Occlusal changes during a 10-year posttreatment period and the effect of fixed retention on anterior tooth alignment

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Introduction: The objectives of this research were to evaluate changes in occlusal components in 3 subperiods during a 10-year posttreatment time span and to examine the long-term effects of fixed retention on maxillary and mandibular anterior alignment. **Methods:** Ninety-six patients were examined; the Peer Assessment Rating Index and Little's Irregularity Index were measured at pretreatment, posttreatment, and 3 (T3), 5 (T5), and 10 (T10) years posttreatment. Unweighted Peer Assessment Rating component scores were analyzed for differences between all subperiods. The effect of fixed retention on posttreatment changes in Little's Irregularity Index was analyzed for both jaws with regression analysis. For the maxilla, 2 groups were compared: MX0, removable retainer until T3 (n = 52) and MX10, removable retainer until T3 combined with a fixed retainer until T10 (n = 23). For the mandible, 3 groups were compared: MD3, fixed retainer until T3 (n = 19); MD5, fixed retainer until T5 (n = 19); and MD10 fixed retainer until T10 (n = 48). **Results:** The Peer Assessment Rating Index percentage of improvement was 79% at T10. A gradual deterioration of occlusal components was seen, with small insignificant changes in each subperiod. Corrected for pretreatment irregularity, MX10 showed 0.6 mm lower LII than MX0. MD10 had significantly better alignment than MD3 (1.1 mm) and MD5 (0.7 mm). **Conclusions:** Gradual occlusal changes of limited clinical importance were seen during a 10-year posttreatment period. Long-term fixed retention in the maxilla was of minor importance in patients also wearing removable retainers. In the mandible, a 10-year fixed retention protocol gave moderately lower alignment scores compared to a 3-year protocol and slightly better alignment compared to a 5-year protocol. (Am J Orthod Dentofacial Orthop 2018;154:487-94)

Total stability of the occlusion after orthodontic treatment seems to be unlikely to achieve. With time, changes in tooth alignment are inevitable, and both relapse and growth are contributing factors.[1] To counteract unwanted changes, orthodontists prescribe different types of retainers, sometimes intended to be used indefinitely.

Both removable and fixed retainers have been found to be equally effective in controlling relapse up to 2 years posttreatment.[2,3] Part-time wear of thermoplastic and Hawley retainers has proved to be as efficient as full-time wear.[4,5] Methods for controlling the anterior alignment even without retainers such as interproximal reduction, sometimes used in combination with overcorrection, have been shown to be viable in the short term.[3,6]

It is unclear at what point after debonding the greatest posttreatment changes occur. Some authors have found that most changes take place during the first 2 years after treatment, a period corresponding well with relapse and settling.[7] In contrast, early stability has been reported for all components of occlusion 2 years after treatment.[8] Others have reported that most occlusal changes take place during the first 4 years.[9] Moreover, long-term studies have concluded that significant occlusal changes take place even between 19 and 31 years of age.[10] With more information about posttreatment changes, one could possibly improve retention strategies.

Prolonged retention can interfere with the natural reduction in dental arch parameters. Since long-term

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compliance with a removable retainer is expected to be limited and less practical, a semipermanent or permanent retainer is often the bonded type. It has been stated that lifetime permanent retention is the only way to prevent relapse.[11] Al Yami et al[7] found a positive effect of fixed retainers on the Peer Assessment Raing (PAR) score 11 years posttreatment. Furthermore, presence of fixed retainers gave better occlusal results 17 years posttreatment in a long-term follow-up.[10] In contrast, some studies have concluded that fixed retention is not of major importance to the treatment outcome. Rather than being a protective measure against long-term changes on an occlusal level, fixed retainers were found to primarily inhibit changes in anterior alignment.[12] The efficacy of fixed retainers on mandibular anterior relapse has been reported.[13] Nonetheless, satisfactory alignment has also been found at 10 years postretention, even after a short retention protocol.[14] In the maxilla, fixed retainers appear to have less influence on the stability of alignment compared with the mandible.[13,15] There seems to be uncertainty about how much a fixed retainer will improve the alignment in the long term.

For the time being, the preferred type and duration of retention have not been established.[16,17] Use of retention appliances varies between countries and largely depends on personal preferences.[18,19] It is therefore important to improve our knowledge about the effect of different retention protocols, types, and durations on long-term treatment outcomes.

The aims of the study were to evaluate changes in occlusal components in 3 stages during a 10-year posttreatment period and to examine the effect of type and duration of retention on maxillary and mandibular anterior alignment.

MATERIAL AND METHODS

The Department of Orthodontics at the University of Oslo in Norway routinely summons patients for checkups at 3, 5, and 10 years posttreatment. Included in this retention archive are nonsurgical patients aged 20 years or younger at the beginning of treatment, without agenesis, trauma, or autotransplantations to the anterior regions. To detect a minimum difference of 10 PAR score points between pretreatment and 10 years posttreatment with a standard deviation of 11, a sample size of 12 patients was required to provide 80% statistical power with an alpha of 0.05. Attendance at the 10-year follow-up appointment per March 22, 2017 served as inclusion criteria for this longitudinal analytical study. Approval was granted by the Regional Committee for Medical and Health Research Ethics and the Norwegian Data Protection Official for Research.

Table I. Dental cast measurements with definitions

Measurement	*Definition*
PAR index	Measured according to the conventions described by Richmond et al[20]
LII	The sum of the linear displacements of the anatomic contact points from canine to canine, according to Little[21]
Overjet	Distance parallel to the occlusal plane from the buccal surface of the most protruding maxillary incisor to the buccal surface of the corresponding mandibular incisor
Overbite	Maximum distance of the mandibular incisors overlapped by the maxillary central incisors
Canine relationship*	Distance from the cusp tip of the maxillary canine to the distal contact point of the mandibular canine
Molar relationship*	Deviation from a neutral occlusion, defined as occlusion of the mesiobuccal cusp of the maxillary first molar within the buccal groove of the mandibular first molar
Intercanine distance	Distance between the cusp tips of fully erupted teeth

*Distal occlusions were recorded as positive values; mesial occlusions as negative values.

One hundred twenty-five patients met the inclusion criteria. Exclusions were made according to the following criteria: missing or damaged dental cast (pretreatment, posttreatment, or 10-year follow-up) (n = 18), retreatment (n = 5), single-arch treatment (n = 4), and extractions of incisors (n = 2). The final study sample included 96 patients (43 male, 53 female) treated with full fixed appliances. Study casts were available for all patients at pretreatment (T0), posttreatment (T1), and 10 years posttreatment (T10), as well as for 70 patients at 3 years posttreatment (T3) and 86 patients at 5 years posttreatment (T5). Fifty-six patients were treated without extractions, 28 patients were treated with extraction of 4 premolars, 8 patients had extraction of 2 maxillary premolars, and 4 patients had extraction of 2 mandibular premolars. Mean pretreatment age was 12.2 years (±1.4). Mean treatment duration was 2.6 years (±0.9). Average follow-up periods were 3.1 years (±0.4) at T3, 5.3 years (±0.6) at T5, and 10.1 years (±0.8) at T10.

The PAR index[20] was used to assess the occlusion at all time stages. Anterior tooth alignment was scored using Little's Irregularity Index (LII).[21] In addition, several dental cast measurements were registered (Table I). All variables were measured by the same examiner (R.B.) to the closest 0.1 mm using a digital caliper (Digital 6; Mauser, Oberndorf, Germany), except