Review Article

Ligation ties in orthodontics

ABSTRACT

During fixed orthodontic treatment, ligation method refers to the means by which an archwire is held inside the bracket. It can also be used to move the tooth in a particular direction depending on the type of ligature used and its method of ligation. Ligation can be done using stainless steel ligatures or elastomeric modules, or more recently, ligation methods have been designed and built directly into the bracket. Metal or elastic ligatures are used for this purpose, and the way they are tied affects tooth movement. Because of their design, twin brackets can be tied in a large variety of ways. Knowing how to use all the bracket's resources makes for better and faster treatment results. Elastic ligature may be a substitute for the wire ligatures in most situations. In various treatment mechanics, ligation ties are modified to accomplish variable tooth movement or to maintain arch form integrity during finishing of an orthodontic case. This article will highlight different ligation methods used in different bracket systems and their indications as well.

Keywords: Elastic modules, ligation ties, rotation ties, stabilization ties, stainless steel ligation

INTRODUCTION

In orthodontics, ligation method refers to the means by which an archwire is held inside the bracket. It can also be used to move the tooth in a particular direction depending on the type of ligature used and its method of ligation.

In general, metal or elastic ligatures are used for this purpose, and the way they are tied affected the tooth movement.[1] As twin brackets have four tie wings, so wire can be tied to brackets in a variety of ways. Ligation ties play an important role not only in twin brackets (edgewise, MBT, and Roth) but also in different bracket prescriptions such as Begg, tip edge, and lingual orthodontics. In this review article, we will be discussing the various types of ligation techniques, their indication and contraindication as well as their application in orthodontics.

Ligation in twin bracket system

During orthodontic tooth movement, archwires are tied to the bracket slots with metal ligatures, elastic modules. Recently, self-ligating brackets can be used that do not incorporate any ligation method [Figure 1A-C].[1,2]

Classification of ligature ties

Based on material used

- Metal ligature
- Elastic ligature
- No ligation system.

Based on the modes of tying archwire to the slot

1. Basic ligation ties
   a. Straight tie
   b. Double tie

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2. Isolated tie
3. Rotation tie
   a. Circumferential tie
   b. Anti-rotation tie
4. Extrusion tie
5. Stabilization tie
6. Double ligation tie
7. Tie together or figure of eight
   a. Anterior region
   b. Posterior region
   c. Lace back tie
8. Kobayashi ties

Ligation in lingual orthodontics

1. Double over tie
2. Modified double over tie
3. Smith's rotation tie.

Ligation ties in Begg

1. Cuspid tie.

Based on material used

Metal ligature

Majority of fixed orthodontic appliances have stored tooth-moving forces in archwire, which are deformed within their elastic limit. For this force to be transmitted to a tooth, wires need a form of connection to the bracket.

1. Stainless steel (SS) alloy wires of varying gauge (0.009–0.014 inch) are used
2. Tips are twisted together to ensure firmness
3. Twisted end is folded back under the archwire
4. Secured tie of archwire to bracket slot
5. Lesser friction
6. Slower rate of force decay compared to elastomeric modules.

Elastic ligature

1. Substitute for metal ligatures
2. Easier to apply
3. Lesser strength
4. Available in different colors
5. As fluoride-releasing agent
6. To reduce the white spot lesions
7. Less patient discomfort
8. They are preferred in those situations where there is a higher tendency for debonding of brackets.

No ligation system

Self-ligating brackets do not use any ligation method and can be divided into two main categories, active and passive, according to their mechanisms of closure. Active self-ligating brackets have a spring clip that stores energy to press against the archwire for rotation and torque control. On the other hand, passive self-ligating brackets usually have a slide that can be closed which does not encroach on the slot lumen, thus exerting no active force on the archwire.[1]

Basic ligation ties

Basic ligation ties secure the wire into the bracket slot firmly. This could be done in normal (straight tie) pattern [Figure 2] or double tie pattern [Figure 3] with elastic as well as metal ligatures.

Isolated tie

For rotation correction, a single wing of one bracket is tied to pull the tooth into the arch form using either elastomeric modules or metallic ligature [Figure 4a-c].

Rotation tie

Rotation ties used for derotation of tooth to get the desired inclination of the tooth on its axis are further divided into three types:

Circumferential tie

A elastic module attached to the ligature wire, and then, the elastic module is tied to the bracket slot and tightly tied to the main archwire to deliver a force for longer period of time in both anterior and posterior teeth [Figure 5a].[2]

To improve the mechanical efficiency of circumferential ligations, a combination of ligature wires and elastomeric ligatures is used. In this case [Figure 5b], the ligature thread passes through the elastomeric ligature previously fitted into

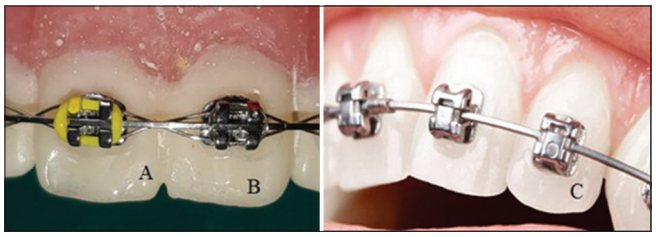

Figure 1: (A) Elastic ligature, (B) Metal ligature, (C) Self-ligating brackets

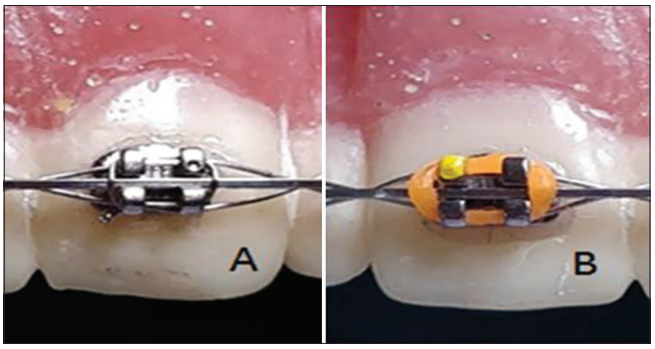

Figure 2: Straight tie with metal ligature and elastic module

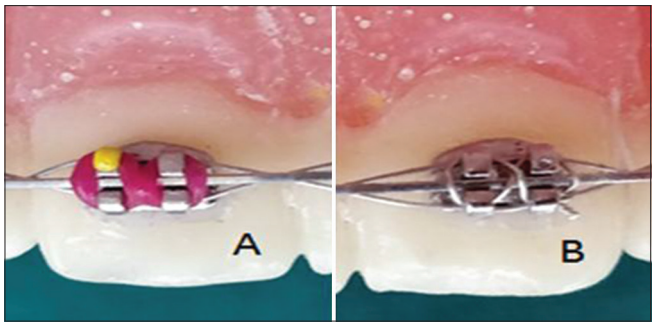

Figure 3: Double tie in figure-of-eight pattern with elastic module and metal ligature

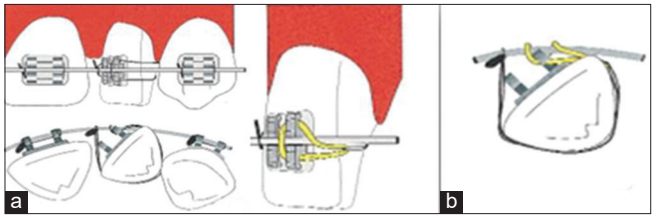

Figure 5: (A) Circumferential tie with elastic module and metal ligature for correction of rotated tooth. B) Circumferential tie with elastic module and ligature thread for correction of rotated tooth

the part of the twin bracket closest to the archwire. When the metal ligature is tied to the archwire, the elastomeric ligature will be activated. An additional advantage of this type of tie is that it provides prolonged action of the force applied.

Anti-rotation ties

A probe is inserted while ligation to ensure slack to reduce friction and reduce rotation during space closure [Figure 6].

In a number of situations, the orthodontist needs to make an extrusion tie for a tooth positioned cervically to such an extent that the archwire cannot be properly bent for insertion in the bracket slot even if loops are made or memory shape alloys are used. The ties are repeated as often as necessary until sufficient extrusion has been obtained for the archwire to be slotted and a basic tie performed. There are three techniques for extrusion ties.[3]

1. The ligature thread is looped around the archwire, wrapped around the cervical portion of the bracket's wings, and attached to the archwire [Figures 7a,8a]
2. The ligature loops around the cervical wing of one bracket, wraps around the archwire, [Figure 7b]
3. The ligature thread is looped around the cervical bracket wings, pulled toward the archwire, which also loops around, and then threaded back to the wing where the tie was initiated. At this point, it is twisted until the archwire becomes slightly deflected [Figure 7c].

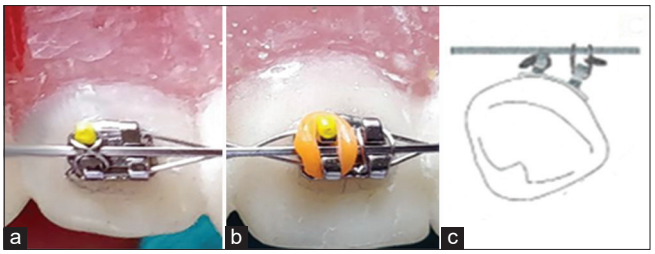

Figure 4: (A,B) Isolated tie with elastic module and metal ligature for correction of rotated tooth. C. Occlusal view of isolated tise for derotation of tooth.

Figure 6: Anti-rotation tie prevents unwanted rotation during orthodontic treatment

It should be ensured that the twist is made as close as possible to the bracket as it is susceptible to displacement, which can evoke trauma to the buccal and labial mucosa.

Stabilization tie

Some orthodontic cases require the use of segmented round archwires. One common problem that arises in such cases is the rotation of the archwire in the bracket slots because of a combination of the curve of Spee and the shape of the archwire. To prevent such rotation, stabilization ties are used [Figure 8]. This can be done by introducing a vertical bend at one end of the archwire. The technique consists of using the ligature wire to bind the vertical section of the archwire so that the loop tightens even more when the tie is made. The same principle allows one to attach artificial teeth to round archwires in the initial phases of treatment for patients with missing teeth [Figure 8b]. This requires the incorporation of a simple loop on the archwire, slightly larger than the height of the bracket and at the mesial or distal. The loop must be located next to the bracket.[4]

Double ligation tie

This technique uses a SS ligature instead of elastic O rings [Figure 9]. First, place the ligature under both the bracket wings and the archwire (A). Cross the ligature over itself on the gingival side (B). Next, bring the ligature over the wire on the less rotated side, seating it loosely into the bracket slot. Finally, tie the ligature under the bracket wings and into a pigtail on the more rotated side of the tooth (C). This allows full engagement of the wire and thus a complete expression of its properties.[5]

Tie together or figure-of-eight ligation

1. Anterior segment
2. Laceback tie
3. Posterior segment.

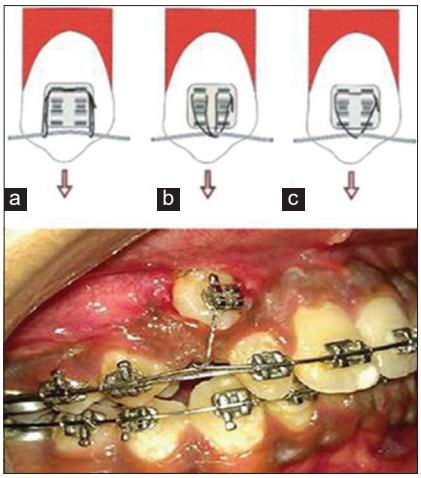

Figure 7: Various types of extrusion ties (a)The ligature thread is looped around the archwire, wrapped around the cervical portion of the bracket's wings and attached to the archwire. (b) The ligature loops around the cervical wing of one bracket, wraps around the archwire, (c) The ligature thread is looped around the cervical bracket wings, pulled toward the archwire, which also loops around, and then threaded back to the wing where the tie was initiated. At this point, it is twisted until the archwire becomes slightly deflected.

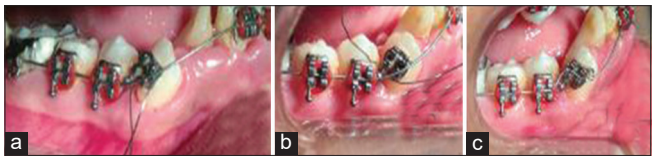

Figure 9: Double ligation tie- (A) place the ligature under both the bracket wings and the archwire. (B) Cross the ligature over itself on the gingival side. (C) Next, bring the ligature over the wire on the less rotated side, seating it loosely into the bracket slot. Lastly, tie the ligature under the bracket wings and into a pigtail on the more rotated side of the tooth

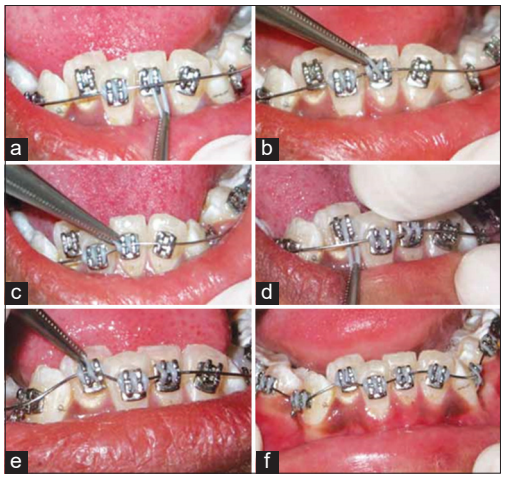

Figure 11: Double ligation tie- (A) place the ligature under both the bracket wings and the archwire. (B) Cross the ligature over itself on the gingival side. (C) Next, bring the ligature over the wire on the less rotated side, seating it loosely into the bracket slot. Lastly, tie the ligature under the bracket wings and into a pigtail on the more rotated side of the tooth

Anterior segment

Figure-of-eight ligation in the anterior segment can be done to make anterior 6 or 4 teeth as a unit. This prevents unnecessary tooth movement during retraction or intrusion [Figure 10a].

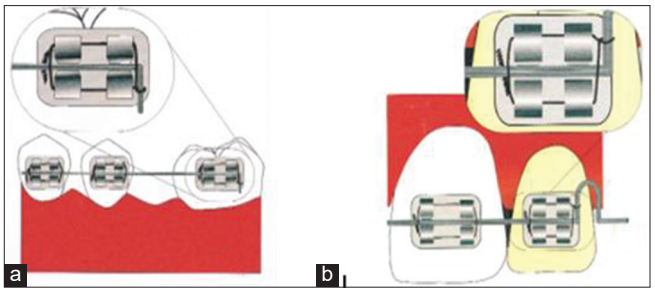

Figure 8: Stabilization tie, (a) Stabilization tie for Segmental round wire, (b) Stabilization tie for artificial tooth

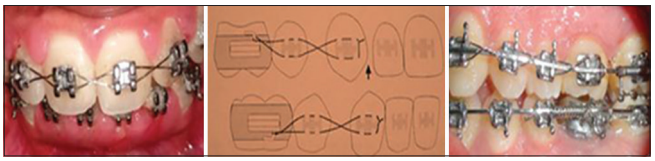

Figure 10: (a) Figure of 8 ligation in anterior segment (b) Laceback Tie (c) Fig. of 8 pattern ligation is done to make posterior unit

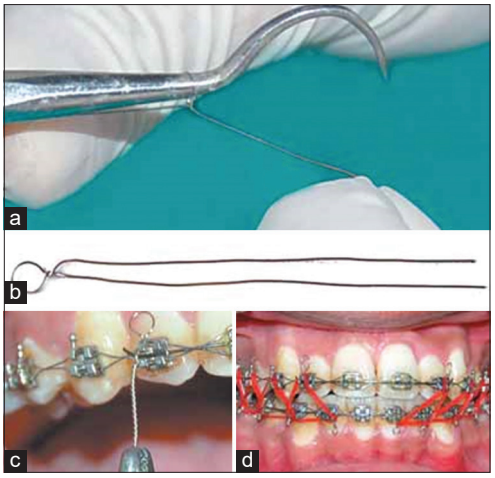

Figure 12: Kobayashi Ties (A) Wrap a length of .010" stainless steel ligature wire around an explorer. (B). Give the wire two or three twists, so that a small, circular loop is formed when the wire is removed from the explorer. (C). Ligate the Kobayashi tie to the bracket with the loop on the distogingival or mesiogingival side as required. (D) Up-and-down elastics can then be engaged for settling the occlusion

Laceback tie

This figure-of-eight pattern ligation is done from first molar to canine during and before retraction as well, to tip the canine distally and to relieve the crowding in the anterior segment as well [Figure 10b].

Posterior segment

This figure-of-eight pattern ligation is done to make the posterior unit as a segment and to provide better anchorage during canine retraction [Figure 10c].

Modified figure-of-eight pattern

Sometimes, conventional ligation either fails to seat the wire firmly into the slot or exerts excessive force leading to failure of the bond. A modified figure-of-eight ligation for speedy correction of rotated teeth is suggested to ensure better ligation of the wire into the bracket by increasing the tension of the elastomeric module at the same time preventing excessive ligation force and risking bond failure. It ensures a faster transition to the regular figure-of-eight ligation that ensures complete derotation. This method has been used by the author for the last couple of years and has proved successful in derotating anteriors and premolars alike. A stepwise description of the technique is presented here.[6]

- Step I: Place the elastic module over one wing of the bracket of the rotated tooth, preferably the one closer to the wire without including the wire [Figure 11a and d]
- Step II: Bring the module over the wire from the gingival or occlusal in a figure-of-eight fashion including the wire and place over the other wing or the more distant or second wing [Figure 11b, c, e and f].[6]

Advantages

This modification has many advantages

- It ensures early ligation of the more distant wing with adequate force
- The wire presses against the module at the less deviated wing pushing it in the opposite direction, thereby hastening the derotation
- The modules can be changed without removing the wire
- Faster transition to the regular figure of eight to complete the derotation
- Faster derotation.

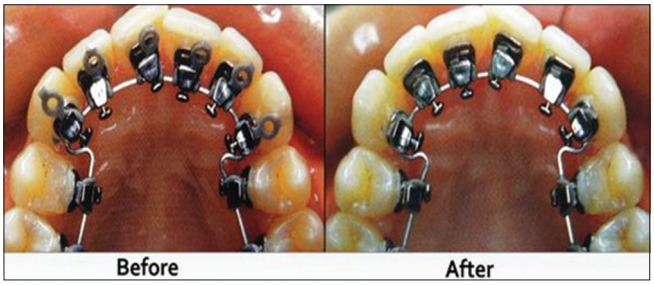

Figure 13: Double over tie

Figure 15: Modified double over tie

Kobayashi ties

The Kobayashi tie is commonly used for attaching up-and-down elastics during the settling stage of treatment. We have devised a new method of forming the loop for a Kobayashi tie by twisting the ligature wire rather than spot welding the ends together, as is done with the preformed commercial version [Figure 12].

Wrap a length of 0.010" SS ligature wire around an explorer 1 (A). Give the wire two or three twists, so that a small, circular loop is formed when the wire is removed from the explorer (B). Ligate the Kobayashi tie to the bracket with the loop on the distogingival or mesiogingival side as required (C). Up-and-down elastics can then be engaged for settling the occlusion (D).[7]

Ligation in lingual orthodontics

Double over tie

Standard ligation is not sufficient to seat and hold the bracket into the lingual slot. The ligation method in lingual orthodontics is double over the tie, and it is done with both metal and elastic ligatures. This tie improves the rotation and

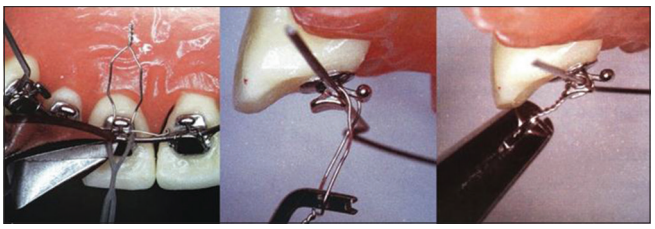

Figure 14: Steel double over tie

Figure 16: Smith's rotation tie

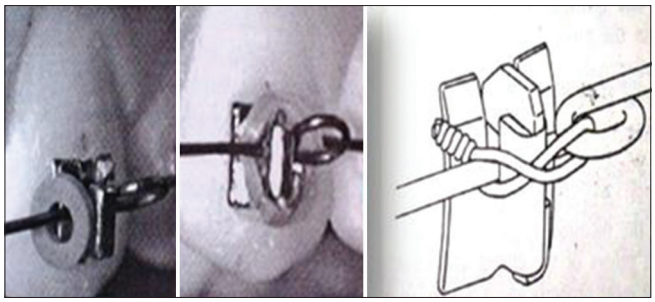

Figure 17: Ligation ties in Begg

torque control. The bicuspids are ligated with a conventional tie. To accomplish a double over tie ligation, a three-unit power chain is mounted on each anterior bracket. The wire is then inserted and chain is stretched over wire. The excessive two pieces of chin are cut with scissors [Figure 13]. It is very effective at controlling tip in lingual brackets using a variety of archwires.

Steel double over tie: The same procedure was done with ligature wire [Figure 14].

Modified double over tie

It is used in lingual orthodontics to secure the wire under occlusal wing [Figure 15].

Smith's rotation tie

This is the most effective method to correct a rotated tooth in lingual orthodontics. A 5–7-unit power E-chain is first tied to the archwire at the interproximal junction in direction in which the tooth is rotated. The last lumen of the chain is slipped over the end of the archwire if it was removed from the mouth. A slipknot may be formed over the archwire by passing one end of the chain through the expanded lumen at the other end of the chain. The chain is then brought around the labial surface, through the interproximal contact using a floss threader, under the archwire, and attached to the ball hook [Figure 16].[7]

Ligation ties in Begg

Cuspid tie

This type of ligation is usually done in Begg bracket system, and this maintains anterior teeth as a unit and causes closure of generalized spacing in the anterior segment this could be done with elastic module or ligature wire [Figure 17].[8]

CONCLUSIONS

1. The design of twin brackets can be implemented in different ways to obtain tooth movement
   a. Knowing how to use all the bracket's resources makes for better and/or faster treatment results
2. Orthodontists should use their knowledge and creativity in tying the brackets as tools for obtaining excellence in orthodontics.

This review article will help us in selecting appropriate tie as per the clinical requirements for easy and stable accomplishment of fixed orthodontic treatment.

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Conflicts of interest

There are no conflicts of interest.

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