Comparison Of Alignment Efficiency Of Steel Vs Elastomeric Ligatures In Lower Anterior Teeth: A Randomized Clinical Trial.

Dr. Aatikah Javaid

BDS

FCPS II Trainee Orthodontic Department

KHYBER COLLEGE OF DENTISTRY, PESHAWAR

Correspondence: aatikah.javaid1@gmail.com

Supervisor Prof Dr. Ahsan Mehmood Shah

BDS, FCPS, M.ORTH, FFDRCSI, MHR, MHPE Chairperson Department of Orthodontics,

KHYBER COLLEGE OF DENTISTRY, PESHAWAR .

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INTRODUCTION

It is important to have an efficient treatment approach that yields positive treatment outcomes while reducing the time spent in clinical settings and the overall duration of treatment.[1] The initial stage of fixed appliance therapy involves aligning the teeth, which can vary based on different factors. The biological condition of the tissues plays a crucial role in how orthodontic forces are applied to the periodontium, enabling tooth movement within the alveolar bone.[2] The success of orthodontic tooth movement relies on various biological factors such as tooth vitality, cellular and connective tissue response, and periodontal health.[3] However, the choice of bracket system and archwire directly influences these biological factors.[4] To effectively address crowding in orthodontic treatment, an ideal ligation system should ensure complete bracket engagement with the arch wire and demonstrate minimal friction between brackets and the arch wire.[5]

In orthodontic treatment, achieving proper alignment of anterior teeth is a key objective.[6] Different ligation methods, such as elastomeric and steel ligatures, have been employed to achieve alignment.[7] Elastomeric ligatures are preferred by orthodontists due to their ease of use and reduced chairside time, but the effectiveness is reduced overtime due to absorption and friction.[8] Steel ligatures on the other hand require manual twisting of wire thereby increasing chairside time but provide effective engagement of wire into bracket slot and provide low friction mechanics.[9] The duration of treatment is an important factor for both patients and orthodontists, as it can impact overall treatment efficiency and patient satisfaction.[10] In a study by Reddy et al on comparison of different ligation method on time to reach alignment reported that the mean treatment time for alignment in elastomeric ligature was 176.3±11.08 days while in steel ligature was 175.56±9.41days.[11] Another study reported the mean treatment time for alignment in elastomeric ligature was 224.95±8.702 days while in steel ligature was 176.15±9.81days.[12]

This study aims to compare the mean treatment time required to achieve alignment of anterior teeth using elastomeric ligatures versus steel ligatures. By evaluating and analyzing these two

commonly used ligation techniques, we can gain valuable insights into their respective effectiveness in facilitating the alignment of anterior teeth. Owing to the contradictory results of the aforementioned studies this study would put to rest the contradictions. Ultimately, the findings from this study may contribute to informed decision-making regarding ligation methods, optimizing treatment outcomes, and enhancing patient experiences in orthodontic practice. There is lack of research on this topic in Pakistan, so this study will provide local statistics. The results can be variable across different populations due to genetic, ethnic and environmental factors.

OBJECTIVE

To determine the mean treatment time required by elastomeric ligatures and steel ligatures, in days, to achieve complete alignment of the lower anterior teeth.

OPERATIONAL DEFINITIONS

1. **Littles irregularity index:**

Measure of the distance in mm, using a Castroviejo caliper, of the sum of horizontal displacements of the anatomical contact points of the mandibular anterior teeth. It will be recorded as 0 (Perfect alignment), 1-3 (Minimal irregularity), 4-6 (Moderate irregularity), 7-9 (Severe irregularity), 10 (Very severe irregularity)

2. **Alignment:**

Littles irregularity index score of zero. Calculated by summing the distances (in mm) of the horizontal displacements of the anatomical contact points of the mandibular anterior teeth.

3. Elastomeric ligature:

O- shaped synthetic elastic of 0.1" diameter that holds the archwire in bracket slots.

4.Steel ligature:

Soft grade stainless steel wire of 0.009” thickness that holds the archwire in bracket slots.

OUTCOME

To determine the mean treatment time required by elastomeric ligatures and steel ligatures

RESEARCHER'S HYPOTHESIS

The treatment time taken to complete alignment of lower anterior teeth is shorter in steel ligature ligation than elastomeric ligature.

MATERIALS AND METHODS

Study Design: Randomized Clinical Trial

Setting: Department of Orthodontics and Dentofacial Orthopedics, Khyber College of Dentistry Peshawar.

Duration: 6 months after approval of synopsis.

Sample Size: By using Openepi,[13] assuming the mean duration of 224.95± 8.7 days for Elastomeric ligature group and mean duration of 219.95 ±9.82 days for steel ligature group [12] , a sample of 90 participants per group will detect a 5 days difference in mean duration, with 95% power at 5% significance level.

Sampling Technique: Consecutive, Non-probability.

Inclusion criteria

1. Patients coming for fixed orthodontic treatment requiring premolar extraction in mandibular arch.
2. Age 12-18 years.
3. No adjunct therapeutic intervention involving functional or orthopaedic appliances.
4. Little's Irregularity index score of 7-9mm.

Exclusion criteria

1. Patients with systemic conditions and taking medications affecting tooth movement.
2. Lower anterior teeth that are missing, impacted or unerupted, or have fractured crown, restorations, Enamel Defects, Caries.
3. Poor periodontal health

DATA COLLECTION PROCEDURE

Approval of the hospital ethical committee will be taken. Patients from Orthodontics department, Khyber College of Dentistry fulfilling the inclusion criteria will be invited to take part in the study. The purpose, procedures, risk and benefits of the study will be explained to them. An informed written consent will be taken.

The subjects fulfilling inclusion criteria will be assigned to one of two groups using lottery method. Group A will receive steel ligature, while Group B will receive elastomeric ligature for wire engagement in brackets. All participants will be bonded with a metal 0.022" slot of MBT pre-adjusted appliances. Archwire sequence will be 0.012 NiTi, 0.014 NiTi, 0.018 NiTi and 0.019x0.025 NiTi until alignment is reached. Adjustment appointments will be conducted at six-week intervals. Mandibular dental casts will be taken on the day of appliance placement (T1) and then on the day when alignment is reached (T2). Littles irregularity index will be calculated on mandibular casts using Castroviejo caliper. The alignment time from the day of appliance placement to the day when alignment is reached (T2-T1) for each participant will be recorded in days. All the above-mentioned information will be recorded in predesigned proforma (see Annex I).

Bias and confounders will be controlled in the study by strictly following inclusion/exclusion criteria, and randomization. Effect modifiers include gender, age and pre-treatment irregularity, which will be controlled by randomization.

Statistical Analysis:

Data will be analyzed using SPSS (statistical package for social sciences) version 25.0. Mean and standard deviation will be calculated for numerical explanatory variables like age and time to reach alignment. Frequency and percentage will be calculated for qualitative explanatory variables like gender. Independent Samples t Test will be applied to compare time of alignment in days between two groups (steel and elastomeric) at T2. Normality of data will be checked through Shapiro-Wilk Test. In case of skewed data Mann-Whitney U test will be applied instead of independent samples t test. Confounders like age and gender will be controlled through stratification. Post- stratification Independent Samples t Test/ Mann-Whitney U test will be applied. P value less than or equal to 0.05 will be considered significant.

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ANNEXURE I: DATA COLLECTION PROFORMA

Comparison of mean treatment time to alignment of anterior teeth of elastomeric ligatures versus steel ligatures- A randomized clinical trial

Age: _____years

Gender: ◙ Male ◙ Female

Date: ____/_____/_____

Case #:_____

Group ◙ Steel ligature (Group A) ◙ Elastomeric ligature (Group B)

1. **Littles irregularity index before treatment: _____mm**
2. **Lower brackets bond up (T1), Dated: / / .**
3. **Alignment reached (T2), Dated: / / .**
4. **Time to reach alignment in mandible (T2-T1) : _____days**