ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Retraction Mechanics: A Review.

Vinaya S Pai*, Siri Krishna, Abraham Thomas, Goutham Kalladka, and Tawqueer Afshan.

Department of Orthodontics and Dentofacial Orthopaedics, Bangalore Institute of Dental Sciences, Bangalore, Karnataka, India.

ABSTRACT

Extraction space closure is an integral part of orthodontic treatment which demands a thorough understanding of the biomechanics which leads to a better ability to decide on the anchorage and treatment options and prognosis of various alternatives. In the pre-adjusted edgewise technique, retraction is achieved either with friction (sliding) or frictionless mechanics. Sliding mechanics involves, moving of the teeth along an arch wire through brackets and tubes. Segmental mechanics involves, closing fabricated loops either in a full or sectional arch wire. Both the mechanics have their own merits and demerits. This article consolidates the basic information regarding the loop and sliding mechanics, their merits and demerits and also retraction with implants, their importance and application in contemporary practice.

Keywords: Frictionless mechanics, Sliding mechanics, Friction mechanics, Loop mechanics, Implants.

**Corresponding author*

INTRODUCTION

Extraction is a common option during the orthodontic treatment. For desired treatment objectives and outcomes, proper space closure mechanics is necessary [1]. The Anteroposterior therapeautic procedures carried out to close the spaces, correct procumbency, reduce overjet and eliminate extraction sites are generally categorized as "Retraction mechanics" [2].

Space closure requires the clinicians' ability to predict force system and control tooth movement after due consideration of the periodontal tissues. Orthodontic tooth movement during space closure is achieved through two types of mechanics:

- Sliding mechanics (friction mechanics)
- Segmental or Sectional mechanics (frictionless mechanics)

One of the disadvantages of sliding mechanics is that the friction is generated at the bracket / archwire interface, which may reduce the amount of desired orthodontic movement obtained. This slows tooth movement, compromises the delivery of desired force levels, causes anchor loss and may be associated with undesirable side effects such as uncontrolled tipping and deep bite.

In the sliding mechanics, the wire and position of the bracket control the tooth movement, whereas in a loop-spring system, control is built into the spring [2].

Hence, orthodontic space closure should be individually tailored based on the diagnosis and treatment plan. The selection of any treatment, whether a technique, stage, spring or appliance designs, should be based on the desired tooth movement. Consideration of the force system produced by an orthodontic device aids in determining the utility of the device for correcting any specific problem.

Friction mechanics

In friction mechanics, for bodily movement, there is no need to apply a balancing moment. The appropriate moment is applied via continuous arch wire to the teeth that passes through the brackets (Figure 1).When force is applied through a continuous arch wire passing through brackets, it undergoes a cycle of events. Example, on canine first there is controlled tipping then translation then root movement. The moments are delivered via couple forces, equal and opposite non-collinear vertical forces, at the mesial and distal bracket extremities. First the canine will tip distally until the diagonally opposite edges of the bracket slot contact and bind with the arch wire and produce a couple to upright the root. The magnitude of the moment is determined by the width of the bracket, wire size, shape and alloy. The moment to force ratio changes as the tooth moves from controlled tipping to translation to root movement. To predict accurate moment to force ratio it is difficult as the wire bracket friction is a variable factor [2].

Figure 1: Sliding mechanics

Frictionless Mechanics

Sliding mechanics has the disadvantage of frictional binding and swinging effect. This can be overcome by the use of a frictionless system, in which the loop acts as the source of the applied force. However, the frictionless system also has disadvantage of the complexity of loop forming and the presence of unknown factors. Minor errors can also result in major differences in tooth movement, and even the loop is uncomfortable for some patients [3]. Bending archwire loops of various configurations, sectionally is done to deliver the desired moment to force ratio to an individual tooth segmentally or in a continuous archwire. These arch wire loops when activated are friction free. As the teeth move, they distort from their original configuration, later the loop gradually returns to its preactivated position. Since brackets are not sliding along the arch wire during the process, it is completely friction free. Individual tooth or groups of teeth can therefore be moved more accurately for more precise anchorage control to achieve treatment [2].

Spring properties are determined by, wire material – Steel or β titanium, length of the wire incorporated, inter bracket distance, leg length of loop which includes wire diameter and loop design.

Advantages of Frictionless Mechanics [4]

The advantages of frictionless mechanics are as follows:

- There is precise control over anterior and posterior anchorage.
- Movement of tooth can be limited by activation of loop.
- Differential movement of tooth is possible.
- Retraction loops or springs, since they are frictionless offer more controlled tooth movement.

Disadvantages of Frictionless Mechanics [4]

The disadvantages of frictionless mechanics are as follows

- A thorough knowledge of mechanics is required when using retraction loops or springs, since minor error in mechanics can result in major errors in tooth movement.
- Time consuming- wire-bending skill and chair time are required.
- Retraction loop may be uncomfortable in patients with less vestibular depth.
- Loops sometimes produce an undesirable mesial out moment when individual teeth are retracted

Some of the loops are discussed below.

Burstone T-Loop Retraction Spring

Orthodontic load system of ideal moment-to-force ratio is the commonly used design parameter of segmental T-loops for canine retraction. But the load system, including moment- to-force ratios, can be affected by the changes in inter-bracket distances and changes in the canine angulations [5].

Figure 2: Activated T loop placed between canine and premolar for enmasse anterior retraction

The T-loop was first introduced by Charles H. Burstone at the University of Connecticut in 1982. It is fabricated from 0.017 x 0.025 inch TMA or 0.16 x 0.022 inch SS wires. It was specially designed for canine retraction in segmented arch technique and enmasse or separate incisor retraction. It has a horizontal loop of

10 mm length and 2 mm diameter. Mesial leg is of 5 mm height and distal leg is of 4 mm height. Anti-rotation bends of 120° is given between the legs during pre-activation. T-loop is activated horizontally by 4mm [4]. (Figure 2).

K-SIR Loop

K-SIR loop is a modification of the segmented loop mechanics of Burstone and Nanda. It is also known as Kalra Simultaneous Intrusion and Retraction. It is made up of 0.019 x 0.025 inch TMA archwire with closed 7 x 2 mm U-loops at the extraction sites [4]. A trial activation of the archwire is performed outside the mouth. This releases the stress built up from bending the wire and thus reduces the severity of the V-bends. Neutral position of the each loop is determined after trial activation is determined with the legs extended horizontally. U-loop will be about 3.5 mm wide in neutral position. K sir loop archwire is inserted into the auxillary tubes of the first molars and engaged in the six anterior brackets and then activated for about 3 mm, so that the mesial and distal legs of the loops are barely apart. To increase the interbracket distance between the two ends of attachment second premolars are bypassed [4].

PG Universal retraction spring

Sectional arch technique facilitates creation of an optimal force system to fulfill the biomechanical requirements for planned tooth movements. During the retraction, for controlled canine retraction, in extraction cases, it requires the creation of a biomechanical system to deliver a predetermined force and a relatively constant moment-to-force ratio to avoid distal tipping and rotation. To avoid any unwanted side effects and undesirable changes in the occlusal plane, the responsive couple delivered to the anchorage unit should be adjusted well. A PG Universal canine-retraction spring is constructed from 0.016 × 0.022 inch stainless steel wire, a double ovoid loop of 10 mm being the principal element. A “sweep” bend should be incorporated to avoid any unwanted side effects at the second premolar [6]. The spring is activated by pulling distal to the molar tube until the two loops separate (Figure 3).

Figure 3: Activated PG spring for retraction of canine

Opus loop

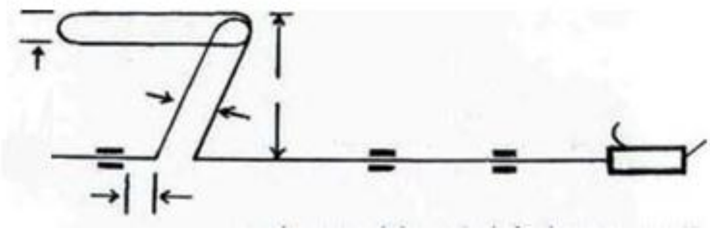

Figure 4: Opus loop

Opus loop is designed in such a way that its inherent moment-to-force ratios are sufficient for en masse space closure via translation for teeth of average dimensions (Figure 4). Since moment-to-force ratios of loop are high enough, no activation bends or bends are added before insertion. Due to lack of activation bends, the loop's neutral position is precisely and accurately defined. Since the loop's neutral position is easily and accurately determined by the clinician, cinch- back activations after insertion can take advantage of tooth movement thresholds to meet anchorage treatment objectives [7].

Ricketts' maxillary canine retractor

Ricketts' maxillary canine retractor is a combination of a double closed helix and an extended crossed *'T.* This retraction spring is a double vertical helical extended crossed T closing loop spring which contains 70 mm of the wire made of 0.016'' x 0.022'' SS wire. This spring produces only 50 gm per mm of activation. Because of the additional wire used in its design and when all loops are being contracted during its activation 3-4 mm of activation is sufficient for upper cuspid retraction [4].

Other Types of Loops include tear drop loop, double key hole loop, Omega loop, box loop, boot loop, double delta, vertical loop etc.

Retraction by implants

In cases of dental bimaxillary cases were maximum posterior teeth anchorage is of prime importance, Implants are of great consideration. With the introduction of dental implants, as anchorage units, it is possible to close the extraction spaces completely by anterior tooth retraction with absolute anchorage of the posterior teeth [8]. (Figure 5).

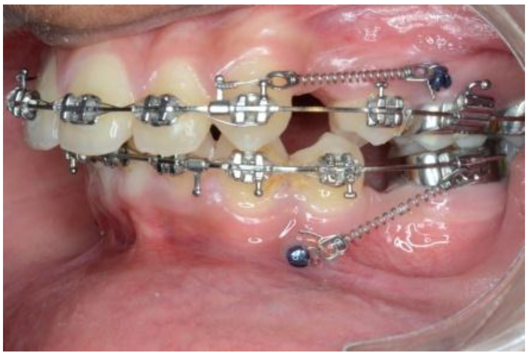

Figure 5: Retraction by Implants

Tooth movement that can be produced with microimplant anchorage is determined by the same biomechanical principles and considerations that operate during conventional orthodontic treatment, *e.g.,* force, moment, center of resistance, center of rotation. In order to achieve desired movement in particular case, a microimplant can be placed in many different areas of the mouth and at different heights on the gingiva relative to the occlusal plane, creating several biomechanical orientations, *e.g.,* low, medium and high. Thus, depending on the position of the microimplant, various types of tooth movement can be produced [9,10].

CONCLUSION

Extraction is a common treatment option in orthodontics. Friction and frictional mechanics have their own merits and demerits. Frictionless mechanics are more effective at reducing tipping and extrusion while the Frictional binding and the swing effect are the main problems associated with sliding mechanics. In order to overcome this, frictionless system is opted, which includes a loop as the source of the applied force. Again frictionless system also has its demerits. It fails to produce better results in practice because of the complexity of loop forming and sometimes it is not comfortable to the patient. In addition, minor errors in loop can result in major differences in tooth movement. Biggest advantage of retraction with closing loop mechanics is that force level can be predicted which helps for the desired tooth movement. Load deflection rate is considered as a principle characteristic to describe a spring for closing loop mechanics. Friction mechanics is considered superior over frictionless system in terms of rotational control and dimensional maintenance of the arch. No difference is found in anchorage control. Implants serve a major purpose whenever anchorage is of prime consideration.

REFERENCES

[1] Nanda R. Clin Orthodont 2005 ; 194-209.
[2] Shivkumar A. J Ind Orthod Soc 2006;39:101-109.
[3] Rhee JN, Chun YS, Row J. Am J Orthod Dentofacial Orthop 2001;119:292-9.
[4] Chakravarthy CHN, Kumar PK. Indian J Mednodent Allied Sci 2014;2(1):57-63.
[5] Xia Z, Chen J, Jiangc F, Li S, Rodrigo F, Viecilli and Liu SY. Am J Orthod Dentofacial Orthop 2013;144:548-56.
[6] Gjessing P. Am J Orthod Dentofacial Orthop. 1985; 87: 353-61.
[7] Siatkowski RE. Semin Orthod 2001;7: 141-149
[8] Upadhyay M, Yadav S, Nagaraj K, Patil S. Am J Orthod Dentofacial Orthop 2008;134:18-29
[9] McNamara J.A -Microimplants in Orthodontics; Page no 62-65.
[10] Park HS, Kwon TG. Angle Orthod 2004;74:703-710.