NiTi SEGMENTAL WIRE SYSTEM FOR THE DEROTATION OF CANINES AND PREMOLARS

Sander FM*, Inglezos E**, Sander FG***, Sander C***
* Frankfurt (Germany)
** Athen (Greece)
*** Ulm (Germany)

SUMMARY

In the case of a fixed appliance therapy, canines or premolars must often be derotated. If this derotation is carried out during the levelling phase on the continuous archwire, it can lead to undesired side effects on the neighboring teeth. A 0.018" x 0.018" derotation segmental archwire was developed at the University of Ulm in order to start the derotation as early as possible. It can already be inserted during levelling. A vertical slot bracket, an elastic ligature, and the derotation archwire are necessary for it. The derotation archwire was tested in its clinical application. The occurring forces and torquing moments were measured in vitro with the help of a three-dimensionally working sensor. In this test a derotation moment of 12 Nmm occurred for the canine in the case of a 140° rotation of the archwire and a force in lingual direction. An overcorrection was also possible with this archwire, since it is still active after complete derotation. The complete derotation of the tooth was effected without any reactivation due to the superelasticity of the wire.

MATERIAL AND METHOD

We use brackets with a 0.018" x 0.018" vertical slot for the derotation of teeth (Figure 1). These brackets belong to the Mini-Mano series of brackets (Forestadent, Pforzheim). For the exertion of the torquing moments a 0.018 x 0.018 NiTi wire (Titanol®, Forestadent, Pforzheim) is used (Figure 2). This segmental archwire can be purchased prefabricated from the Forestadent company as “derotation spring”, or it can be fabricated by the practitioner himself out of a 0.018" x 0.018" NiTi wire with the help of a Memory-Maker (Forestadent, Pforzheim). The NiTi wire shows a 90° bend and can either be put in the second molar tube for distorotation, or, depending upon the tooth to be derotated, ligated to the more mesial or more distal brackets as piggy-back archwire (Figure 3, Figure 4). Figures 5 and 6 show the in vitro measurement set-up during the derotation of a canine and the corresponding coordinate system. In an experiment, the acting forces and moments are measured. The experimental set-up consists of a rotary table. That allows the simulation of rotational movements without restriction. In order to measure the forces and moments, a force/moment sensor (self-construction) was put on the rotary table recording the forces and moments acting on the tooth to be derotated (Figures 5). This sensor has a measuring range of +/- 10 N with a resolution of 12 Bit. This means that the resolution is 0.01 N. The torquing moments have a range of +/- 0.1 Nm and a resolution of +/-0.05 Nm. Although this measuring set-up (Figure 6) reproduces all forces and moments in three-dimensional direction, only the forces in transversal direction and the torquing moments around the vertical dental axis are represented graphically for this publication. For the measurements the wire length of the nickel-titanium wire was fixed to 30 mm and the wire was torqued by up to 140°. All measurements were carried out at a temperature of 37°C +/- 0.5°C.

RESULTS

The resultant torqueing moment was about 6 Nmm with a 80° torque and achieved 12 Nmm at 140° (Figure 7). The course of the torqueing moment graph corresponds to the expectation for a pseudoelastic wire. The unloading curve shows a plateau of about 5 – 7 Nmm in the case of an activation of 30° - 110°. The result means that a moment of about 6 Nmm is still acting on the derotated tooth, and this can be used for an over-derotation of the tooth. If an over-correction is required, a steel ligature on the canine can stop the movement or the derotation spring can be removed.

The torqueing moment acting on the canine has the effect of an eccentric bond. This means that a tooth to be derotated is moved lingually or palatally with the force to read from figure 8. At the same time, the anchoring segment (the molar) is loaded vestibularly with this force. The torqueing moment produces a buccally directed force at the molar and the same force at the canine in opposite direction. The eccentric forces also show the typical behaviour of a pseudoelastic alloy on the unloading curve. There is a force plateau of 0.35 N – 0.6 N between 40° - 110° activation. The tooth should be tied to the archwire via a ligature (Figure 9) in order to avoid a lateral movement. The lateral movement of the tooth to be derotated is fixed to the levelling arch in order to avoid a palatal or lingual movement of the tooth. The element for derotation must have a cross section of 0.018" x 0.018", so that the vertical slot is completely filled.

CLINICAL RESULTS

During levelling, space is created for the tooth to be derotated. This is done with the help of compression springs or correspondingly fixed tension springs. In cases where the patient reacts sensitively to the NiTi wire, there is the possibility to cover it with a tube. In the case of an over-rotation, the tooth 43 is mesially rotated by about 90°. The derotation archwire is inserted. After eight weeks the canine is completely derotated, a reactivation is not necessary (Figure 12). A fixation of the spring is not necessary, since it is held by friction. In the case of the male patient C.K., both maxillary canines are mesially rotated. The derotation archwires are applied directly after bonding fixed appliance (Figure 13). The teeth are derotated without reactivation (Figures 14, 15).

DISCUSSION

It is very seldom that a tooth movement can be carried out without side effects. The side effects should be kept to a minimum or compensated. The segmental arch technique is a solution [2, 3, 9]. Only slight side effects on the lateral incisors may be accepted during the derotation of canines and premolars. The method reproduces all forces and moments in three-dimensional direction, only the forces in transversal direction and the torquing moments around the vertical dental axis are represented graphically for this publication.

CONCLUSIONS

The derotation of premolars and canines with a NiTi wire is a simple and clear method that can also derotate extremely rotated teeth without interrupting the levelling phase. The occurring torqueing moments are quite moderate, and the forces from the eccentric bond can be intercepted by the existing levelling arch. Since the nickel-titanium wire has a large range of activation, reaction during rotation is not necessary. The tooth to be derotated is fixed to the levelling arch in order to avoid a palatal or lingual movement of the tooth. The element for derotation must have a cross section of 0.018" x 0.018", so that the vertical slot is completely filled.