Original Article

Posterior occlusion changes with a Hawley vs Perfector and Hawley retainer

A follow-up study

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ABSTRACT

Objective: To characterize postorthodontic settling of the posterior occlusion of patients wearing Hawley retainers vs patients who initially wore Perfector retainers and then switched to Hawley retainers.

Materials and Methods: This follow-up study was based on 40 patients (25 Perfector and 15 Hawley), who were part of a larger sample of 50 patients randomly assigned to wear either Hawley or Perfector retainers. The Perfector patients were given Hawley retainers 2 months after retainer delivery. Occlusal bite registrations were scanned and traced to quantify posterior areas of contact and near contact (ACNC). A seven-item questionnaire was used to assess the patient's perception of occlusion. Measurements were obtained at the on the day of retainer delivery, 2 months post delivery, 6 months post delivery, and 8 months post delivery.

Results: ACNC increased significantly ($P < .05$) during the first 6 months of retainer wear. The ACNC of the Hawley and Perfector/Hawley groups increased by 129% and 105%, respectively, over 8 months of retention. The greatest increases in ACNC occurred during the first 2 months. The ACNC further increased between 2 and 6 months in both groups. The Perfector/Hawley group also showed slight increases in ACNC between 6 and 8 months. Overall group differences were not statistically significant. The Perfector/Hawley group perceived greater improvements in occlusion than the Hawley group, but group differences after 8 months were small.

Conclusions: Substantial amounts of settling occurred at decelerating rates during the first 6 months after retainer delivery. No significant differences in ACNC were found between the Hawley and Perfector/Hawley groups after 8 months of retainer wear. (*Angle Orthod.* 2010;80:853–860.)

KEY WORDS: Hawley retainers; Perfector retainers; Posterior occlusion; Areas of contact and near contact

INTRODUCTION

Posterior occlusion pertains to the relationships between cusp tips and their opposing central fossa and marginal ridges.[1] These relationships are important because the posterior teeth establish and maintain the vertical dimension of occlusion and are designed to withstand the heavy forces of mastication.[1] Posterior occlusal contact areas, especially near contact areas, have been shown to be among the most important factors determining masticatory performance.[2–5] Because occlusal contacts represent the most important fraction of the total area involved in mastication,[2] subjects with normal occlusion are able to break down foods more efficiently than subjects with malocclusion.[6,7] Good intercuspation and occlusal contacts may also be essential for stable orthodontic results.[8,9] Furthermore, the location of posterior contacts is one of the main factors responsible for stabilization of the mandible; failure to provide adequate centric stops may promote occlusal instability.[9]

Although changes in posterior occlusion should be expected during the retention phase of orthodontic treatment, our understanding of the pattern of change that takes place remains limited. Most studies indicate that the number of contacts increase and that occlusion improves over time,[10–14] although no im-

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provements, occlusion worsening, and occlusal regression to the mean have also been reported.[8,15–17] How the various retention devices affect postorthodontic settling also remains controversial. Sauget et al.[18] reported more settling for Hawley than for clear overlay retainers after 3 months of retention, whereas Basciftci et al.[14] found no differences in posterior occlusal contacts between Hawley and Jenson plate retainers 1 year post treatment. Durbin and Sadowsky[12] reported significantly more settling with the active positioners than with passive Hawley retainers; Haydar and coworkers[10] found no differences. Selection bias could explain these controversies because most studies did not randomly assign their patients. Moreover, most studies have used counts or visual assessments of occlusal contacts, which might be expected to be less discriminating than areas of occlusal contact and near contact (ACNC).[6,7,19,20]

A recent randomized controlled trial found no differences in ACNC between patients wearing Perfector or Hawley retainers.[19] It remains unknown whether ACNC change when patients switch from active Perfector (TP Orthodontics Inc, La Port, Ind) retainers to passive retainers, as they commonly do after 2 or 3 months. Because most studies have evaluated posterior occlusion at only two time points, it also remains unknown whether settling occurs rapidly, or whether rates of settling change over time.

A follow-up to the 2-month-long study by Horton et al.[19] was designed (1) to evaluate the time course of the occlusal changes that occur over the first 8 months of retention, and (2) to determine whether the posterior occlusion of patients who switch from the Perfector to the Hawley retainers after 2 months differs from the occlusion of patients who wore only Hawley retainers for 8 months.

MATERIALS AND METHODS

Fifty subjects who had completed full orthodontic treatment with Class I molar and canine relationships were recruited by Horton et al.[19] The study was approved by the Biomedical Institutional Review Board at Saint Louis University. Subjects were excluded if they had any history of temporomandibular dysfunction, large restorations on the posterior teeth, allergies to any materials used in the study, periodontal disease, and/or muscular dysfunction, or if they were noncompliant with retainer wear.[19] Forty-four of the original 50 patients who completed the first part of the study consented to participate in the present study for an additional 6 months. Because of patient dropout and missed appointments, 40 patients completed the second part of the study, including 25 patients (11 males and 14 females) originally assigned to the Perfector/Spring aligner group and 15 patients (5 males and 10 females) assigned to the Hawley group. During an interim period of 4 weeks from debonding of braces to delivery of retainers, the subjects in both groups wore Essix retainers while their retainers were being fabricated.

The Hawley group wore the same retainers throughout the 8 month observation period. After the first 2 months, maxillary and mandibular alginate impressions were taken of the Perfector group, and Hawley retainers were delivered within 2 weeks. Both groups were instructed to wear the maxillary and mandibular Hawley retainers full-time for the duration of the follow-up study.

Data were collected at four time points: on the day of retainer delivery, 2 months post retainer delivery, 6 months post delivery, and 8 months post delivery. At each time point, duplicate bilateral posterior occlusal bite registrations were taken in maximum intercuspation with the use of Blu Mousse (Parkell Bio-Materials, Farmingdale, NY), a silicone impression material.

The Blu Mousse was applied to the occlusal surfaces of the mandibular premolars and first molars, and the patient was instructed to bite firmly on the back teeth for 30 seconds.[10,18,19] With the use of a holder, each registration was placed in a standardized position and scanned at 300 dpi with the mandibular occlusal surfaces facing downward. The occlusal surfaces of the scanned premolars and first molars were then traced using Image Tool (University of Texas Health Science Center, San Antonio, Tex) software, which calculated the area of the traced teeth and the frequency distribution of pixels within the platform area based on 256 possible gray scales. Because all methods and procedures were the same, the calibration curve developed by Horton et al.[19] was used to establish the relationship between the gray scales and ACNC at thicknesses ranging between 0 μm and 350 μm. Thicknesses were recorded in increments of 50 μm, with 0 to 50 μm representing contacts and the other increments representing areas of near contact.

Patient perceptions of how well their teeth fit together, their level of occlusal discomfort, and their masticatory function were assessed using the seven-item questionnaire developed by Horton et al.[19] A 148 mm visual analogue scale was used to evaluate the following questions:

> Q1. How well do your back teeth fit together when you bite down hard?
> Q2. Do your back teeth contact each other evenly when you bite down hard?
> Q3. How well can you chew tough meats, such as steak or chops, with your back teeth?

Table 1. Medians and Interquartile Ranges for Areas (mm^2) of Contact and Near Contact of the Posterior Occlusion Evaluated on the Day of Retainer Delivery and at 2, 6, and 8 Months Post Retainer Delivery

	Day of Retainer Delivery				2 Months Post Delivery				6 Months Post Delivery				8 Months Post Delivery			
	Hawley		Perfector		Hawley		Perfector		Hawley		Perfector/ Hawley		Hawley		Perfector/ Hawley	
Thickness, μm	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th
Absolute Thickness																
≤50	0.7	0.2/1.4	0.7	0.3/1.2	1.4	0.7/2.3	1.3	0.8/2.0	1.8	1.3/3.5	1.8	0.9/2.6	1.7	1.4/2.7	1.8	1.2/3.4
50–100	0.7	0.3/1.9	1.1	0.4/1.8	1.7	1.2/3.0	1.8	1.1/2.3	2.2	1.5/3.8	2.4	1.4/3.2	2.3	1.9/3.9	2.3	1.8/3.5
100–150	0.9	0.4/2.0	1.2	0.4/1.8	1.7	1.3/3.0	1.7	1.0/2.5	2.0	1.5/3.2	2.2	1.4/3.1	2.4	1.6/3.1	2.4	1.80/3.3
150–200	0.9	0.5/1.9	1.0	0.5/1.6	1.5	1.3/2.8	1.7	1.1/2.6	2.0	1.5/3.3	2.2	1.4/2.9	2.1	1.6/3.2	2.4	1.8/3.0
200–250	1.1	0.5/2.0	1.2	0.5/1.6	1.7	1.3/2.7	1.9	1.1/2.4	2.1	1.6/3.7	2.3	1.5/2.7	2.1	1.6/3.6	2.4	1.9/3.1
250–300	1.3	0.5/2.2	1.3	0.6/1.7	1.8	1.5/3.0	2.0	1.2/2.7	2.3	1.8/4.4	2.6	1.75/3.2	2.5	2.0/4.0	2.9	2.2/3.8
300–350	1.6	0.6/2.6	1.6	0.7/2.0	1.9	1.7/3.6	2.3	1.4/2.9	3.0	2.2/5.9	3.2	2.1/3.7	3.1	2.4/5.3	3.2	2.8/5.1
Cumulative Thickness																
≤100	1.2	0.6/3.1	2.0	0.7/3.0	3.0	1.8/5.1	2.9	2.0/4.2	4.2	2.8/7.7	4.4	2.2/6.0	4.4	2.7/8.1	4.2	2.9/7.2
≤150	2.1	1.2/5.2	3.0	1.2/4.7	4.5	3.3/8.2	4.9	2.8/6.2	6.1	4.3/11.7	6.4	3.7/9.5	6.2	5.4/11.1	6.3	5.0/10.2
≤200	3.0	1.6/7.4	4.1	1.7/6.5	5.7	4.7/11.1	6.7	3.6/8.7	8.0	5.9/15.2	8.5	5.2/12.0	8.5	7.5/14.4	8.1	6.8/13.8
≤250	4.1	2.2/9.4	5.4	2.2/8.0	7.3	6.2/13.9	8.6	4.9/11.1	10.6	7.7/18.9	10.7	6.7/14.5	10.5	8.9/18.1	10.6	8.7/17.1
≤300	5.4	2.8/11.5	6.7	2.8/10.0	8.9	7.7/16.7	10.8	6.2/13.8	13.4	9.8/23.3	13.4	8.5/17.5	13.1	10.7/22.3	13.5	11.0/20.9
≤350	7.0	3.4/13.9	8.3	3.4/11.8	10.7	9.4/20.3	13.2	7.6/16.6	16.6	12.6/29.2	16.3	10.7/22.3	16.0	12.8/27.6	17.0	13.9/26.4

Q4. How well can you chew fresh vegetables, such as carrots or celery, with your back teeth?
Q5. How much pain do you feel when you bite down hard on your back teeth?
Q6. How much discomfort do you experience when you bite down hard on your back teeth?
Q7. When you bite down hard, do you feel your back teeth slide?

The terms ''very well'' or ''very poor,'' ''none'' or ''very much,'' and ''no slide'' or ''large slide'' served as anchors for the visual analogue scale.

Statistical Analysis

On the basis of their skewness and kurtosis, the variables showed significant ($P < .05$) departures from normality. As such, they were described by medians (50th percentile) and interquartile ranges (25th and 75th percentiles). Wilcoxon signed ranks tests evaluated changes over time; the Mann-Whitney *U*-test was used to compare the two retainers.

RESULTS

Areas of Contact and Near Contact

Hawley group. Wilcoxon signed ranks tests showed significant ($P < .05$) increases in ACNC with Hawley retainers during the first 6 months for all thickness levels (Tables 1 and 2; Figure 1). Changes that occurred after 6 months were not statistically significant. Greater overall absolute increases in ACNC occurred at thicker than thinner levels. The total cumulative ACNC increased from 7.01 mm^2 immediately post bond to 10.7 mm^2 at 2 months, to 16.6 mm^2 at 6 months, to 16.0 mm^2 at 8 months, with all changes being significant ($P < .05$) except those that occurred during the last 2 months. Increases at the thinner ACNC (<150 μm) tended to be greater during the first 2 months; the greatest increases at the thickest levels (>300 μm) occurred between 2 and 6 months.

Perfector/Hawley group. The Perfector/Hawley group showed increases in ACNC similar to those of the Hawley group. Increases in ACNC were significant ($P < .05$) at all thickness levels during the first 6 months. The Perfector/Hawley group also showed small but significant increases in ACNC >200 μm between 6 and 8 months (Table 2). Overall absolute increases were greatest at the thicker levels. The total cumulative ACNC increased from 8.3 mm^2 to 13.2 mm^2 after 2 months, to 16.3 mm^2 after 6 months, and to 17.0 mm^2 after 8 months (Figure 2). The cumulative increases in ACNC were significant at all levels during the first 6 months.

Group comparisons. Absolute and cumulative ACNC showed no significant group differences at any of the four time points (Table 1). Changes in ACNC were significantly greater between 2 and 6 months for the Hawley than for the Perfector/Hawley group at the 200 to 250 μm, 250 to 300 μm, and 300 to 350 μm levels (Table 2). In contrast, the Perfector/Hawley showed significantly greater increases in contact area (<50 μm) between 6 and 8 months. Although the Hawley group showed greater overall increases than the Perfector/Hawley group in absolute (Figure 3) and cumulative areas (Figure 4), differenc-

Table 2. Changes in Areas of Contact and Near Contact (ACNC) from the Day of Retainer Delivery Through 8 Months Post Retainer Delivery

	Delivery to 2 Months Post Delivery				2 to 6 Months Post Delivery				6 to 8 Months Post Delivery				Immediate 8 Months Post Delivery			
	Hawley		Perfector		Hawley		Perfector		Hawley		Perfector/ Hawley		Hawley		Perfector/ Hawley	
Thickness, μm	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th
Absolute Thickness																
≤50	0.5	0.3/1.2	0.5	0.1/1.1	0.7	0.6/2.3	0.3	−0.1/0.0	−0.1	−0.6/0.2	0.4	−0.2/0.8	1.0	0.6/2.04	1.2	0.3/2.7
50–100	1.1	−0.1/1.5	0.4	0.0/0.7	0.7	0.5/1.4	0.7	0.2/1.0	0.4	−0.2/0.9	0.2	−0.4/0.7	1.6	1.2/2.0	1.2	0.6/2.2
100–150	0.9	0.2/1.4	0.2	−0.1/1.0	0.4	0.1/1.0	0.7	0.2/0.8	0.2	−0.1/0.5	0.0	−0.3/0.3	1.5	0.7/2.1	1.1	0.4/1.8
150–200	0.8	0.1/1.3	0.3	0.0/1.0	1.0	0.2/1.1	0.5	0.1/0.9	0.1	−0.1/0.3	0.1	−0.2/0.3	1.4	0.7/1.8	1.1	0.4/1.5
200–250	1.0	0.1/1.4	0.5	0.0/1.0	0.9	0.4/1.5	0.4	0.0/0.7	0.2	−0.4/0.3	0.2	−0.1/0.5	1.5	0.8/1.8	1.3	0.6/1.5
250–300	1.0	0.1/1.3	0.6	0.0/1.0	1.0	0.5/1.8	0.5	0.1/1.0	0.0	−0.7/0.4	0.2	−0.1/0.5	1.7	0.8/2.5	1.4	0.7/2.0
300–350	1.0	0.1/1.4	0.7	0.2/1.1	1.5	0.6/2.9	0.7	0.2/1.4	−0.3	−0.7/0.6	0.2	−0.1/0.7	2.0	0.9/3.7	1.8	1.0/2.9
Cumulative Thickness																
≤100	1.5	0.1/3.1	0.8	0.2/2.0	1.4	0.8/3.7	0.9	0.0/1.7	0.0	−0.6/1.2	0.5	−0.5/1.5	3.0	1.9/5.3	2.4	1.2/3.8
≤150	3.0	0.4/4.1	1.2	0.3/2.8	1.7	.91/4.0	1.7	0.2/2.4	0.2	−0.8/1.7	0.5	−0.5/1.8	4.8	2.2/7.4	3.6	1.5/6.3
≤200	4.1	0.5/5.1	1.4	0.5/4.2	2.1	1.4/5.0	1.9	0.7/3.3	0.3	−0.9/2.0	0.6	−0.6/1.7	6.2	2.8/9.1	4.8	2.1/7.4
≤250	5.3	0.6/6.4	1.9	0.6/5.1	3.3	1.8/6.6	2.1	1.1/2.1	−0.2	−0.8/2.3	0.7	−0.6/1.9	7.8	3.6/10.8	6.3	2.6/8.8
≤300	6.5	0.6/8.1	2.7	0.6/5.9	5.1	2.4/8.9	2.7	1.4/4.8	−0.2	−1.0/2.3	1.0	−0.7/2.4	9.6	4.3/13.1	7.9	3.2/10.8
≤350	7.4	.68/10.5	3.8	0.32/6.7	6.42	3.2/11.7	3.34	1.6/5.8	−0.3	−1.8/2.7	1.4	−0.9/3.2	11.3	5.1/17.7	9.6	4.0/13.7

es between initial and final measurements were not statistically significant.

Patient Perceptions

The only significant ($P = .035$) change in perception for patients in the Hawley group occurred between 2 and 6 months for Q6, indicating that they experienced increased discomfort when they bit down hard on their back teeth (Tables 3 and 4). The Perfector/Hawley group showed significant improvement during the first 2 months in how well their back teeth fit together (Q1; $P = .001$), how well their back teeth contact each other when they bite down hard (Q2; $P = .012$), and how well they can chew tough meats with their back teeth (Q3; $P = .026$). During the last 2 months, the Perfector/Hawley patients also perceived less of a slide when they bit on their back teeth ($P = .026$; Q7). Over the entire 8 months, Perfector/Hawley patients showed significant ($P < .05$) improvement on all questions except Q5.

At the time of debond, the Perfector/Spring Aligner group perceived significantly more difficulty chewing tough meats (Q3; $P = .029$) and more pain when biting (Q5; $P = .004$) than did the Hawley group (Table 3). At 8 months, the Perfector/Hawley group reported signif-

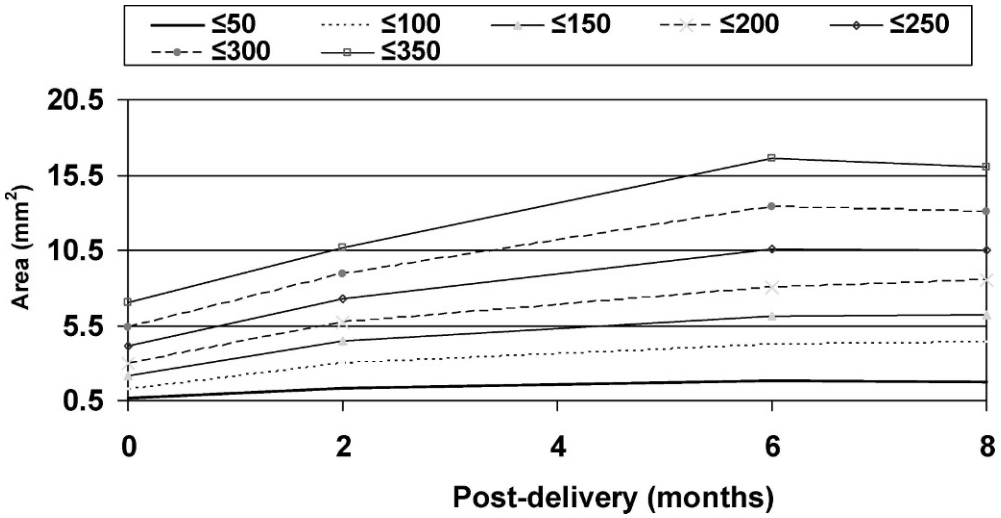

Figure 1. Median cumulative areas of contact and near contact measured at 50 μm thickness levels between the day of delivery and 8 months post retainer delivery for patients initially wearing Hawley retainers.

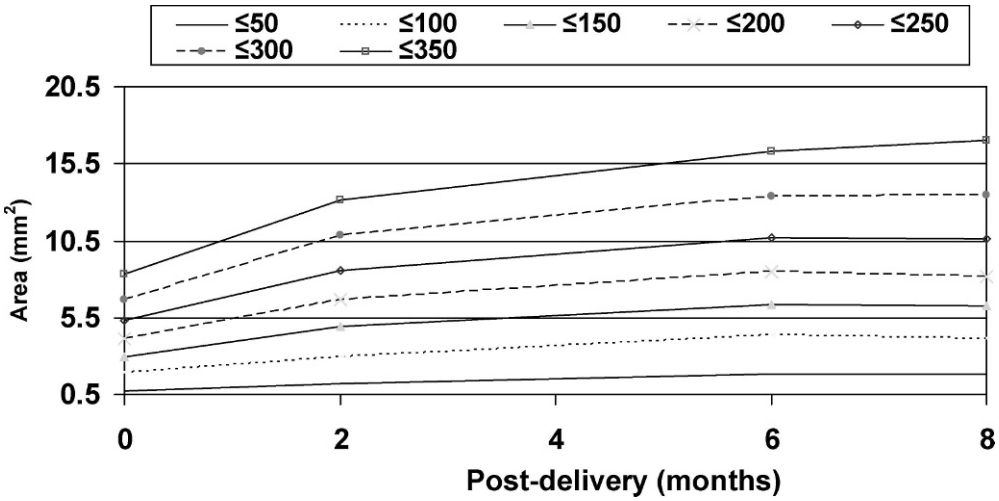

Figure 2. Median cumulative areas of contact and near contact between the day of retainer delivery and 8 months post retainer delivery for patients initially wearing Perfector retainers.

icantly more pain when biting (Q5; $P = .047$) than was reported by the Hawley group.

During the first 2 months, the Perfector/Hawley group perceived greater improvements than the Hawley group in how well their back teeth fit together (Q1; $P = .009$), how well they could chew tough meats (Q3; $P = .021$), and how much pain they felt when they bit down (Q5; $P = .025$). Over the entire observation period, the Perfector/Hawley group showed significantly ($P < .05$) greater improvement in how well their back teeth fit together (Q1; $P = .026$).

DISCUSSION

The Hawley group demonstrated substantial settling during the first 6 months of retention, with ACNC increasing by more than 130%. Changes were greatest at the thicker areas of near contact and least at the areas of contact. Increases were substantially larger than those previously reported for Hawley retainers, which ranged from 6% to 67%.[10,12,18,21] Although duration of retention was probably a factor (ie, studies of shorter duration have reported smaller increases ranging from 6% to 42%),[10,12,18] studies following patients for 9 to 12 months have reported gains of only 55% to 67%.[11,21] This suggests that the methods used in the present study are better able to discriminate differences in posterior occlusion. Horton et al.,[19] who used the same methods, also showed substantially higher relative increases in ACNC after 2 months than studies based on counts,[10,12,18] which followed subjects over comparable time periods.

The Perfector/Hawley group demonstrated substantial settling over the first 8 months of retention, with ACNC increasing by more than 100%. Changes were greatest at the thicker areas of near contact, and

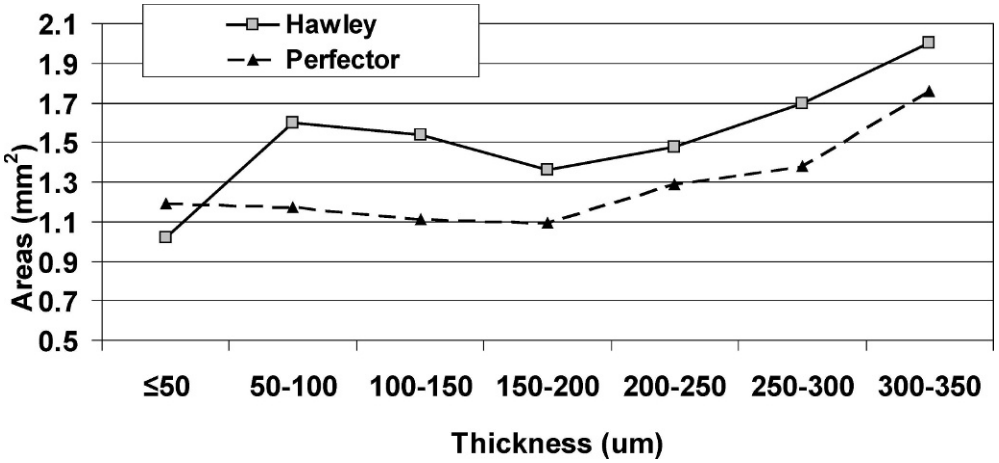

Figure 3. Median changes in areas of contact and near contact that occurred during the first 8 months after retainer delivery at each of the thickness levels for patients initially wearing Hawley or Perfector retainers.

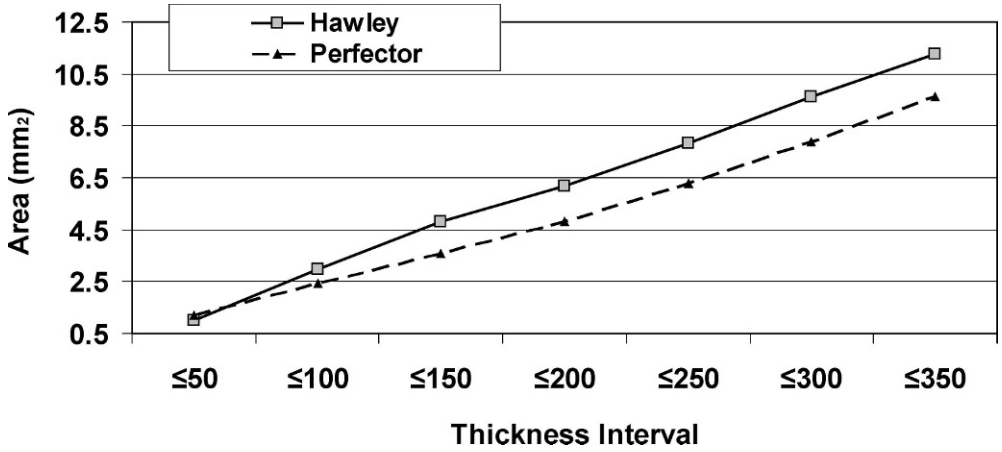

Figure 4. Median cumulative changes in areas of contact and near contact that occurred over the first 8 months after retainer delivery for patients initially wearing Hawley or Perfector retainers.

overall increases were again substantially greater than those previously reported.[9,14,19] Although the differences may again reflect differences in methods and study duration, they could be due in part to the materials used. The Perfector appliance is fabricated from silicone material, which is softer and more pliable than the rubber used to fabricate tooth positioners. The added resiliency may facilitate movement of the teeth under functional forces; the seating springs of the Perfector and a labial bow may also have affected settling.

The rates of increase in ACNC for both Hawley and Perfector retainers were greatest during the first 2 months and slowed down between 2 and 6 months. Although no longitudinal data with multiple observations were available for comparison, decreasing rates of settling might be expected on the basis of the law of diminishing returns. Immediately after debond, the teeth were farthest from their ''settled'' position and therefore had farther to move. Because ACNC decreased during retention, the potential to increase decreased proportionately. This may explain why most settling was observed early during retention, and why a majority of the increases occurred at thicker areas of near contact. The Essix retainers that patients wore during the first 4 weeks, which might be expected to alter occlusion, could also help to explain the dramatic increase in ACNC that occurred initially.

It was hypothesized that the Perfector/Hawley combination would demonstrate greater settling after occlusal coverage of the Perfector had been removed. The Perfector/Hawley group did show a significant increase in ACNC between 6 and 8 months, but the Hawley did not. The lack of statistically significant group differences could be due in part to patient compliance. Although all patents were repeatedly instructed to wear their retainers full-time, it was difficult to assess how long they actually wore their Hawley retainer. Sample sizes could also have reduced the power of the comparisons.

Overall posttreatment increases in posterior ACNC were similar for the Hawley and Perfector groups. This suggests that, regardless of the retainer used, the teeth have only limited potential for settling. Haydar et

Table 3. Patient Perception of Posterior Occlusion (measured using a 148 mm visual analogue scale) on the Day of Delivery and at 2, 6, and 8 Months after Retainer Delivery

	Day of Retainer Delivery				2 Months Post Delivery				6 Months Post Delivery				8 Months Post Delivery			
	Hawley		Perfector		Hawley		Perfector		Hawley		Perfector/ Hawley		Hawley		Perfector/ Hawley	
Question	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th
#1	125	110/139	119	101/132	125	113/138	135	127/140	138	125/147	137	128/143	136	124/148	139	136/143
#2	125	118/137	120	98/137	129	124/139	131	120/138	130	111/148	135	125/140	142	118/147	138	132/142
#3	142	139/146	135	128/143	139	130/144	140	132/143	146	140/148	140	136/145	143	132/148	140	137/146
#4	139	126/144	133	128/143	140	131/145	139	129/145	145	127/148	143	136/146	145	138/148	141	138/145
#5	145	143/148	138	132/144	143	131/146	143	137/147	143	131/148	141	133/145	145	142/148	141	135/146
#6	138	112/146	135	116/142	142	117/144	142	125/144	143	134/148	143	133/146	143	127/147	143	131/144
#7	138	125/145	140	126/143	139	125/145	139	131/143	145	140/148	137	131/143	143	132/148	141	136/145

Table 4. Changes in Patient Perception of Occlusion From the Day of Retainer Delivery Through 8 Months Post Retainer Delivery

	Day of Delivery to 2 Months Post Delivery				2 to 6 Months Post Delivery				6 to 8 Months Post Delivery				Immediate 8 Months Post Delivery			
	Hawley		Perfector		Hawley		Perfector		Hawley		Perfector/ Hawley		Hawley		Perfector/ Hawley	
Question	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th	50th	25th/ 75th
#1	−1	−10/12	14	2/37	4	0/22	0	−5/3	1	0/5	0	−2/9	4	−5/19	14	10/29
#2	−1	−8/14	9	−4/34	1	0/4	0	−9/10	0	−1/4	4	−2/6	2	−7/23	11	3/25
#3	0	−8/1	4	−2/11	1	0/8	2	−3/7	0	−2/1	0	−5/3	0	−1/33	5	−1/11
#4	1	−5/4	2	−2/11	1	−1/8	2	−1/8	1	−1/5	0	−1/1	4	0/17	8	3/15
#5	−1	−6/1	3	−2/9	0	−1/7	−2	−8/2	1	0/8	1	−1/4	0	−1/2	2	−3/9
#6	0	−10/11	8	−3/24	2	0/18	0	−5/5	0	−8/2	0	−3/3	2	0/23	8	1/24
#7	0	−7/13	0	−8/9	0	−1/19	−1	−5/9	0	−6/4	2	−1/8	4	−1/20	3	−1/10

al.[10] also found no statistically significant differences in the number of contacts between the tooth positioner and the Hawley retainer after 3 months. Durbin and Sadowski[12] reported that the positioner produced a greater increase in the total number of teeth in contact over time than did the Hawley retainer, but the differences were small.

Although no significant differences in ACNC were noted between the Hawley and Perfector groups, other aspects of occlusion, such as axial inclination, rotations, and so forth, may benefit from Perfector wear. These factors could help to explain the overall improvements perceived by the Perfector/Hawley patients over the 8 month observation period. However, it must be emphasized that the improvements observed in the Perfector/Hawley group occurred primarily during the first 2 months of Perfector wear.

To better understand the lack of group differences and the changes in patient perception that occurred, it is important to emphasize that, as noted by Horton,[19] the Perfector/Hawley group initially reported more pain and discomfort than patients assigned to the Hawley group. This implies that the Perfector/Hawley group had a greater potential to improve than the Hawley group. These initial group differences in perception, along with the slight improvements demonstrated by the Hawley group, could explain the lack of group differences after 8 months of retention. It should be emphasized that the Perfector was designed to influence many aspects of occlusion such as rotation, axial inclinations, alignment, interproximal space closure, crossbite correction, arch coordination, and overjet correction.[22] Such changes may have altered patients' perceptions of occlusion; this could also explain the improvements identified for those patients who initially wore the Perfector. This suggests that the Perfector/Hawley combination may be a useful retention protocol for patients who need corrections other than occlusal settling.

Because most posttreatment settling of the occlusion occurs during the first 6 months, it is recommended that Hawley and Perfector/Hawley retainers should be worn for at least this length of time before a switch is made to other retention protocols. Moreover, many practitioners prefer to perform equilibrations after orthodontic treatment but do not know when settling is complete.

CONCLUSIONS

- Areas of contact and near contact (ACNC) increased by 130% for the Hawley group and by 104% for the Perfector/Hawley group after 8 months, but the differences were not statistically significant.
- Greater amounts of settling occurred during the first 2 months than during the next 4 months, with little or no change in ACNC noted during the last 2 months.
- The greatest increases occurred at the thicker areas of near contact.
- Although the Perfector/Hawley group perceived greater improvements in their occlusion than the Hawley group, the differences after 8 months of retention were not statistically significant.
- On the basis of the results of this study, it is recommended that the practitioner wait 6 months before performing occlusal equilibration.

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