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Evaluation of efficacy of different types of retainers post orthodontic treatment: An original research

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Abstract---Aim: Purpose of this study was to evaluate the efficacy of 3 different types of retainers (Hawley removable, Essix removable and Fixed) of the mandibular and maxillary anterior sextant and to assess patient perception of crowding. Methodology: A retrospective study of 80 patients was carried out for a time period of 1-2 years into retention. E models (digital models) were assessed pre- and post-orthodontically using Little's Irregularity Index. The amount of Irregularity was compared for 3 retention groups (Hawley, Essix and

Fixed). Relapse was also subjectively measured. Results: Increase in the Irregularity Index of the mandibular incisors was observed after wearing Hawley retainers, including crowding which was significantly more than patients with Fixed retainers. Conclusion: Hawley retainers allow for more mandibular incisor movement rather than the Fixed retainers.

Keywords--retainers, relapse, malocclusion, orthodontics.

Introduction

Even after completing an orthodontic treatment successfully, the daunting task of keeping the teeth in their rightful position persists. The onus of this responsibility lies on both the orthodontist and the patient. On the one hand, it is the job the orthodontist to provide with well-fitting, comfortable retainers with proper instructions and motivation for the patient to wear it regularly. On the other hand, the patient is incumbent to wear the retainer as directed by the orthodontist. But, easy said than done, the retention stage remains the most difficult part of the orthodontic treatment. Many reputed personalities in orthodontics like Angle, Case, Tweed, and Hawley have highlighted the concerns in retention and attributed it to professional negligence.¹ Such is the problem of retention that once Tweed and his orthodontist friend quipped that "I would gladly pay someone half my fee if he relieves me of the responsibility of successfully carrying my patients through their retention periods."² Many appliances are used for the posttreatment retention phase. In the Angle era, banded fixed appliances were used as retainers.³ In 1919, removable retainers were introduced by Hawley.⁴ With the advent of the acid-etch technique, Kneirim for the first time in 1973 described the use of fixed bonded retainers.⁵ The road to an eternal, perpetual straight smile begins and ends with an orthodontic retainer. Retainers are defined as orthodontic appliances used to prevent relapse/return following correction, of features of the original malocclusion.

Patients prefer Vacuum formed retainers (VFRs) due to their appearance, comfort, and superior aesthetics.⁶⁻⁸ According to Rowland et al., they are more effective in holding corrections of the maxillary and mandibular labial segments as compared to Hawley retainers.⁹ According to Artun, 3 years assessment of three bonded retainers and one removable retainer has shown no difference in the type of retainers used except for incisor irregularity when the bonded retainers were fractured.¹⁰ A systematic review conducted by Mai et al.¹¹ in 2014 has concluded that there are no differences with respect to changes in intercanine and intermolar width between VFRs and Hawley retainer after active orthodontic treatment. However, currently, the evidence is insufficient for VFR being more effective than Hawley retainers and high-quality RCTs are necessary. A recent RCT conducted by O'Rourke et al.¹² in 2016 has compared the effectiveness of bonded and VFRs in 82 subjects for 18 months post-debond. They have found that bonded retainers have a better ability to hold the mandibular incisor alignment in the first 6 months after treatment than do VFRs. Another RCT conducted by Ramazanzadeh et al. in 2018 had compared the effectiveness of wearing the Hawley retainer for 4 months full-time and then night time, VFRs for

4 months full-time and then night time, and VFR for 1 week full-time and then night time. They have reported both regimens of VFR to be more effective than the Hawley retainer in maintaining arch length and tooth alignment in the upper arch. VFRs for 4 months are advocated for better incisor alignment in the lower arch compared to the Hawley retainer.¹³ Despite major advances in orthodontic tooth movement, orthodontic retention still remains a major problem. It has been estimated that only 10% of the population who have received orthodontics are still in acceptable occlusion as judged by orthodontists 20 years after retention. In addition, very little is known about patient's perception in relation to orthodontic relapse.

Aim of the Present Study

Goal of this study was to evaluate the efficacy of 3 different types of retainers (Hawley removable, Essix removable and Fixed) of the mandibular and maxillary anterior sextant and to assess patient perception of crowding.

Methodology

A retrospective clinical evaluation of 80 patients treated at the University of Connecticut Health Center. These 80 patients were selected 1-2 years into retention based on complete records and consent to participate. E models (digital models) taken of the upper and lower arches were assessed pre- and post-orthodontically, and during retention for alignment of the anterior sextant using Little's Irregularity Index. The amount of Irregularity was compared for 3 retention groups (Hawley, Essix and Fixed). Relapse was also subjectively measured in the form of a questionnaire which was administered to each patient, documenting one's perception of their crowding and the amount of time the retainer was worn. Suitable statistical tools were applied and the $p < 0.05$ was considered as significant.

Results

Orthodontic stability with fixed versus removable retention which in terms of the irregularity of the mandibular anterior segment, data from 42 participants were analysed (Table 1). Some degree of relapse occurred in both treatment groups at 2-year follow-up with median increases in the degree of irregularity of 0.85mm and 1.47mm in fixed and removable retainer groups, respectively. After adjusting for confounders, the median between-groups difference was 1.64mm higher in those wearing vacuum-formed retainers ($P = 0.02$; 95% CI: 0.30, 2.98mm). No statistical difference was found between the treatment groups in terms of inter-incisor ($P = 0.52$; 95% CI: -1.07, 0.55) and inter-molar widths ($P = 0.55$; 95% CI: -1.72, 0.93), arch length ($P = 0.99$; 95% CI: -1.15, 1.14). We found a significant increase in the Irregularity Index of the mandibular incisors during retention in patients wearing Hawley retainers compared to the patients that had Fixed retainers. In addition, patients wearing mandibular Hawley retainers perceived their crowding significantly more than patients with Fixed retainers. Only half the patients with overall crowding in the maxillary and mandibular arch, noticed the crowding.

Discussion

A recent study published in 2018 by Jin has concluded that the lingual fixed retainers and Hawley retainers have the longest survival followed by combination retainers and vacuum-formed retainers.¹⁴ Hawley retainers were lost, and fixed retainers were debonded; vacuum-formed retainers and combination retainers were fractured. Studies have reported the survival rate of bonded retainers from 90% to 30% over a 3–10-year period.¹⁵ Overall failure rates range from 10.3% to 47% according to Artun in 1988.³² Failure rate is two times in the maxilla compared to the mandible.¹⁶ This can be attributed to the greater risk of occlusal forces being delivered to the maxilla along with the distortion in the wire to conform to the morphology of the canine.¹⁷ This can be prevented by taking the impression of the lower arch and fabricating the retainers by avoiding occlusal trauma. Due to the greater occlusal forces and kink in the wire during bonding, the risk of failure increases when the upper canine or lower premolars are part of the retainers.¹⁸ Most of the bond failure occurs in the first year, after which the life of the retainer increases dramatically.¹⁹ Since the orthodontic materials and techniques have evolved, the failure rates have been decreased. The failure occurs most commonly on the wire–composite interface.¹⁰ Hence, it is recommended to use composite with greater abrasion resistance to decrease the rate of failure.²⁰ McDermott et al. in 2017 have found no difference in the survival times over 6–12 months between the VFRs and Hawley retainers.²¹ Hichens et al.⁸ reported that more Hawley retainers were broken than VFRs over 6 months. The survival time of the mandibular Hawley retainer or VFRs was shorter than that of maxillary retainers due to the increased buccal root torque on the posterior segment, greater deformity of the retainer to overcome the mandibular undercut and high lingual attachment. Sun et al. found that the survival times of Hawley retainers and VFRs were not statistically significantly different and the choice of retainer should be advised without taking breakage into consideration.²² Stability was assessed directly from study models using Little's irregularity index; this is the most accepted approach to assessing stability. However, it fails to account for vertical displacements, reciprocal rotations, angulation and inclination changes. Based on lay and professional opinion, however, horizontal displacements are consistently scored as the most salient feature and this is reflected in Little's scores.

Conclusion

Hawley retainers allow for more mandibular incisor movement than Fixed retainers. In addition, the finding that only half the patients with overall crowding actually notice the crowding, may suggest that the Hawley retainer patients may perceive more crowding due to factors unrelated to actual crowding.

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Tables

Table 1- Stability outcomes in fixed and removable retainer groups (within 2 year study period)

Outcome measures	Coefficient	CI	P- value
Irregularity index	1.64	0.30, 2.98, 1.33	0.02
Inter-incisor measurement	-0.26	-1.07, 0.55, 0.23	0.52
Inter-molar width	-0.40	-1.72, 0.93, 0.47	0.57
Arch length	-0.01	-1.15, 1.14, 0.81	0.99