COMPARE DENTAL MOBILITY FOR TWO TYPES OF CAD/CAM RETAINERS – PRELIMINARY STUDY

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Abstract

Relapse or "complete or partial return of the primary dento-alveolar deformity" is a problem accompanying evey orthodontic treatment. To prevent it, different types of retainers are used, and over time the fixed retainers have become more popular. They are best suited for lifelong retention and provide long term stability of the treatment results.

Remodeling of gingival fibers during and after orthodontic tooth movement leads to imbalance after removal of orthodontic appliances. The purpose of retention is to maintain the teeth in the post-treatment position during the periodontal remodeling period and to minimize changes from growth, thus achieving a stable result. The periodontal remodeling is delayed if the physiological mobility of the teeth during function is absent or severely limited. For this reason, the retention device must simultaneously ensure the retention of the treatment result and allow the physiological mobility necessary for the remodeling of the periodontal fibers.

Aim:

The goal of the study is to determine the differences in tooth mobility when using CAD/CAM retainers made by milling from Ti and by direct metal laser sintering from Co-Cr.

Material and methodology:

In the study, we measured the individual tooth mobility of the lower frontal teeth after orthodontic treatment with braces removed and with fixed retainer. We performed the measurements with Periotest M. The retainers used were made using two CAD/CAM technologies – milling and direct metal laser sintering. For the milled

retainers we used Titan Biostar °5 (SILADENT) and a 5-axis dental milling machine. For the sintering of the retainers we used Virobond C+ metal powder and a laser sintering machine Truprint 1000.

Results :

Research has shown that retainers made by milling Ti alloy discs allow greater tooth mobility compared to Co-Cr retainers made by direct metal laser sintering. Ti retainers allow for greater thinning during postmilling processing. Along with this, Ti alloy has greater elasticity compared to Co-Cr alloy.

Conclusion :

Retainers made by milling Ti limit to a lesser extent the physiological mobility of the teeth. The reason for this is the mechanical properties of the material. This allows for a better biological response and a faster and adequate restorative processes in the periodontal ligament during the retention phase.

Keywords: Titanium, Co-Cr, Retainer , Milling , Laser sintering of metal

Introduction

The relapse or "full or partially return on the primary dento-alveolar deformity” represents a form of physiological recovery or adaptation after the treatment to changes in mechanical conditions related to the removal of orthodontic forces without including the normal changes in the body during aging (1).

When the teeth are moved during orthodontic treatment, the periodontal fibers are stretched by the applied forces. These stretched fibers create an imbalance after the removal of orthodontics appliances. (2,3) The tendency to create equilibrium in the system leads to relapse and it is most pronounced immediately after the removal of the appliances(4).

The purpose of retention is to maintain the teeth in the post-treatment position during the periodontal remodeling period and to minimize changes from growth, thus achieving a stable result(5). The remodeling and adaptation of the periodontium to the new conditions decreases if the physiological mobility of the teeth during function is not ensured(6,7,8). For this reason, the retention device must simultaneously ensure the retention of the treatment result and allow the physiological mobility necessary for the remodeling of the periodontal fibers.

The permanent retention provides long term stability of the results of the treatment (9). After the introduction of fixed retainers for the first time by Knerim in 1973(10) Zachrison introduced the use of a multistrand wire fixed on the lingual surface of the teeth, which allows the retention of the result for a long period of time (11,12,13). Over the years, this type of retainers have been accepted as the "gold standard" for retaining the treatment result, as there are many varieties in thickness, section and number of twisted threads (14). Zachrisson (15) describes the main indications for a retainer fixed to all frontal teeth, but these indications, in most cases, require long-term or permanent retention after completion of orthodontic treatment (16).

The standard multistrand wire retainers continue to be considered temporary due to concerns related to high risk from defects at the bonding site (17,18,19,20), reduced comfort on the patient, limited access for maintenance on hygiene (21), thick layers of material in places on adhesion – up to 1 mm and significant distances between wire and teeth . The success rate of these retainers decreases furthermore when, in addition to the 4 incisors , the retainer also extends to the canines. The failure rate of these retainers increases significantly when premolars are included (22).

These disadvantages can be significantly reduced through the use of CAD/CAM methods for design and manufacture of retainers(23). This technology allows precise determination of the retainer's boundaries, its shape, size and contact with the teeth. In addition to the high accuracy and predictability of the result, the possibilities for passive fixation of the retainer and its retention effect are significantly improved. Three-dimensional visualization of the situation allows planning that improves the accuracy of fixed retainer positioning in limited space or atypical tooth shapes, especially in the upper frontal segment (24,25).

Aim

The goal of the study is to determine the differences in tooth mobility when using CAD/CAM retainers made by milling from Ti and by direct matte laser sintering from Co-Cr.

Materials and methodology

In the study we included 25 patients who have concluded their orthodontic treatment . 10 of the patients received fixed lower lingual Co-Cr retainer, and 15 of them recieved fixed lower lingual Ti retainer. Both types of retainers were manifactured using CAD/CAM technology.

For the manufacture of titanium retainer we used a disc Titan Biostar °5 (SILADENT) composed of Ti-90%, Al-5.5%, V-4%, which we milled with a 5-axis milling machine Icore Coritec 650i. For the fabrication of a Co-Cr retainer we used metallic powder Wirobond C+ (BEGO Medical GmbH) with composition Co-64%, Cr-25%, V-5%, Mo-5% and a laser sintering apparatus Truprint 1000 (Trump Group).

Individual tooth mobility was measured after the removal of the braces and cleaning the residual adhesive. After the fixation of lingual retainer a second measurement was conducted.

For the determination of dental mobility we used Periotest (Medizintechnik Guldenya e. K., Modautal, Germany)(26, 27)(Fig. 1). The measurements were performed in standardized way, as the device is calibrated according to recommendations provided by the manufacturer. The patients are in sitting position, the device is held perpendicularly to the buccal surfaces of the clinical crowns on all incisors and canines in the lower front segment (tolerance ±20°), within 0.5–2 mm distance of the middle of the clinical crowns. (Fig. 2) The correct position of the device is confirmed during the measurement process through sound signal(30).

Fig. 1 Periotest M

Fig. 2 Measurement of tooth mobility in the middle of the clinical crown

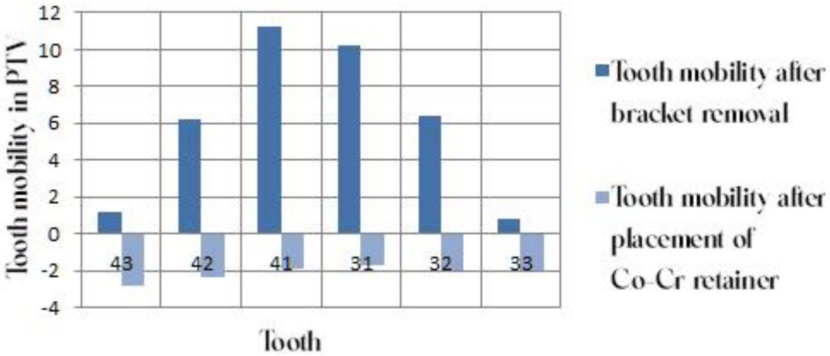
As the time of contact is not of clinical significance, the device shows a value called "Periotest value" (PTV). This value varies from —8 to +50 which corelates to the degree of tooth mobility (31). In the study, for normal values we accepted the interval between – 3 and +8.

Miller classification	Mobility index	PTV
There is no perceptible movement	0	- 8 to +9
Slight mobility	1	10 to 19
Deviation on the crown at least 1 mm from the normal situation	2	20 to 29
Easily noticeable movement of the crown more than 1 mm in any direction or the tooth may rotate in the alveolus.	3	30 to 50

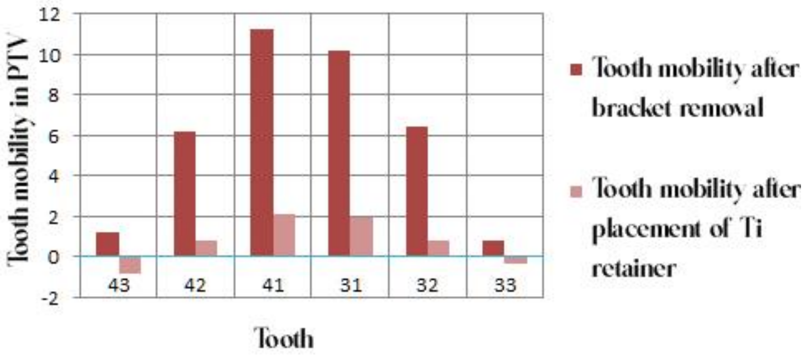
Table 1 PTV , relative to the values of Miller 's tooth mobility index

Results

In graph 1 and 2 are presented the average values of the measurements of individual tooth mobility after removal of the braces and after the placement of Co-Cr and Ti - retainers. The results show that after removal of the braces, the greatest tooth mobility is observed in the central incisors in the lower jaw, and the lowest is in the canines. After the placement of a fixed retainer, tooth mobility decreases, as with a laser- Co-Cr sintered retainer this reduction is significantly more noticeable. Normal tooth mobility corresponds to PTV values in the range of -3 to +8. After placement of a Co-Cr retainer , the mean values range from -2.83 to -1.7, while after placement of Ti retainer these values range from - 0.83 to + 2.14.



Graph 1 Individual tooth mobility after removal of braces and after fixation of Co-Cr retainer



Graph 2 Individual tooth mobility after removal of braces and after fixation of Ti retainer

Discussion

The aim of the study was to find out differences in individual dental mobility when using CAD /CAM retainers made through milling and direct metal laser sintering. The Periotest used data obtained by percussion with its impact head on the clinical crown. The percussion head, which has a mass of 8 g, moves almost without any friction and it is driven by a magnetic coil in the tip. The deceleration of the percussion head at the contact with the tooth is measured with an accelerometer within the head. This cycle is repeated on each tooth 16 times for an interval of 4 seconds (28,29).

After the fixation of the retainer, the tendency for the lowest tooth mobility to be observed in the canines and the largest in the central incisors remains.

The results show that retainers made of milled Ti restrict individual tooth mobility less. One explanation for this fact is that Titan 's modulus of elasticity SILADENT 's Biostar °5 is 125 GPa , while this modulus in laser sintering Wirobond C+ is 215 GPa (according to manufacturers' data). Although the elastic modulus of the Co-Cr alloy is almost twice as large, the difference in tooth mobility between the two types of retainers is not as great. The reason for this is the thickness of the retainer. Because of this difference, it can be expected that retainers made of Ti have an advantage over steel alloys, as they are more elastic and the likelihood of unwanted permanent deformation is reduced. For the same reason Ti retainers allow greater thinning during processing, without the risk of fracturing, as Co-Cr steel is harder and more brittle. These retainers restrict individual tooth mobility less, which improves the remodeling of the peridontal structures and alveolar bone, and this in turn leads to fewer post-treatment changes. Their use for permanent retention can also lead to a reduction in late negative effects associated with retainer deformation. On one hand, it can be the cause of breaking its adhesion to the tooth and debonding, but the more unpleasant negative effect is deformation without debonding, which makes the retainer active and can be the cause of tooth displacement initiated by it.

Conclusion

Retainers made by milling Ti disc limit to a lesser extent the physiological mobility of the teeth fixed with them. The mechanical qualities of the material allow greater thinning during processing, which does not negatively affect the qualities of the retainer , but significantly increases a patient's comfort. This allows for a better biological response and a faster and more adequate restorative processes in the periodontal ligament during the retention phase.

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