Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 32s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

Comparative Evaluation of Space Closure Using Different Elastomeric Modules During Sliding Mechanics: An In Vivo Study

Dr. Stuti Raj[1], Dr. Jitendra Bhagchandani[*2], Dr. Vaibhav Vashishta[3], Dr. Amit Kumar Singh[4], Dr. Ayushi Singh[5], Dr. Latika Sehgal[6]

[1]Assistant Professor, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raibareily Road, Uthrathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

Email ID: dr.stuti.raj@gmail.com

[*2]Professor & HOD, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raebareli Road, Utarathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

ORCID ID: 0000-0002-0183-6796

[3]Professor, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raebareli Road, Utarathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

Email ID: drvaibhavvashishta@gmail.com

[4]Associate Professor, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raebareli Road, Utarathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

Email ID: amitkr1088@gmail.com

[5]Assistant Professor, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raebareli Road, Utarathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

Email ID: drayushisingh87@gmail.com

[6]Assistant Professor, BDS, MDS, Sardar Patel Post Graduate Institute of Dental and Medical sciences, Raebareli Road, Utarathia, Lucknow – 226029, (Affiliated from – Atal Bihari Vajpayee Medical University), Uttar Pradesh, INDIA

Email ID: latika03sehgal@gmail.com

[*]**Corresponding author:**

Dr. Jitendra Bhagchandani

Email ID: drjitendrabhagchandani@sppgidms.org

Cite this paper as: Dr. Stuti Raj, Dr. Jitendra Bhagchandani, Dr. Vaibhav Vashishta, Dr. Amit Kumar Singh, Dr. Ayushi Singh, Dr. Latika Sehgal, (2025) Comparative Evaluation of Space Closure Using Different Elastomeric Modules During Sliding Mechanics: An In Vivo Study. *Journal of Neonatal Surgery*, 14 (32s), 5290-5294.

1. INTRODUCTION

Orthodontics is an area in dentistry which has a long run of existence and at all times it comes through various profound and comprehensive changes in terms of diagnosis, treatment planning, biological and biomechanical applications. In contemporary orthodontics, retraction of teeth after extraction of premolars is a prerequisite part of orthodontic treatment.[1] Retraction mechanics are categorized as different methods to close space, reduce overjet, procumbency and eliminate extraction space by anterior-posterior therapy.[2]Single step enmass retraction of 6 anterior teeth at once or two-step procedure in which canine has to retract first followed by retraction of 4 incisors are the most frequent routines to close the space created by the extraction of premolars.[3] Closing of extraction space is generally achieved by two general approaches i.e. by sliding mechanics/ friction or frictionless mechanics. The sliding mechanics involves pushing and pulling of the tooth along the continuous arch wire with a force delivery system able to sustain the movement.[4] Pre adjusted orthodontic treatment uses sliding mechanics with force delivery system such as elastomeric chain, nickel titanium coil springs, elastic module attached to wire ligatures or intraoral elastics.[5] Anchorage has long been one of the greatest problems in the field of orthodontics because teeth, even molars, move in response to orthodontic forces.[6] Temporary anchorage devices (TADs) have been used since the last century and have become an alternative reinforcement method to provide anchorage during space closure.[7,8]

There is limited data found in the literature till date for evaluating and comparing the space closure, using Alastic (3M Unitek) and O-Rings (Ormco) elastomeric modules in active tiebacks during distalisation of canines. The purpose of the study is to compare and evaluate space closure by distalisation of canine in maxillary arch using Alastic (3M Unitek) and O-Rings (Ormco) elastomeric modules with the help of TADs using siding mechanics after 6 weeks and 12 weeks.

2. METHODOLOGY

The study was conducted in Department of Orthodontics and Dentofacial Orthopaedics,

Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow. There were 36 subjects included in the study. The sample size was calculated using G Power software (version 3.1.9.4). The subjects were taken on the basis of inclusion and exclusion criteria.

Inclusion Criteria

- Informed written consent was obtained from the patient or guardian.
- Adult patients of age between 19-25 years who were fit for orthodontic treatment.
- Healthy individuals with DMFT>1 were considered.
- Patient with First premolar extraction in maxillary arch.
- Patients who were undergoing upper and fixed appliance treatment using pre-adjusted brackets system with a 0.022 slot with sliding mechanics.
- Patients in whom Temporary Anchorage devices were used as absolute anchorage.
- Retraction of each segment was done on 0.019x0.025-inch stainless steel arch wire.

Exclusion Criteria

- Patients with subsistence of periodontal disease.
- Patient with bone resorption.
- Patient having poor oral hygiene.

After extraction of maxillary first premolars TADs were placed for anchorage. A split mouth study was done for space closure with separate canine retraction from TAD in maxillary arch. Canine retraction was done with the help of active tieback type one using Alastic (3M Unitek) and O-Rings (Ormco) modules. The sample was divided into two groups

1. Group A- Upper left segment by active tieback one using Alastic (3M Unitek) modules. (Figure 1)
2. Group B- Upper right segment by active tieback one using O-Rings (Ormco) modules

The impression will be made periodically:-(Figure 2)

A. T0 at the time of retraction starts.
B. T1 at the time of 6 weeks of T0.
C. T2 at the time of 12 weeks of T0.

Figure 1: Group A

Figure 2 : Group B

Models were prepared at every interval. Space was measured on models at threetime intervals with the help of standardized Digital Vernier Caliper. The distance was measured from the tip of the canine and the mesiobuccal groove of the 2nd permanent molar of each maxillary right and left quadrant. (Figure 3) The data was recorded and was statistically analyzed.

Figure 3: Measurements of space closure with a calibrated Digital Vernier Caliper

3. RESULT

A total of thirty-six patients were enrolled in the study, with eighteen allocated to Alastiks (Group I) and the remaining eighteen to O-Rings (Group II). The mean space closure for participants in Group I was 23.72 mm (SD = 0.83) at 6 weeks and 21.29 mm (SD = 0.73) at 12 weeks. For Group II, the corresponding values were 24.1 mm (SD = 0.79) at 6 weeks and 21.65 mm (SD = 0.80) at 12 weeks. Descriptive statistics confirmed that the data were normally distributed. Group II participants treated with O-Rings showed slightly greater space closure than Group I participants treated with 3M Unitek Alastiks at both time points (Table 1).

Measurement	**Group I** (6 Weeks)	**Group I** (12 Weeks)	**Group II** (6 Weeks)	**Group II** (12 Weeks)
Mean (mm)	23.72	21.29	24.1	21.65
Standard Deviation	0.83	0.73	0.79	0.8
Median (mm)	23.7	21.26	24.12	21.7

Table 1 : Mean Space Closure of Group I and Group II

Boxplot analysis further illustrated this trend, revealing that O-Rings generally had a higher median space closure than Alastiks at both 6 and 12 weeks. The spread of values was similar across both groups, indicating comparable variability in treatment outcomes. The data suggest a slight clinical advantage for O-Rings, particularly evident at the 6-week interval (Figure 4).

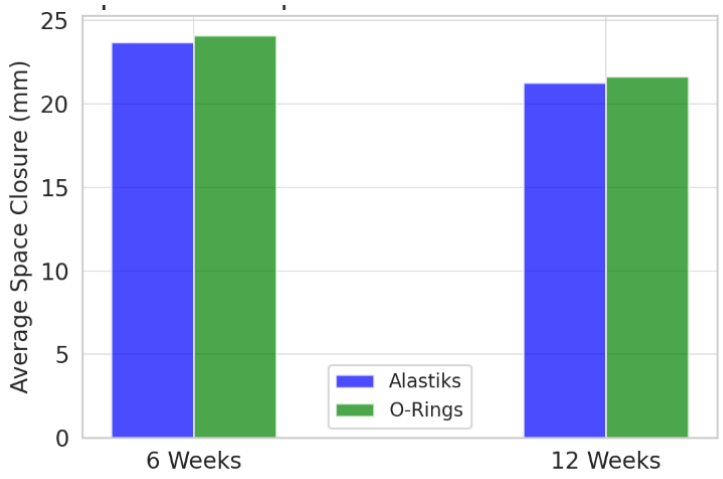

Figure 4 : Graph showing space closure at 6 and 12 weeks

The present study thus identified a consistent trend favouring O-Rings over Alastiks in terms of space closure efficiency. However, the differences between the two groups did not reach statistical significance at the 0.05 level. This indicates that while O-Rings may offer a modest advantage, the sample size used in this study may have been too limited to detect a statistically significant effect.(Table 2)

Time Point	t-Statistic	p-Value	Interpretation
6 Weeks	**-1.96**	**0.054**	**Close to statistical significance, but slightly above the 0.05 threshold.**
12 Weeks	**-1.98**	**0.052**	**Again, close to statistical significance, but just above 0.05.**

Table 2: Showing T-Test Results and P value

To further understand the magnitude of the observed differences, effect size analysis was conducted using Cohen's d. The effect size was calculated to be -0.47 at both 6 and 12 weeks, indicating a small to moderate effect. The negative values reflect the slightly superior performance of O-Rings compared to Alastiks. Although the associated p-values were just above the significance threshold, the moderate effect sizes point to a potentially meaningful difference in clinical practice.

4. DISCUSSION

The present study aimed to compare the efficiency of space closure between two common elastomeric ligature systems—Alastiks (Group I) and O-Rings (Group II)—at 6- and 12-weeks intervals. While the results did not reach conventional levels of statistical significance ($p > 0.05$), the trend and effect size analyses suggest a clinically meaningful difference favoring the use of O-Rings for orthodontic space closure.

Space Closure Efficiency

The mean space closure was greater in Group II (O-Rings) at both 6 weeks (24.10 mm vs 23.72 mm) and 12 weeks (21.65 mm vs 21.29 mm). These findings are consistent with previous studies indicating that the design and material properties of elastomeric ligatures can influence force delivery and efficiency of tooth movement. Nanda et al. (1994)[9] demonstrated that force degradation in elastomeric modules varies significantly by brand and material composition, with some O-Ring designs showing better sustained force delivery than other ligatures over time. Similarly, Bourauel et al. (1998)[10] emphasized that elastomeric rings with a tighter internal diameter tend to produce higher initial force levels, which may translate to more efficient space closure in clinical settings.

Effect Size and Clinical Relevance

While the p-values (0.054 at 6 weeks and 0.052 at 12 weeks) were slightly above the traditional threshold for significance, the Cohen's d of -0.47 indicates a small-to-moderate effect. This suggests that the difference, though not statistically significant due to sample size constraints, may still be clinically relevant. According to Sullivan and Feinn (2012)[11], effect size is a critical measure that helps contextualize the magnitude of difference in clinical research and should not be overlooked when p-values are borderline. Fleming et al. (2009)[12] also highlighted that moderate effect sizes in orthodontic interventions often have direct implications for treatment planning, even in the absence of statistical significance.

Correlation with Initial Space

The weak positive correlations observed between initial space and total closure ($r = 0.25$ for Alastiks and 0.12 for O-Rings) were not statistically significant ($p > 0.05$). This aligns with findings from Iwasaki et al. (2003)[13], who reported that the rate of tooth movement is influenced by multiple factors including bone density, anchorage control, and individual biological response, and not solely the size of the initial space.

Force Degradation and Clinical Implications

One potential explanation for the superior performance of O-Rings is lower force degradation over time. Studies by Kanchana and Godfrey (2000)[14] reported that Alastiks lose up to 50% of their force within the first 24 hours, whereas some O-Ring types retain more consistent force levels, especially in the first few weeks. This degradation pattern may explain the slightly greater space closure observed with O-Rings, especially during the critical early phases of space closure. Clinically, this suggests that O-Rings might be preferable in cases requiring predictable and continuous force application.

Limitations of the Study

- The sample size may not have been sufficient to achieve statistical significance, even though trends and effect sizes suggest meaningful differences.
- Patient-specific variables such as bone metabolism, oral hygiene, and compliance were not controlled in detail.
- Longer observation periods might provide a better understanding of cumulative space closure and relapse tendencies.

5. CONCLUSION

In conclusion, while the statistical analysis did not demonstrate significant differences between O-Rings and Alastiks, the moderate effect size and consistent trend favoring O-Rings suggest that these may offer more efficient space closure in clinical orthodontic practice. Further studies with larger sample sizes and longer follow-up periods are warranted to confirm these findings and better guide clinical decisions.

REFERENCES

[1] Erdinc AE, Nanda RS, Isiksal E. Relapse of anterior crowding in patients treated with extraction and nonextraction of premolars. AmJ Orthod Dentofacial Orthop. 2006;129(6):775–84.

[2] Mc Lauglin, Benett, Trevisi Systemized Orthodontic Treatment Mechanics. Mosby Elsevier. (2001); 249-277.

[3] Janson G, Busato MCA, Henriques JFC, DeFreitas MR, DeFreitas L. Alignment stability in class II malocclusion treated with 2- and 4-premolar extraction protocols. Am J Orthod Dentofacial Orthop. 2006;130(2):189–95.

[4] Barlow M, Kula K. Factors influencing efficiency of sliding mechanics to close extraction spaces: A systematic review. Orthod Craniofac Res 2008; 11: 65–73.

[5] Nightingale C, Jones SP. A clinical investigation of force delivery systems for orthodontic space closure. J Orthod 2003; 30: 229–236.

[6] Nanda R. Biomechanics and Esthetic Strategies in Clinical Orthodontics. 1st ed: Elsevier Inc.; 2005.

[7] Wahl N. Orthodontics in 3 millennia. Chapter 15: skeletal anchorage. Am J Orthod Dentofac Orthop. 2008;134(5):707–10.

[8] Antoszewska-Smith J, Sarul M, Lyczek J, Konopka T, Kawala B. Effectiveness of orthodontic miniscrew implants in anchorage reinforcement during enmasse enmasse retraction: a systematic review and meta-analysis. Am J Orthodontics Dentofacial Orthopedics. 2017;151(3):440–55.

[9] Nanda RS, Ghosh J. Biomechanics in Clinical Orthodontics. Elsevier; 1994.

[10] Bourauel C, et al. Force degradation of elastomeric chains—A comparison of in vitro and in vivo measurements. Eur J Orthod. 1998.

[11] Sullivan GM, Feinn R. Using Effect Size—or Why the P Value Is Not Enough. J Grad Med Educ. 2012;4(3):279–282.

[12] Fleming PS, Johal A. Self-ligating brackets in orthodontics: a systematic review. Angle Orthod. 2009;79(3):577–584.

[13] Iwasaki LR, et al. Tooth movement and root resorption associated with different force levels: a histologic study. Am J Orthod Dentofacial Orthop. 2003;123(3):312–318.

[14] Kanchana P, Godfrey K. Force degradation of elastomeric chain—A literature review. Eur J Orthod. 2000;22(4):401–405.