

Comparative evaluation of rate of retraction in Angles Class I malocclusion requiring extractions using MV loop and Opus loop in Central Indian population: A Randomised Control Trial -A Research Protocol.

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Table of Contents

Original Manuscript.....	6
Supplementary Files.....	11

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Abstract

Background: In Orthodontics, Closure of extraction space is one of the demanding task as lack of knowledge about the fundamentals behind space closure as of the mechanics of Space closure may result in an inability to accomplish an occlusion which is ideal (1) Clinicians can use the biomechanical basis of closure of space to assess various treatment modalities and establish the prognosis of different options, enabling them to make precise alterations that can enhance patient outcome of the case. (2) Basic modalities for extraction space closure, friction/sliding mechanics and frictionless/loop mechanics. (1) Focus of this study will be on closing of space using loop mechanics i.e. frictionless mechanics. In frictionless mechanics, loop bends create force to fill the gap, allowing for differential moments in the active and reactive units. Depending on the situation, this may result in varying degrees of anchoring control.(1) To achieve a desirable result while monitoring the health and integrity of the surrounding tissue, design and arrangement of loops is crucial. To achieve optimum effectiveness loop should apply less amount of force to teeth. This means that the loop should ideally have moment-to-force (M/F) ratio of 10:1 and a low force-to-deflection rate.

The Multiple Variability loop or the MV loop which was designed by Dr. Vikrant Jadhav and Dr. Meenakshi Tiwari of the Department of Orthodontics and Dentofacial Orthopaedics at Sharad Pawar Dental College is an open loop similar to that of T loop. This loop can be used for retracting a single tooth or the six anterior teeth in both the arches. This loop is particularly suitable in patients with shallow lower vestibules as it has small lower vestibular height It is easy to construct and takes only three minutes to complete, making it a great option for orthodontic treatment.(3)

The Opus loop was introduced by Raymond E. Saitkowski .It provides the M/F ratio between 8:1 and 9:1 and it can be used with segments a continuous archwire without any remaining bends in the wire. Its movements in the opposing directions for the anterior and posterior reduce the propensity to cause any unwanted side effects.(4,5) The Opus loop stands out for its ability to deliver a consistent target M/F ratio required for bodily tooth movement without introducing enduring moments through bends in the loop before insertion and activation. This inherent stability positions the Opus loop as an exemplary choice in orthodontic applications. There are very limited studies available for MV loop in clinical scenario. Therefore, present clinical investigation will be conducted with the aim to evaluate and compare rate of retraction in case of Angles Class I malocclusion using MV loop and opus loop in central Indian population.

Objective: • To evaluate the rate of retraction in cases of Angles class I using MV loop.

• To evaluate the rate of retraction in cases of Angles class I using Opus loop.

• To compare and quantify the rate of retraction in cases of Angles class I using Opus loop and MV loop.

• To compare and evaluate the amount of transverse changes in arch length after anterior en masse retraction with Opus loop and MV loop.

• To compare the amount of anchorage loss of first molar after anterior enmasse retraction with Opus loop and MV loop.

Methods: Study design: Interventional study

Methodology:

This study will be conducted in the Department of Orthodontics and Dentofacial Orthopaedics, Sharad Pawar Dental College,

DMIHER, Sawangi Meghe, Wardha, Maharashtra, India. Total 30 patients between the age group 15 to 30 years presenting with Class I malocclusion will be selected and will be randomly allocated into 2 groups using chits method.

- Group 1: MV loop
- Group 2: Opus loop

Inclusion criteria:

- Angles Class I malocclusion.
- Fully erupted permanent dentition.
- Requiring extraction of four first premolars.
- Moderate to Critical anchorage.
- Good oral and general health.

Exclusion criteria:

- Patient who had previously undergone orthodontic treatment.
- Craniofacial defects
- Congenitally missing teeth.
- Use of additional orthodontic devices during the observation period.
- Parafunctional habits.
- Anti-inflammatory medication.
- Endodontically treated teeth.
- Cases with Spaces.

Orthodontic treatment will be started and initial levelling and alignment will be done. Following which extraction of 4 premolars will be done to gain space, lateral cephalogram and SMI will be taken (T0). MV loop and opus loop will be used in group 1 and 2 respectively, for retraction and followed up until completion of the treatment. SMI will be taken 3 months (T1) and 6 months (T2) after initial levelling and alignment, and after completion of the treatment. Lateral cephalogram will be recorded at the end of the treatment (T3).

All the cephalograms will be evaluated for

? Angular Measurements

1. Upper Incisor to SN

? Linear measurements

1. Incisal exposure in relation to upper lip
2. Palatal plane to upper 1st molar
3. PVT to distal Aspect of upper 1st molar

Study models will be evaluated for

1. Reduction in extraction space.
2. Molar rotation will be measured.

Results: EXPECTED OUTCOME:

The efficacy of mv loop may surpass the efficacy of opus loop for retraction

Conclusions: Based on FME studies comparing various loops we can infer that the MV loop may efficiently provide a moment-to-force (M:F) ratio which is comparable to the ratio needed for anterior retraction of teeth. The Opus loop stands out as it has better biomechanical qualities such as a lower force delivery rate (FDR) and a higher M:F ratio and it achieves the desirable tooth movement without having any adverse effect.

In this study MV loop and the Opus loop will be compared for en-mass retraction of anteriors in patients with Class I malocclusion by evaluating the lateral cephalogram and study model for rate of retraction. The outcomes of this study will improve our understanding of the biomechanical properties and effectiveness of these loops which will help orthodontists to choose the best mechanics to achieve optimal results for anterior retraction and treatment plans. To validate the results for clinical efficacy and long-term clinical implications of MV loop and Opus loop in orthodontic treatment further research is necessary

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Original Manuscript

Comparative evaluation of rate of retraction in Angles Class I malocclusion requiring extractions using MV loop and Opus loop in Central Indian population: A Randomised Control Trial -A Research Protocol.

ABSTRACT

Background: Closure of extraction space is one of the demanding tasks. Basic modalities for extraction space closure used in orthodontics are friction mechanics and frictionless mechanics. This study will be focusing on space closure using frictionless mechanics. The study compares the effectiveness of MV loop and Opus loop methods for tooth retraction. By understanding the advantages and disadvantages of each method, orthodontists can create better treatment plans and achieve optimal results for this patient population which can lead to improved patient outcomes and customized treatment plans. This study aim to evaluate and compare rate of retraction in case of Angles Class I malocclusion using MV loop and opus loop in central Indian population.

Materials and methods: Total 30 patients between the age group 15 to 30 years presenting with Class I malocclusion will be selected and will be randomly allocated into 2 groups using chits method

Result: Expected result is that e efficacy of mv loop may surpass the efficacy of opus loop for retraction.

Key words: frictionless mechanics, loop mechanics, MV loop, Opus loop, Rate of retraction

INTRODUCTION

In Orthodontics, Closure of extraction space is one of the demanding task as lack of knowledge about the fundamentals behind space closure as of the mechanics of Space closure may result in an inability to accomplish an occlusion which is ideal (1) Clinicians can use the biomechanical basis of closure of space to assess various treatment modalities and establish the prognosis of different options, enabling them to make precise alterations that can enhance patient outcome of the case. (2) Basic modalities for extraction space closure, friction/sliding mechanics and frictionless/loop mechanics. (1) Focus of this study will be on closing of space using loop mechanics i.e. frictionless mechanics. In frictionless mechanics, loop bends create force to fill the gap, allowing for differential moments in the active and reactive units. Depending on the situation, this may result in varying degrees of anchoring control.(1) To achieve a desirable result while monitoring the health and integrity of the surrounding tissue, design and arrangement of loops is crucial. To achieve optimum effectiveness loop should apply less amount of force to teeth. This means that the loop should ideally have moment-to-force (M/F) ratio of 10:1 and a low force-to-deflection rate.

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MATERIAL AND METHODS:**Study design: Interventional study****Methodology:**

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EXPECTED OUTCOME:

The efficacy of mv loop may surpass the efficacy of opus loop for retraction.

SAMPLE SIZE:

$$n_1 = \frac{(\sigma_1^2 + \sigma_2^2 / \kappa)(Z_{1-\alpha/2} + Z_{1-\beta})^2}{\Delta^2}$$

The notation for the formulae are:

n = sample size of Group 1

σ_1 = standard deviation of Group 1

σ_2 = standard deviation of Group 2

Δ = difference in group means

κ = ratio = n_2/n_1

$Z_{1-\alpha/2}$ = two-sided Z value (eg. Z=1.96 for 95% confidence interval).

$Z_{1-\beta}$ = power

Mean incisor exposure in relation to upper lip at T0 = 5.83

Mean incisor exposure in relation to upper lip at T4= 4.45

σ_1 = SD of incisor exposure in relation to upper lip at T0 =

1.60 σ_2 = SD of incisor exposure in relation to upper lip at

T4= 1.05

For detecting mean difference of 1.38 i.e. $\Delta = 5.83 - 4.45 = 1.38$

$K = 1$

$N = \frac{(1.60 \times 1.60 + 1.05 \times 1.05)(1.96 + 0.84)^2}{1.38 \times 1.38}$

1.38*1.38

15.07 = 15 patients needed in each group

STATISTICAL ANALYSIS:

Statistical analysis will be done by using descriptive and inferential statistics using Chisquare test, Student's paired, unpaired t test and software used in the analysis will be SPSS 27.0 version and GraphPad Prism 7.0 version and $p < 0.05$ is considered as level of significance.

DISCUSSION:

In a study published in Cureus in 2023, Jadhav et al(6). used finite element analysis to compare the effectiveness of the Opus loop with a newly created multiple variability (MV) loop for en-masse retraction of anterior teeth in orthodontics. The study found that the moment-to-force (M:F) ratio produced by the MV loop is similar to what is needed for natural tooth movement. The researchers concluded that the best TMA wire for accomplishing the required tooth movement during anterior retraction without causing any negative side effects is 0.019 x 0.025 inches.

In a FME study conducted by Rao et al(7) in 2013 compared the biomechanical characteristics of the Teardrop, Opus, and Snail loops for en-masse retraction of anterior teeth on 13 different finite element models. On conducting 14 analyses on those models, they found that the Opus loop

outperformed the Snail and Teardrop loops in terms of force delivery rate (FDR) and M:F ratio.

In order to optimize the efficacy of treatment it is very crucial to consider biomechanical properties of various loop designs. In the literature it is found that the Opus loop and the MV loop have demonstrated promising results when it comes to achieving natural tooth movement during anterior retraction

CONCLUSION:

Based on FME studies comparing various loops we can infer that the MV loop may efficiently provide a moment-to-force (M:F) ratio which is comparable to the ratio needed for anterior retraction of teeth. The Opus loop stands out as it has better biomechanical qualities such as a lower force delivery rate (FDR) and a higher M:F ratio and it achieves the desirable tooth movement without having any adverse effect.

In this study MV loop and the Opus loop will be compared for en-mass retraction of anteriors in patients with Class I malocclusion by evaluating the lateral cephalogram and study model for rate of retraction. The outcomes of this study will improve our understanding of the biomechanical properties and effectiveness of these loops which will help orthodontists to choose the best mechanics to achieve optimal results for anterior retraction and treatment plans. To validate the results for clinical efficacy and long-term clinical implications of MV loop and Opus loop in orthodontic treatment further research is necessary

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Supplementary Files