paired student t-test was performed to compare the two measurements within the same group.

Pearson's correlation was calculated to estimate the degree of correlation between two quantitative variables.

Agreement between quantitative variables was evaluated by Bland-Altman analysis. A two-tailed P value ≤ 0.05 was considered statistically significant.

Table (1): En Mass retraction effect on Labial bone height at group 1 & 2

		Group 1 (n=10)	Group2 (n=10)	P value (Unpaired t-test)
Pre	mean ± SD	3.5 ± 0.23	3.56 ± 0.32	0.639
	range	3.2 – 3.9	3 – 3.9	
Post	mean ± SD	4.27 ± 0.29	4.14 ± 0.45	0.451
	range	3.9 – 4.9	3.5 – 4.9	
Change		0.77 ± 0.38	0.58 ± 0.31	0.240
P value (Paired t-test)		**<0.001***	**<0.001***	---

Data are expressed as mean ± SD and range, *: Statistically significant as p-value ≤0.05.

shows that there was no statistically significant difference regarding measurements of labial bone height between both groups at the start of the study. After performing both techniques of En masse retraction, labial bone significantly moved from its original site under the effect of retraction (P values<0.001).

By comparing both techniques, there was no significant difference in terms of change in labial bone height. The labial bone resorption after retraction showed no statistically significant difference between both groups.

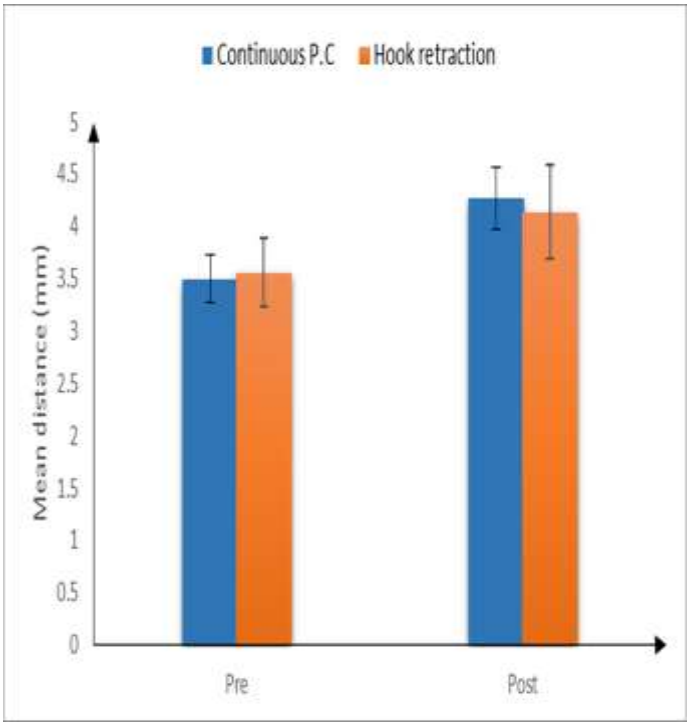

Figure (1): En Mass retraction of labial bone by Continuous P.C and Hook retraction techniques

4. DISCUSSION

The bone around the alveolar socket remodels when orthodontic tooth movement occurs, it is commonly accepted. Orthodontic treatment, on the other hand, is identified as one of the etiological reasons of dehiscence, fenestration, and gingival recession. Is it possible to discern between a normal periodontal tissue reaction and an iatrogenic effect proclination or retroclination of mandibular incisors resulted in an increase in the distance from CEJ to marginal bone crest in a group of growing patients [6-9]. What is more, after proclination (total bone thickness) [6] and retraction (lingual and buccal) of lower anterior teeth [10,11], the thickness of the alveolar bone was reduced. Adult patients had comparable outcomes [12-15]

The safe incisor movement limits in adult patients are unknown, however the majority of authors agree that the occurrence of bone dehiscences is higher in older patients, both before and after orthodontic treatment [16]. When therapy was conducted without extraction, the degree of dental crowding was related with the likelihood of bone dehiscence [17].

In skeletal class III patients, incisor decompensation prior to orthognathic surgery is a major risk to their periodontal health. Facial divergence, incisor irregularity, tooth site, treatment time, and proclination alteration all influence the quantity of bone loss [12]. The absence of link between the degree of incisor inclination and bone change is explained by Lee et al. [13]. The bone remodeling process is required for tooth displacement. This is the reason for changes in tissue dimension during orthodontic treatment. Uncontrolled movements that extend beyond the original bone limitations may result in severe bone dehiscences, which are a risk factor for gingival recession. The etiology of dehiscences during orthodontic treatment is multifactorial and includes the following factors: orthodontic force direction, magnitude, and duration, tooth size and initial position, alveolar bone anatomy, occlusal trauma, bacteria exposure, oral habits, and individual biological response to orthodontic forces. All these issues should be managed both before and throughout orthodontic treatment. Periodontal accelerated osteogenic orthodontics (PAOO) is a clinical treatment that combines selective alveolar corticotomy, particulate bone grafting, and orthodontic force application. Theoretically, this approach is based on the well-known bone healing pattern.

Alveolar volume does not have to be a constraint, and teeth can be relocated twice as far in one-third to one-fourth the time necessary for typical orthodontic therapy [18,19]. It can be used to treat moderate to severe malocclusions in both adolescents and adults, according to Wilcko et al., and can lessen the need for extractions. PAOO can also be used in place of some orthognathic surgery. When planning treatment for skeletal class III patients, more attention should be used. Corticotomy or grafts are recommended to restore alveolar bone health during presurgical incisor decompensation, although they will not substitute orthognathic surgery in severe situations. Extraction therapy, which is a preferred treatment option for protrusion patients but is also frequently recommended in other circumstances.

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