RESEARCH ARTICLE

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Effects of Acrylic-Bonded Rapid Maxillary Expansion on Oral Health-Related Quality of Life and Pain

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Objective: To evaluate the early effects of acrylic-bonded (cap-splint) rapid maxillary expansion (RME) on pain intensity (NRS) and oral health–related quality of life (OHIP-14).

Materials and Methods: This single-center, prospective observational study included 29 patients (16 females, 13 males) aged 12–15 years with transverse maxillary deficiency. All participants were treated with an acrylic cap-splint–bonded RME appliance incorporating a Hyrax-type midline expansion screw. The appliance was activated twice daily during the first 7 days (0.25 mm per activation), followed by once-daily activation until adequate expansion was achieved. Pain intensity was assessed using a numeric rating scale (NRS; 0–10) on days 1, 3, 7, and 14. Oral health–related quality of life was evaluated using the OHIP-14 at baseline (day 0), day 7, and day 14. Changes over time were analyzed statistically (p<0.05).

Results: The OHIP-14 total score increased from 1 (1–2) at baseline to 23 (21–26) on day 7 and decreased to 16 (14–19) on day 14 (overall p<0.001). The most pronounced time-dependent changes were observed in functional limitation, physical pain, and psychological discomfort subdomains. NRS scores changed significantly over time, peaking on day 3 and decreasing on days 7 and 14 (p<0.001). No significant association was found between NRS pain scores and OHIP-14 measurements.

Conclusion: Acrylic-bonded RME causes a marked but mainly transient deterioration in oral health-related quality of life, particularly during the first week; the impairment appears to reflect functional adaptation as well as pain.

Key Words: *Rapid maxillary expansion, acrylic-bonded appliance, oral health impact profile, OHIP-14, quality of life, pain*

Akrilik Bonded Aparey ile Yapılan Hızlı Üst Çene Genişletmesinin Yaşam Kalitesi ve Ağrı Üzerine Etkileri

Amaç: Akrilik bonded (cap-splint) aparey ile yapılan hızlı üst çene genişletmesinin (RME) erken dönemde ağrı şiddeti (NRS) ve ağız sağlığına ilişkin yaşam kalitesi (OHIP-14) üzerindeki etkisini değerlendirmektir.

Gereç ve Yöntem: Tek merkezli, prospektif gözlemsel çalışmaya transversal maksiller darlığı olan 12–15 yaş arası toplam 29 olgu (16 kız, 13 erkek) dahil edilmiştir. Tüm olgularda Hyrax tipi vida içeren akrilik cap-splint bonded RME uygulandı. Aktivasyon ilk 7 gün günde iki kez (0,25 mm/aktivasyon), ardından yeterli genişleme sağlanıncaya kadar günde bir kez planlandı. Ağrı şiddeti Nümerik Derecelendirme Skalası (NRS; 0–10) ile 1. , 3. , 7. ve 14. günlerde; ağız sağlığına ilişkin yaşam kalitesi ise OHIP-14 ile başlangıçta (gün 0), 7. ve 14. günlerde değerlendirildi. Zaman içindeki değişimler istatistiksel olarak analiz edildi (p<0,05).

Bulgular OHIP-14 toplam skoru gün 0'da 1 (1–2) iken gün 7'de 23 (21–26)'e yükseldi ve gün 14'te 16 (14–19)'a geriledi (genel p<0.001). En belirgin değişimler fonksiyonel kısıtlılık, fiziksel ağrı ve psikolojik rahatsızlık alt alanlarında izlendi. NRS skorları zaman içinde anlamlı değişim gösterdi; 3. günde pik yaptı ve 7. ile 14. günlerde azaldı (p<0.001). NRS ile OHIP-14 ölçümleri arasında anlamlı ilişki saptanmadı.

Sonuç: Akrilik Bonded Aparey ile Yapılan Hızlı Üst Çene Genişletmesi, özellikle ilk hafta belirgin ancak büyük ölçüde geçici bir yaşam kalitesi düşüşüne yol açmakta; bu etkide ağrı kadar fonksiyonel adaptasyon süreçleri de rol oynamaktadır.

Anahtar Kelimeler: *Hızlı maksiller genişletme, akrilik bonded aparey, OHIP-14, yaşam kalitesi, ağrı*

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Introduction

Rapid maxillary expansion (RME) is a widely used orthodontic-orthopedic approach for the treatment of transverse maxillary deficiencies (1). Its primary aim is to increase maxillary width by separating the midpalatal suture and to improve functional occlusion (2). RME has been shown to be particularly effective in growing individuals, in whom skeletal responses are more favorable (3).

Various expansion appliances have been described, including Hyrax, Haas, tooth-borne, tooth–bone-borne, and acrylic-bonded (cap-splint) expanders (4, 5). Bonded

RME appliances are frequently preferred because the acrylic coverage of the posterior teeth may provide vertical control and limit unwanted posterior extrusion (6, 7). Althoughbonded and banded expanders produce comparable skeletal effects, bonded appliances may offer advantages for patients with increased vertical growth patterns (2). The acrylic cap-splint design allows a more uniform distribution of expansion forces to the dentition (8).

Pain and discomfort are common during RME, especially at the beginning of activation. Several studies have noted that pain is typically greatest during the first few days of expansion and gradually subsides afterwards (9). Pain may influence patient compliance and treatment acceptance. Therefore, assessing pain with standardized and reproducible methods is clinically important. The Numeric Rating Scale (NRS) is a commonly used patient-reported measure of pain intensity. Patients rate their pain from 0 to 10, and the method has been reported to be both reliable and practical in orthodontic studies (10, 11).

In recent years, patient-centered outcomes in orthodontics, including comfort, pain perception, and oral health-related quality of life, have received increasing attention (12, 13). Validated tools, including the Oral Health Impact Profile-14 (OHIP-14), have been used to evaluate these outcomes (14, 15). However, few studies have examined the short-term effects of acrylic-bonded RME appliances on patient comfort and quality of life with repeated questionnaire assessments, since many investigations evaluate only one outcome or a single time point (16). Accordingly, this study investigated how patient comfort changes during the early phase of RME. The results are expected to offer clinically relevant insight into the patient-centered aspects of bonded RME treatment.

Materials and Methods

The study protocol was approved by the Scientific Research Ethics Committee of Biruni University (Approval No: 2024-BIAEK/14-39). The study was conducted in accordance with the Declaration of Helsinki, and written informed consent was obtained from all participants and their legal guardians.

This single-center, prospective observational study evaluated the early effects of rapid maxillary expansion (RME) performed with an acrylic-bonded (cap-splint) appliance on pain perception and oral health–related quality of life (OHRQoL). A total of 29 adolescents (16 females, 13 males) aged 12–15 years were included in the study. Participants were recruited consecutively from patients presenting to the orthodontic clinic who met the inclusion criteria. Participants with transversal maxillary deficiency and an indication for acrylic-bonded RME, with largely completed permanent dentition, no previous orthodontic treatment, and no systemic disease were included. Individuals with craniofacial anomalies, previous maxillary expansion, systemic or psychiatric conditions affecting pain perception or quality of life, regular analgesic or anti-inflammatory use, or incomplete questionnaires were excluded.

A priori sample size calculation was performed for the primary outcome (OHIP-14) using G*Power based on repeated-measures ANOVA for three within-subject measurements. Under the assumptions of Cohen's f = 0.25, alpha = 0.05, power = 0.90, correlation among repeated measures = 0.50, and nonsphericity correction = 1.0, the minimum required sample size was calculated as 28 participants. The final sample comprised 29 participants. All participants were treated with an acrylic cap-splint–bonded RME appliance incorporating a midline Hyrax-type expansion screw. The appliance was activated twice daily (0.25 mm per activation) during the first 7 days, followed by once-daily activation until adequate expansion was achieved, targeting a total expansion of approximately 7–10 mm.

Pain intensity was assessed using a numeric rating scale (NRS; 0–10) on postoperative days 1, 3, 7, and 14. Oral health–related quality of life was evaluated using the Oral Health Impact Profile-14 (OHIP-14; total score 0–56) at baseline (day 0), postoperative day 7, and postoperative day 14.

Statistical analysis: Statistical analyses were performed using IBM SPSS Statistics for Windows, version 31.0 (IBM Corp., Armonk, NY, USA). The distribution of variables was assessed using visual methods and the Shapiro–Wilk test. As the data were not normally distributed, non-parametric tests were applied. Repeated measures were analyzed using the Friedman test, and pairwise comparisons were performed with the Wilcoxon signed-rank test. Correlations between variables were assessed using Spearman's rank correlation coefficient. Data were presented as median (interquartile range). A p value of <0.05 was considered statistically significant.

Results

A total of 29 participants (16 females, 13 males) were included in the analysis. The median age was 13 (interquartile range: 12–14) years, with an age range of 12–15 years (Table 1).

OHIP-14 scores increased significantly from baseline to day 7 and decreased at day 14 (Table 2). The median total score was 1 (1–2) at baseline, 23 (21–26) on day 7, and 16 (14–19) on day 14 (overall p<0.001). Pain intensity measured by the NRS showed a significant change over time (Table 3, p<0.001), with scores peaking on day 3 and decreasing on days 7 and 14. No significant correlation was found between NRS scores and OHIP-14 domain scores at days 7 and 14 (Table 4).

Table 1. Demographic characteristics of the participants

Variable		Value
Age, years (median [IQR]; range)		13 (12–14); 12–15
Sex, n (%)	Female	16 (55.2)
	Male	13 (44.8)

* Data are presented as median (interquartile range) or n (%).

Table 2. Time-related changes in OHIP-14 total and domain scores

Variables	Day 0	Day 7	Day 14	*p*-value	Pairwise *p*-value		
				Overall*	Day 0 vs Day 7	Day 0 vs Day 14	Day 7 vs Day 14
Total score	1 (1-2)	23 (21-26)	16 (14-19)	<0.001	<0.001	<0.001	<0.001
Functional limitation	0 (0-0)	5 (5-6)	4 (3-4)	<0.001	<0.001	<0.001	<0.001
Physical pain	1 (0-1)	5 (5-5)	4 (3-4)	<0.001	<0.001	<0.001	<0.001
Psychological discomfort	0 (0-1)	5 (5-6)	4 (3-4)	<0.001	<0.001	<0.001	<0.001
Physical disability	0 (0-0)	2 (2-3)	2 (1-2)	<0.001	<0.001	<0.001	0.001
Psychological disability	0 (0-1)	4 (4-5)	3 (3-4)	<0.001	<0.001	<0.001	<0.001
Social disability	0 (0-0)	1 (1-2)	0 (0-1)	<0.001	<0.001	<0.001	<0.001
Handicap	0 (0-0)	1 (0-1)	0 (0-1)	<0.001	<0.001	0.014	0.005

* The Friedman test was used for overall comparisons. Pairwise comparisons were performed using the Wilcoxon signed-rank test.

Table 3. Time-Related Changes in Numeric Rating Scale (NRS) scores

Variables	Day 1	Day 3	Day 7	Day 14	*p*-value*
NRS	3 (2-4)	4 (3-4)	2 (2-3)	1 (1-2)	<0.001

* The Friedman test was used for overall comparisons, and the Wilcoxon signed-rank test for pairwise analyses. All comparisons were significant ($p<0.001$)

Table 4. Correlation coefficients between NRS and OHIP-14 domain scores

Time	Ohip-14	Nrs	r	*p*-value*
Day 7	Functional limitation	Nrs 7	-0.169	0.382
Day 7	Physical pain	Nrs7	-0.182	0.344
Day 7	Psychological discomfort	Nrs7	-0.050	0.795
Day 7	Physical disability	Nrs7	-0.283	0.138
Day 7	Psychological disability	Nrs7	-0.235	0.220
Day 7	Social disability	Nrs7	0.020	0.918
Day 7	Handicap	Nrs7	0.142	0.462
Day 14	Functional limitation	Nrs14	-0.023	0.904
Day 14	Physical pain	Nrs14	-0.002	0.994
Day 14	Psychological discomfort	Nrs14	-0.034	0.862
Day 14	Physical disability	Nrs14	-0.316	0.095
Day 14	Psychological disability	Nrs14	-0.349	0.063
Day 14	Social disability	Nrs14	0.193	0.317
Day 14	Handicap	Nrs14	-0.275	0.148

*Spearman's rank correlation coefficient was used to assess correlations

Subscale analyses showed that functional limitation, physical pain, and psychological discomfort exhibited the most prominent time-dependent changes (all pairwise comparisons, $p<0.001$). In contrast, social disability and handicap did not show statistically significant changes over time ($p>0.05$).

Discussion

Previous findings indicate that pain associated with rapid maxillary expansion (RME) typically emerges during the first few days and then gradually subsides (17, 18). Consistent with this pattern, in the present study, pain intensity assessed using the NRS changed significantly over time (Friedman test, $p<0.001$), with pairwise comparisons showing significant differences between all time points ($p<0.001$). Pain peaked on day 3 and decreased significantly on days 7 and 14 (Table 3). This response has been attributed to acute inflammatory changes within the periodontal ligament and midpalatal suture following orthopedic force application; therefore, many studies have focused primarily on short-term pain assessment (19, 20). From a clinical perspective, clearly informing patients and their parents about the expected pain during the first 3–7 days may improve patient compliance.

During orthodontic treatment with RME, patient comfort cannot be explained solely by pain intensity (16, 21); it is also influenced by functional and behavioral factors, such as difficulty in chewing and speaking, changes in eating habits, and adaptation to the appliance (22). Consistent with this, the present study demonstrated that acrylic-bonded (cap-splint) RME significantly affected early patient-reported outcomes. The OHIP-14 total score increased markedly from baseline to day 7 and showed partial improvement by day 14, although it did not fully return to baseline levels in most subdomains (Table 2). Subscale analyses indicated that impairment was predominantly observed in functional limitation, physical pain, psychological discomfort, and psychological disability, whereas social disability and handicap remained relatively low. These findings suggest that the early burden of treatment is primarily related to functional adaptation in daily activities. These findings may be explained by temporary limitations in mastication and phonation due to the acrylic structure covering the occlusal surfaces and increasing palatal volume.

A randomized clinical trial reported that adolescents treated with bonded rapid maxillary expanders experienced greater pain and discomfort, along with more pronounced difficulties in chewing and swallowing during the early phase; however, these complaints decreased over time as adaptation occurred (23). In addition, speech alterations during RME have been reported and may persist at certain time points, contributing to functional limitations (22, 24). In line with previous studies, the lack of a significant correlation between NRS scores and OHIP-14 subscales in the later period suggests that the decline in quality of life cannot be explained by pain alone, but also reflects functional limitations and behavioral adaptation processes (Table 4). Our findings are consistent with those of Altieri and Cassetta (21), who also reported no significant association between pain intensity and OHIP-14 scores during the activation phase.

Overall, acrylic-bonded rapid maxillary expansion is associated with a marked short-term decline in oral health–related quality of life, most pronounced in the first week, with only partial recovery by day 14. The weak relationship between later pain intensity and OHIP-14 subscales suggests that patient-reported impairment is not driven by pain alone, but also by functional limitations and adaptation to the appliance. These findings support the need for early counseling and supportive measures to improve comfort and adherence. However, given the single-center design and short follow-up, larger studies with longer observation are needed to confirm generalizability.

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