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To Evaluate and Compare the Rate of Space Closure and Incisor Retraction between Sliding Mechanics and CNA Mushroom Loop Archwire Using Indirect Anchorage

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ABSTRACT

Introduction: There has been a long discussion in orthodontics about the sliding and loop mechanics as the preferred method of retraction of anterior teeth in maxillary first premolar extraction cases. But no study has compared sliding and loop mechanics with indirect anchorage for enmasse retraction.this study aims to compare sliding and loop mechanics with indirect anchorage while doing enmasse retraction of anterior six maxillary teeth.

Materials and Methods: 11 patients were treated with sliding and loop mechanics each and enmasse retraction was done after maxillary first premolar extraction and using indirect anchorage with the help of miniscrews.

Results: Sliding mechanics is found to be better than loop mechanics in anterior retraction and reducing proclination with faster space closure. Loop mechanics was found to be better in torque control and preventing bite deepening during retraction.

Conclusion: Both mechanics have their own advantages and disadvantages and hence should be used as per the requirement of individual cases.

Keywords: - Sliding, loop, friction, frictionless, indirect anchorage, retraction.

INTRODUCTION

Excessive upper incisor display is one of the major reasons why patients seek orthodontic treatment. The most common way to resolve this problem includes the extraction of premolars followed by retraction of the anteriors.[1] Space closure is a multifactorial process which requires a solid comprehension of biomechanics, clinician's skills and proper treatment planning in order to avoid undesirable side effects.[2] In spite of the variety of appliance designs, Two basic biomechanical methods are used clinically for the space closure: frictionless (loop mechanics) and frictional mechanics (sliding mechanics). Both mechanics have their own advantages and disadvantages.[3]

Sliding mechanics is attractive because it is simple, inexpensive and easy to maintain hygienically. It is superior in terms of rotational control and dimensional maintenance of the arch.[4]

Frictionless mechanics is complicated as compared to sliding mechanics but it is more effective at reducing tipping and extrusion.[4] Materials used for frictionless retraction have also evolved from stiff stainless-steel wires to the more flexible beta titanium wires **b**y Burstone,[5] and to the newer materials like CNA wires[6] which are supposed to reduce the force levels and thus making the treatment more effective and efficient.

Increase anchorage consideration in the maximum retraction cases require miniscrews.[7] Miniscrews serve as an anchor either directly or indirectly. In the direct method, the force module is attached between the mini-screw and the anterior hook whereas in the indirect method the posteriors are rigidly ligated to the mini-screw there by stabilizing them while engaging the force module between the posteriors and the anteriors.

Many studies has been done on comparison between sliding mechanics and various loops[8] but there are very limited studies done on CNA mushroom loop may be because of its high cost factor and it is comparatively newer. A study done by Kamaldeep Sharma[9]compared the T loop and mushroom loop. Although the comparison was during en masse retraction but that comparison was within the same mechanic that is between the two loops. No comparative study between sliding mechanics and loop mechanics have been done with en masse retraction and that too with miniscrews as an indirect anchorage. En masse retraction is always the preferred choice of retraction rather than two step retraction as supported by the meta analysis also which was done by Mumen Z. Rizk[2] which have shown that en masse retraction requires less time than two-step retraction with no

difference in the amount of root resorption. Also, Staggers and Germane[10] described anchorage as "being taxed twice with a two-step retraction, as opposed to once with en masse retraction".

So, the present study was done to compare the rate of space closure between sliding mechanics and CNA mushroom loop archwire by taking indirect anchorage from miniscrews by placing them between first and second molar. The advantage of mushroom loop is that the mushroom shape of the loop did not interfere with gingival tissue [9] Degree of incisor tipping and retraction of anteriors was seen cephalometrically in both the groups by comparing angles U1-NA and U1-SN.

AIM

To evaluate and compare the rate of space closure and incisor retraction between mushroom loop CNA arch wire and sliding mechanics with indirect anchorage.

OBJECTIVES OF THE STUDY

1. To evaluate the rate of space closure using mushroom loop CNA arch wire with indirect anchorage.
2. To evaluate the rate of space closure using sliding mechanics with indirect anchorage.
3. To compare the rate of space closure with above different mechanics with the help of study models and photographs.

MATERIALS AND METHODOLOGY

SAMPLE DISTRIBUTION

- **Source of the patients:** Patients visiting the Department of Orthodontics and Dentofacial Orthopaedics who commenced fixed orthodontic treatment was enrolled
- **Study subjects:** 22 orthodontic patients within the age group of 17 to 25 years indicated for fixed orthodontic treatment with bimaxillary premolar extraction requiring en masse incisor retraction

SAMPLE SIZE CALCULATION

Sample size estimation was done by using GPower software (version 3.0). Sample size was estimated for t test and Mean. Difference between two independent mean was chosen.

A minimum total sample size of 22 (11 in each group) was found to be sufficient for an alpha of 0.05, power of 80%, 0.9 as effect size (assessed for difference in canine inclination from a similar study).

INCLUSION CRITERIA

1. Patient indicated for orthodontic treatment involving bilateral maxillary first premolar extraction or all four premolar extractions and en masse retraction.
2. Patient in the age group of 17 to 25 years.
3. Full permanent dentition with second molars erupted.
4. Patient consenting to be included in the study.

EXCLUSION CRITERIA

1. Mutilated dentition and/or presence of local pathology in the region of interest.
2. Patient taking any medications that may cause alteration to wound healing and/or orthodontic tooth movement.
3. Patient contraindicated for miniscrews.

Treatment was started with right and left first premolar extractions. Banding and bonding upto second molar was done in each group. Levelling and alignment was done until 0.19*0.25”SS wire engaged passively. After levelling and alignment in group 1 (figure 1A) NiTi closed coil spring was used for retraction and in group 2 CNA mushroom loop archwire (figure 1B) was used for retraction. NiTi closed coil spring was place from first molar hook to canine hook bilaterally and it was activated upto 150 g of retraction force and in each visit this force was maintained. Mushroom loop archwire was activated upto 1.5-2mm and cinched distal to first molar on both the sides. Indirect anchorage was taken from miniscrews to first molar with the help of ligature wire in figure of 8 manner by placing them between first and second molar bilaterally. For en masse retraction of maxillary anterior retraction, anteriors and posteriors were consolidated in both the groups. Models were made at first, third and sixth month visit. Dental models of first, third and sixth month visit were digitally scanned using an extraoral digital scanner (Maestro 3D MDS 400) with an accuracy of 10 microns and resolution of 0.07mm. A series of models from each patient was used to assess the change in the position of the canine relative to the stable landmark of the ipsilateral lateral end of the third rugae and the palatal vault for superimposition. The scanned files thus obtained in a STL format were transferred to a advanced 3D mesh processing MeshLab™ software. Using this software, the digitally scanned models (figure 2 A, B) were superimposed (figure 3) on each other with the lateral end of palatal rugae as well as the palatal slope used as stable surface landmarks, thus making it possible to obtain only the movement of the dental units on the maxillary arch over time for each patient. The midpalatal raphe was drawn using the line tool and a perpendicular line was drawn from the distal surface of the right and left maxillary canine to the mid palatal raphe line. The distance was measured with the help of MeshLab’s measuring tool. For anchorage loss measurement the horizontal perpendicular line was drawn from mesial surface of first molar. The distance between this line and horizontal line passing

through third palatal rugae was measured at each visit and was subtracted from the value of subsequent visit. This gave the total anchorage loss happened in last month. Anchorage loss values of all four visits were added for each group and was compared. Total anchorage loss calculated was addition of values of first, second, third and fourth visit. (Af). Mean space present was calculated at each visit. The mean space present in the last visit (T4) was subtracted from mean space present just before starting the retraction (T0). This gave the value of anterior retraction T(f). Lateral cephalograms was taken for each patient after 6 months of retraction. U1 – NA and U1- SN angles were measured and compared with the value of pre-treatment lateral cephalograms for the assessment of degree of tipping.

Total retraction = T(f) – A(f)

$$\text{Rate of space closure} = \frac{\text{Total retraction per month}}{6}$$

Figure 1A - Activated Niti coil spring in group 1

Figure 1B- Activated CNA mushroom loop archwire in group 2

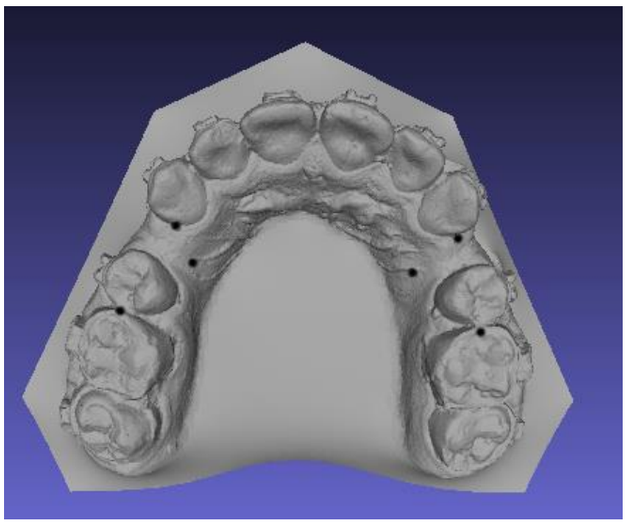


Figure 2A – STL model of first appointment (T0)

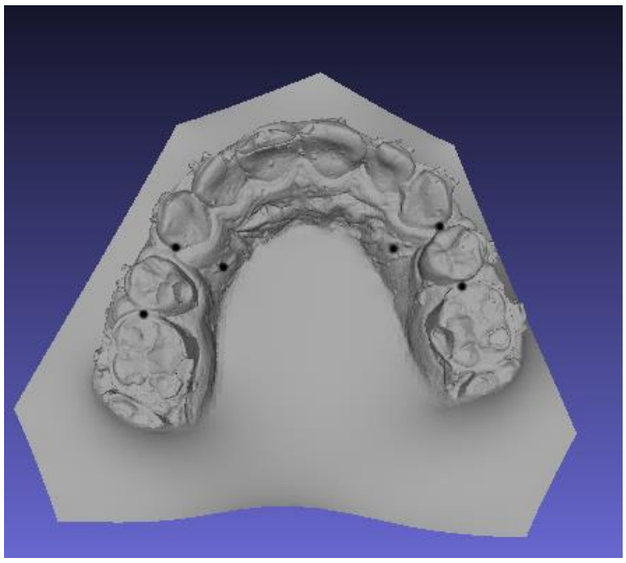


Figure 2B – STL model of sixth appointment T6

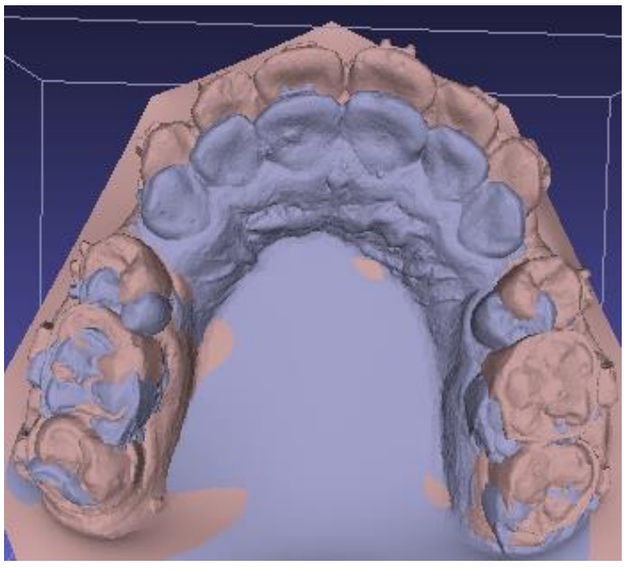


Figure 3 – superimposed STL models of T0 and T3

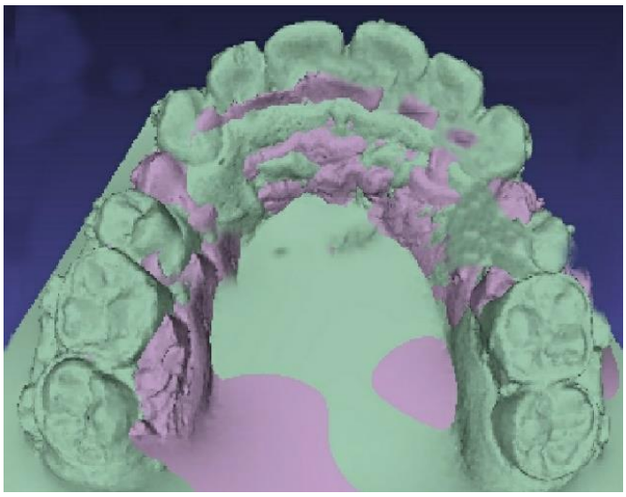


Figure 4 – superimposed STL models of T0 and T6

RESULTS

Data was analysed using Statistical Package for Social Sciences (SPSS) version 21. Categorical variables like gender was summarized as frequency. Interval or ratio based variables i.e., clinical parameters were summarized as Means & Standard deviations. Graphs were prepared on Microsoft Excel.

Continuous data was tested for normality by using Shapiro Wilk test. If the data will achieve normality, then parametric tests of significance (Independent t- test for intergroup comparison) will be used for inferential statistics. The level of statistical significance will be set at 0.05

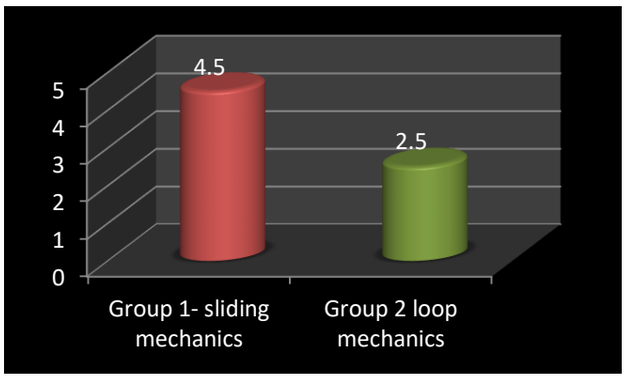
The descriptive statistics before retraction and 6 months after space closure as measured from the radiographs and the study models are summarized in Graphs 1,2,3,4.

In graph 1 the mean space closure achieved in group 1 was 4.5mm as compared to 2.5mm in group 2 over a period of six months and this difference was very highly significant.

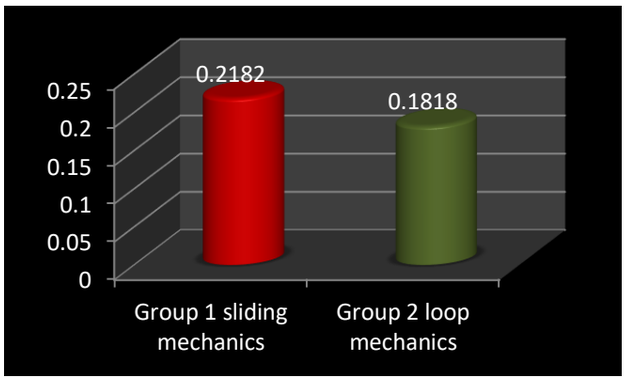
On the other hand, there was no significant difference seen in anchorage loss in both the groups after 6 months of retraction as depicted in Graph 2.

When rate of space closure per month was compared between the two groups in group 1 the rate of space closure (0.74mm per month) was approximately double of that in group 2, i.e., 0.39mm per month.

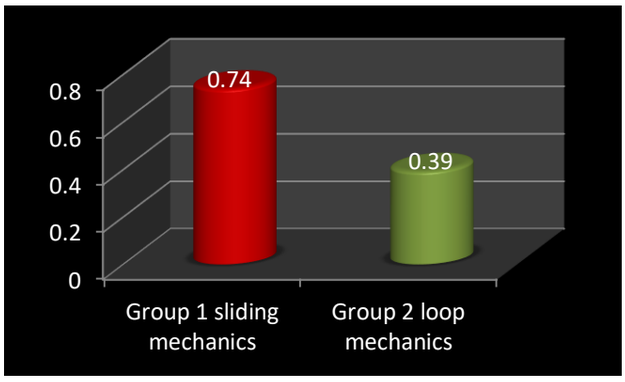
Graph 4 depicts that there was no difference in the upper incisor inclination at baseline whereas at the end of fourth visit, in group 1 there was significant reduction in proclination of upper incisors as given by U1-NA and U1-SN as compared to group2.



GRAPH 1: Significant difference was seen in space closure when compared groupwise using independent t test ($p<0.05$). Space closure from baseline to six months was shown more in group 1than group 2



GRAPH 2: No Significant difference was seen in anchorage loss when compared groupwise using independent t test ($p>0.05$).



GRAPH 3: Significant difference was seen in rate of space closure when compared groupwise using independent t test ($p<0.05$). Rate of space closure was shown more in group 1than group 2.

No significant differences were seen in U1-SN at T0 and T4 when compared using t test ($p>0.05$).Significant differences were observed in the differences of U1-NA and U1-SN when compared groupwise ($p<0.05$)

DISCUSSION

The force of 150 gm employed in the present study followed the recommendations of many authors who applied forces between 100 gm and 200 gm for retraction.[14] Boester and Johnston[15]

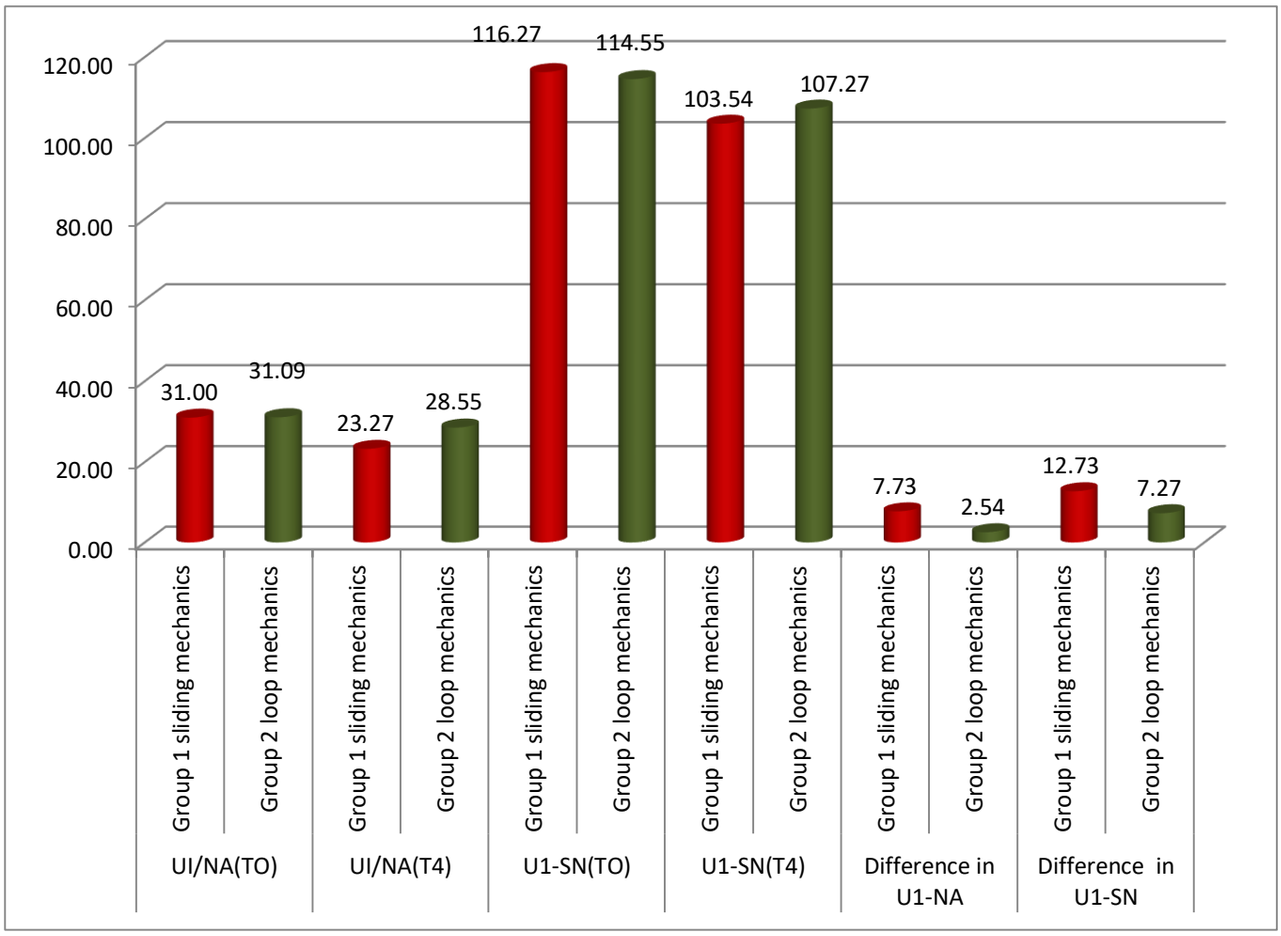
found that 150 gm of retraction force gave the highest amount of retraction.

Third palatal rugae was taken as a reference point because as it was found that the medial and lateral points of the third rugae appear to be stable landmarks for the construction of anatomic reference points in longitudinal cast analysis[15,16].

The amount of retraction in frictional mechanics in our study in group 1 is more than group 2. When groupwise comparison of anchorage loss was done, no significant difference was seen. These results are similar to the study done by Rhee et al[4]. This similarity may be due to the fact that Rhee et al[4] took anchorage from headgear while in our study indirect anchorage was taken from miniscrews.

initial value, that is, pre-treatment values for each group, does not have any significant difference. Mean value of U1-NA after six months of retraction for group 1is 23.27 ± 1.34 degrees and for group 2 it is 28.55 ± 1.36 degrees. When these values were compared using independent t test there was significant difference. Tipping was more in group 1. (GRAPH 4)

When the difference between the values of U1-NA from T0 to T4 is compared between two groups there was significant difference. Mean difference for U1- NA for group 1 is 7.72 ± 0.78 degrees and for group 2 mean difference is 2.54 ± 0.52 degrees showing more tipping in group 1 as compared to group 2 (GRAPH 4). Similarly, when the two groups were compared initially, that is, before starting the treatment, both the groups were having similar values for U1-SN. Pre-treatment mean



GRAPH 4 : No significant differences were seen in UI/NA at T0 when compared using t test but at T4 UI/NA was found to be significantly more in group 1 ($p<0.05$).

Significant difference was seen in rate of space closure between the two groups. Rate of space closure was more in group 1 than group 2. This could be attributed to the fact that there was more tipping in group 1 than group 2. The total retraction by mushroom loop during en masse retraction in the study done by Kamaldeep Sharma and Sumeet Sandhu[9] was found to be 2.97 ± 0.23 mm which is similar to the results of our study (2.37 ± 0.14 mm).

Radiographic values such as upper incisor to NA angle (U1-NA) and upper incisor to SN angle (U1-SN) were compared between pre-treatment lateral cephalograms and the cephalograms after 6 months of retraction in both the groups.

When groupwise comparison of two groups was done for the

value for U1-SN angle for group 1 is 116.27 ± 4.12 degrees and for group 2 mean value is 114.54 ± 4.88 degrees which was clinically insignificant which meant that treatment was started at almost similar values of U1-SN in both the groups. (TABLE 4)

Mean value of U1-SN after six months for group 1 is 103.54 ± 4.13degrees and for group 2 it is 107.27 ± 4.9 degrees. When these values were compared using independent t test there was not significant difference. (GRAPH 4)

When the difference between the values of U1-SN from T0 to T4 is compared between two groups there was significant difference. Mean difference for U1- SN for group 1 is 12.72 ± 1.27 degrees and for group 2 mean difference is 7.27 ± 0.64 degrees showing more tipping in group 1 as compared to group 2. (TABLE 4)

These results are in similar to the study done by Rhee JN, Chun YS, Row J[4] which has shown that frictionless mechanic has

lesser amount of tipping than sliding mechanics. In the superimposition of digital models (figure 3,4) it can be seen that canines have moved distally and there is very less mesial movement of first molars. That means extraction space has been closed by maximum retraction of canine and negligible amount of mesial movement of first molars. However, the tipping was more in group 1. Due to more tipping there will be tendency for deep bite and subsequent torque loss in group 1. While in group 2 although the rate of space closure is lesser then group 1 but the torque of anterior teeth will be maintained and there will be more chances of bodily movement of teeth in group 2(loop mechanics). The torque remains maintained in loops because the tooth will move only to the limit to which loop has been activated. In group 1, that is, in frictional or sliding mechanics the more degree of tipping is owing to the faster rate of space closure then loop mechanic. In sliding mechanics, this torque loss or deep bite tendency can be reduced by making bite opening curves or reverse curve of spee (RCS) in 0.19*0.25" SS wire so that the anterior teeth remain flared. From the present study it can be seen that if sliding mechanics with miniscrews as an indirect anchorage and with torque control of anterior teeth is carried out, it is superior then loop mechanics in terms of faster rate of space closure and less treatment time as compared to loop mechanics with miniscrews as an indirect anchorage. Also, the anchorage loss is similar in both the groups.

CONCLUSION

This study was undertaken to evaluate and compare the rate of space closure of en masse retraction with sliding mechanics using NiTi closed coil spring and loop mechanics using CNA mushroom loop archwire by taking indirect anchorage with miniscrews. Following observations were made: -

1. Both the mechanics are effective in space closure.
2. Amount of retraction and rate of space closure is more in sliding mechanics when en masse retraction was done with miniscrews as an indirect anchorage which is statistically as well as clinically significant.
3. Amount of anchorage loss was similar in both the groups.

Degree of tipping was seen to be more in sliding mechanics than loop mechanics which is statistically significant.

BIBLIOGRAPHY

1. Bills D.A., Handelman C.S., BeGole E.A. Bimaxillary dentoalveolar protrusion: traits and orthodontic correction. Angle Orthod. 2005;75(3):333–339.

2. Rizk ZM , Mohammed H, Ismael O and Bearn DR, Progress in Orthodontics 2017

3. Monini AC, Gandini LG, Jr, Santos-Pinto A, Maia LG. Procedures adopted by orthodontists for space closure and Anchorage control. Dental Press J Orthod. 2013; 18(6):86–92

4. Rhee JN, Chun YS, Row J A comparison between friction and frictionless mechanics with a new typodont simulation system Am J Orthod Dentofacial Orthop 2001;119:292

5. Burstone CJ- A segmented approach to space closure - American Journal of orthodontics and Dentofacial Orthopedics ;1982 ; 82: 5

6. Uribe F and Nanda R, Treatment of Class II, Division 2 Malocclusion in Adults: Biomechanical Considerations. J Clin Orthod. [2003 Nov; 37(11):599-606].

7. Papadopoulos MA, Tarawneh F. The use of miniscrew implants for temporary skeletal anchorage in orthodontics: A comprehensive review. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2007;103: e6–15.

8. Philip P, Jose NP, Versatile retraction mechanics: implant assisted en-masse retraction with a boot loop. Contemp Clin Dent. (March 2015 ;

9. Sharma K , Sandhu S, Gupta S , Malhotra S, A Cephalometric Evaluation And Comparison Of Two Retraction Loops I.e. T Loop And Mushroom Loop For Enmasse Retraction Of Upper Anterior Teeth During Space Closure. An In Vivo Study. Indian journal of dental sciences (December 2015, Issue: 5, Vol.:7).

10. Staggers, J. A. and N. Germane . Clinical considerations in the use of retraction mechanics. J Clin Orthod 1991. 25:364–369.

11. Steiner CC, Cephalometrics for you and me; AJODO October 1953 Volume 39, Issue 10, pages 729-755.

12. W B Down, Analysis of dental facial profile, Angle orthodontics; October 1956

13. Samuels RH, Rudge SJ, Mair LH. A clinical study of space closure with nickel-titanium closed coil springs and an elastic module. Am J Orthod Dentofacial Orthop. 1998 Jul;114(1):73-9

14. Storey E, Smith R. Force in orthodontics and its relation to tooth movement. Aust J Dent 1952;56:11-8.

15. Charles H. Boester and Lysle E. Johnston (1974) A Clinical Investigation of the Concepts of Differential and Optimal Force in Canine Retraction. The Angle Orthodontist: April 1974, Vol. 44, No. 2, pp. 113-119.

16. Almeida MA, Phillips C, Kula K, Tulloch C. Stability of the palatal rugae as landmarks for analysis of dental casts. The Angle Orthodontist. 1995 Feb;65(1):43-8.

17. Christou P, Kiliaridis S. Vertical growth-related changes in the positions of palatal rugae and maxillary incisors. American Journal of Orthodontics and Dentofacial Orthopedics. 2008 Jan 31;133(1):81-6.

18. Choi DS, Jeong YM, Jang I, Jost-Brinkmann PG, Accuracy and reliability of palatal superimposition of three-dimensional digital models. The Angle Orthodontist. 2010 Jul;80(4):685-91.