Retention practices and factors affecting retainer choice among orthodontists in Saudi Arabia

Thikriat S. Al-Jewair, BDS, MSc, Mohammad A. Hamidaddin, BDS, Hamdan M. Alotaibi, BDS, Nasser D. Alqahtani, BDS, MS, Sahar F. Albarakati, BDS, MS, Eman A. Alkofide, MS, DSc, Khalid A. Al-Moammar, MORTH RCSed, PhD.

ABSTRACT

الأهداف: التعرف على بروتوكلات التثبيت التي يمارسها أطباء تقويم الأسنان في المملكة العربية السعودية والعوامل التي تؤثر في اختيار المثبت.

الطريقة: أجريت هذه الدراسة المستعرضة خلال الفترة من فبراير ومارس 2015 في كلية طب الأسنان، جامعة الدمام، الدمام، المملكة العربية السعودية. ارسل استطلاع الكتروني تم اختباره مسبقاً (34 عنصر) إلى جميع أعضاء جمعية تقويم الأسنان السعودية البالغ عددهم 1200 عضو. اشتمل الاستبيان على البيانات الديموغرافيه، وممارسات العلاج المستخدمه في التقويم، وبروتوكولات التثبيت وبعد التثبيت.

النتائج: استلمنا 167 (13.9%) رد خلال فترة الدراسة. وأظهرت النتائج الاستخدام السائد للهولي في قوس الفك العلوي (61.3%) والمثبت اللساني في قوس الفك السفلي، كما أوصى مايقارب 90.3% بارتداء المثبت القابل للإزالة. وبشكل عام، يميل أطباء تقويم الأسنان الذين أجروا عدد أقل من عمليات خلع الأسنان إلى استخدام المثبت الدائم، أما الذين أجروا عمليات خلع أكثر يستخدمون المثبت المتحرك p=0.018. كما استخدم تخفيض المينا المتلاصق من قبل 28% كإجراء مساعد لدعم التثبيت، واستخدم مايقارب 64% مرحلة مابعد التثبيت لارتداء المثبت. كما أن المشاركون الذين استخدموا المثبت المتحرك أكثر شيوعاً لاستخدامه مدى الحياة.

الخاتمة: يعد استخدام كلا من هولي في قوس الفك العلوي والمثبت اللساني في قوس الفك السفلي أكثر البروتوكولات استخداماً. كان التثبيت مدى الحياة الخيار الأكثر شيوعاً للمشاركين الذين استخدموا المثبت القابل للإزالة وخصوصاً عند خلع الأسنان.

Objectives: To identify the retention protocols practiced by orthodontists in Saudi Arabia, and the factors affecting retainer choice.

Methods: This cross-sectional study took place between February and March of 2015 at the College of Dentistry, University of Dammam, Dammam, Saudi Arabia. A previously tested electronic survey of 34 items was sent to all 1,200 orthodontic members of the Saudi Orthodontic Society. The questionnaire elicited data on the subjects' demographics, orthodontic treatment practices, retention, and post-retention protocols.

Results: One hundred and sixty-seven (13.9%) responses were received during the study period. The results showed predominant use of Hawley in the maxillary arch (61.3%), and fixed lingual in the mandibular arch (58.5%). Approximately 90.3% recommended full-time maxillary removable retainer wear. Overall, orthodontists who performed fewer extractions tended to use fixed retainers, and those who performed more extractions used removable retainers (p=0.018). Interproximal enamel reduction was used by 28% of the respondents as an adjunct procedure to enhance retention. Approximately 64% practiced a post-retention phase of retainer wear. Participants who used removable retainers most commonly prescribed lifetime retention.

Conclusion: Hawley in the maxilla, and fixed lingual in the mandible were the most common retention protocols prescribed. Lifetime retention was the most common choice for participants who used removable retainers, especially when extractions were carried out.

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From the Department of Orthodontics (Al-Jewair), State University of New York at Buffalo, Buffalo, USA, the College of Dentistry (Hamidaddin), New York University, New York, New York, the Department of Orthodontics (Alotaibi), King Abdulaziz Airbase Hospital, Dammam, and the Division of Orthodontics (Alqahtani, Albarakati, Alkofide, Al-Moammar), Department of Pediatric Dentistry and Orthodontics, College of Dentistry, King Saud University, Kingdom of Saudi Arabia.

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Address correspondence and reprint request to: Dr. Thikriat S. Al-Jewair, Department of Orthodontics, State University of New York at Buffalo, Buffalo,New York, United States of America. E-mail: taljewair@gmail.com

Moyers[1] defined retention following orthodontic treatment as "the holding of teeth following orthodontic treatment in the treated position for the period of time necessary for the maintenance of the result." The rationale for retention includes reorganization of the tissue, minimizing changes caused by growth and allowing neuromuscular adaptation to the corrected tooth position.[2] Many forms of retention are used in orthodontic treatment. Bonded retainers, removable acrylic retainers, vacuum formed retainers (VFR), and spring retainers are the most commonly used.[1] Orthodontists practice various retention protocols today. Members of the American Association of Orthodontists (AAO) reported predominance in the use of Hawley, or VFR in the maxillary arch and bonded fixed retainers in the mandibular arch.[3] In Norway,[4] orthodontists used fixed bonded retainers in the mandible, while in the maxilla, they used a combination of bonded retainers and removable retainers. In Ireland,[5] a study of 123 eligible orthodontists recommended full-time wear of VFR in the maxillary and mandibular arches followed by part-time wear of removable retainers. Swiss orthodontists preferred using bonded retainers in both arches, except when expansion, or extraction was carried out in the maxillary arch in which a combination of removable and fixed retainers were placed.[6]

In Saudi Arabia, there are approximately 1,200 orthodontists who are members of the Saudi Orthodontic Society (SOS), a major organization for orthodontists in the country. Members of the SOS must hold active registration with the Saudi Council for Health Specialties. Orthodontic treatment in Saudi Arabia can be provided at no cost by the governmental sector, which results in long waiting lists, or by the private sector, which is privately funded and financed, with the advantage of shorter waiting times. There is a lack of literature regarding retention practices among orthodontists in Saudi Arabia. Therefore, the aim of this study was to survey the retention protocols that are followed by orthodontists in Saudi Arabia, and investigate the factors that affect the retainer choice.

Methods. This was a cross-sectional survey of all orthodontists in Saudi Arabia who are members of the SOS (N=1200 members). The study took place between February and March of 2015 at the College of Dentistry, University of Dammam, Damma, Saudi Arabia. Members were invited to participate and asked to fill out an online questionnaire (Google Forms) of 34 items on their maxillary and mandibular retention practices. The questionnaires were sent to members via email 3 times to maximize response rate. The first electronic mailing was in February 2015, while the second and third sendings were 2 and 4 weeks after the initial sending. Additionally, key members of the SOS were contacted to encourage members to participate in this study. Ethical approval was obtained from the Research Committee at the College of Dentistry, University of Dammam, Dammam, Saudi Arabia and the study was conducted in accordance with the Helsinki Declaration.

The questionnaire items were adapted from the study of Valiathan and Hughes.[7] Some questions were revised to be suitable for the sample evaluated. The questionnaire elicited the following data: 1) Demographics (gender, year of graduation from an advanced education program in orthodontics, national or international board certification, country from which the orthodontic degree was obtained, socioeconomic status, years in practice, work place/sector). 2) Orthodontic treatment phase (average number of debondings last year, the use of phase-I as part of treatment, extraction rate). 3) Retention phase (this included general questions regarding types of retainers prescribed and duration of retention, in addition to questions specific to retention practices in each arch). 4) Post-retention phase (this included questions on whether, or not the respondent practiced a post-retention follow-up phase described as patients continuing to wear retainers after the hard and soft tissues have completed remodeling following orthodontic treatment, and the length of this phase).

Data were analyzed using Statistical Package of Social Sciences, version 19 for Windows (SPSS, Chicago, IL, USA). Descriptive analysis was conducted for all variables and frequencies were reported. Chi-square test was used to determine factors affecting the choice of retainers including: gender, years in practice, board certification, number of debonds, Phase-I treatment, extraction rate, and duration of retention. Statistical significance was set at 5%.

Results. One hundred and sixty-seven (13.9%) responses were received. Most of the respondents were male (69%), and more than 46% had 6-15 years of orthodontic experience, **Table 1**.

When asked regarding the total number of cases debonded within the past year, 65% debonded <150 cases, 25.2% debonded 150-300 cases, and only 9.8% debonded >300 cases. Phase-I (early treatment) was commonly practiced by 83.8% of the orthodontists. The rate of extraction treatment was <1/4th of the cases

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by 21.5% of the orthodontists, between one quarter and one half of the cases by 66.9%, and between 1/2 and three quarters of the cases by only 11.7%. The types of retainers used in both the maxillary and mandibular arches and the duration of wear are illustrated in **Figure 1** and **Table 2**. In the maxillary arch, the most commonly prescribed type of retainer was Hawley (61.3%). Vacuum formed retainer (VFR) (16%), VFR with fixed lingual (12.9 %), and VFR followed by Hawley (6.1%) were also used by some orthodontists. The least frequently used retainer was the fixed lingual (3.7%). While in the mandible, the most commonly delivered retainer was the fixed lingual (58.5%). Of the orthodontists who used removable retainers, 90.3% recommended full-time maxillary, and 75.3% mandibular removable retainer wear. Of the few who recommended part-time wear only, most instructed patients to wear the retainer for a duration of 16 hours per day. Forty-four percent of the orthodontists indicated that Hawley was the removable retainer type most patients complied with, followed by VFR (28%). The remaining percentage thought there was no difference in compliance with the 2 retainer types.

Table 1 - Demographic characteristics of 167 orthodontists included in the study on retention practices.

Question	n (%)
What is your gender?	
Male	115 (68.9)
Female	52 (31.1)
When did you graduate from your orthodontic residency program?	
Before 1970	0 (0)
1970-1980	0 (0)
1980-1990	9 (5.4)
1990-2000	32 (19.2)
2000-present	126 (75.4)
For how many years have you been practicing orthodontics?	
0-5 years	56 (33.5)
6-15 years	78 (46.7)
16-25 years	24 (14.4)
>25 years	9 (5.4)
Are you certified by any national or international board	
Yes	93 (55.7)
No	74 (44.3)

Most orthodontists (73.5%) stated that whether, or not a patient received extractions as part of his or her orthodontic treatment influenced the type of retainer the orthodontists provided to the patient. Orthodontists who performed fewer extractions tended to use fixed retainers and those who performed more extractions used Hawley retainers (p=0.018). Also, those that debonded fewer cases per year tended to prescribe fixed retainers compared with those that treated more cases (p=0.016). None of the other factors was statistically significant. When asked regarding the use of adjunct procedures to enhance retention, 28% performed interproximal enamel reduction (IPR), a slightly lower percentage (26.8%) performed no adjunct procedure, 26.1% over-corrected the malocclusion, and 19.1% used circumferential supracrestal fibrotomy (CSF).

The retention check protocol varied among orthodontists (**Table 3**). Approximately 42% of the respondents schedule the first retention check at 1-2 months after debonding, while 10% did not schedule any further appointments after appliance debonding and retainer delivery. Eighty-seven percent of the orthodontists did not charge for retention checks, while 13% have a fee schedule and the average fee

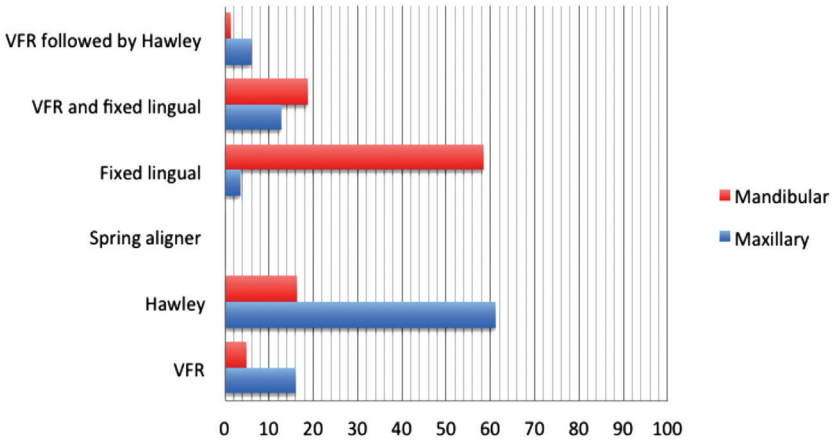

Figure 1 - Frequency of maxillary and mandibular retainer use by type. VFR - vacuum formed retainers

Table 2 - Retention and post-retention protocols in the maxillary and mandibular arches.

Question	Response, n (%)
Do you prescribe a period of full time wear for maxillary removable retainers (>20 hours/day)	Yes = 130 (90.3) No = 15 (9.7)
What instructions do you give to patients regarding maxillary removable retainer full time wear after debonding?	Full time for <3 months = 11 (7.5) Full time for 3-6 months = 69 (47.3) Full time for 7 month - one year = 45 (30.8) Full time for >1 year = 21 (14.4)
Maxillary removable retainer part-time wear protocol (anything <20 hours/day)	Around 16 hours per day = 72 (54.1) Around 8 hours per day = 52 (39.1) Between 16 hours per day to occasional wear = 5 (3.8) Between 8 hours per day to occasional wear = 2 (1.5) Patient decides amount of wear time = 2 (1.5)
Do you prescribe a period of full time wear for mandibular removable retainers (>20 hours/day)	Yes = 64 (75.3) No = 21 (24.7)
What instructions do you give to patients regarding mandibular removable retainer full time wear after debonding	Full time for <3 months = 6 (8.5) Full time for 3-6 months = 31 (43.7) Full time for 7 months - one year = 19 (26.8) Full time for >1 year = 15 (21.1)
Mandibular removable retainer part time wear protocol (anything < 20 hours/day)	Around 16 hrs per day = 39 (54.9) Around 8 hrs per day = 23 (32.4) Between 16 hours per day to occasional wear = 5 (7) Between 8 hours per day to occasional wear = 4 (5.6) Patient decides amount of wear time = 0 (0)
For removable retainers, do you instruct your patient that they can stop wearing their removable retainers at a specific time?	No, wear retainers forever = 34 (37.8) Yes, <2 years after debond = 39 (43.3) Yes, 5 years after debond = 15 (16.7) Yes, after 3rd molars are extracted = 2 (2.2)
For patients given fixed lingual retainers, do you instruct them to have the fixed retainer removed at any time?	Yes = 26 (16.4) No = 133 (83.6)
When do you instruct them to have the fixed lingual retainer removed?	< 2 years after debonding = 8 (25) 2-5 years after debonding = 12 (37.5) >5 years after debonging = 7 (21.9) After 3rd molars are extracted = 5 (15.6)

charged was SAR227 (equivalent to USD60). Reported patient compliance rates at different retention check durations are presented in **Table 4**.

Of the respondents, 63.9% practiced a post-retention phase of retainer wear. Respondents who practiced phase-I (early treatment), and those who did not use any adjunctive retention procedures both instructed a lifetime period of post-retention.

Discussion. Previous evidence has confirmed that retention protocols are case specific in that they take into consideration different factors, such as patient age, type and severity of initial malocclusion, growth potential, and patient compliance.[8,9] Yet, common trends exist among orthodontists practicing in different countries that are perhaps influenced by underlying oral health attitudes, behaviors, and practices among treated patients, type of dental care delivery system, as well as the training backgrounds of orthodontists.[3,4,6] Hence, it was important to investigate the retention practices of orthodontists in Saudi Arabia. In this study, the most commonly used retainer in the maxilla was the Hawley. This was similar to results found by Pratt et al,[3] Keim et al,[10] and Valiathan and Hughes.[7] Vacuum formed retainer alone was the second most common retainer used in the maxilla in our study, while in Ireland[5] it was the first choice, prescribed by 53% of orthodontists. Evidence on the clinical effectiveness of VFR is still limited and variable. One randomized clinical trial[11] compared the effectiveness of VFR and Hawely retainers over a 6-month period of retention. The study measured tooth rotations mesial to first permanent molars, little's irregularity index, and inter-molar, and inter-canine widths. The study found significantly greater changes in irregularity with the Hawley compared to the VFR. Yet, a recent systematic review of 7 studies comparing VFR with Hawley reported insufficient evidence to support the use of one retainer over the other.[12] Overall, the preference of prescribing removable retainers in the maxilla may suggest that orthodontists prefer to shift the responsibility of maintaining the results to the patient. A combination of fixed and removable appliances was the most common maxillary retainer favored by orthodontists in Norway[4] and Switzerland.[6] In our study, it was the third choice. Fixed lingual was the least common retainer used in the maxilla in

this study, in contrast to findings by Renkema et al,[13] where it was commonly used in the maxilla. Maxillary fixed lingual retainers are associated with greater failure compared with mandibular fixed lingual.[14] The success of these retainers is associated with the number of teeth included in the bonded unit, as well as the operator's experience.[14] This may explain their limited use among the sample of our study. In the mandibular arch, fixed lingual was the most commonly used retainer (59%). A similar percentage was reported in the Netherlands[13] and in the United States.[15] The simplicity of the procedure in terms of direct visibility and good aesthetics seem to be the advantages that explain why mandibular fixed lingual is popular[16,17] among orthodontists in Saudi Arabia and elsewhere. A smaller percentage (18.9%) used a combination of fixed lingual and VFR. The most popular retainer combination among Saudi Orthodontists is the maxillary Hawley and the mandibular fixed lingual. According to Hoybjerg et al[15] in their study of U.S. orthodontists, maxillary Hawley used with mandibular fixed retainer showed the greatest

Table 4 - Rates of patient compliance with the retention protocols at 6 months, one and 5 years following debonding.

Question	Number of responses	Mean %	SD
Percentage of patients compliant with retention protocols 6 months following debonding?	151	58.54	29.01
Percentage of patients compliant with retention protocols one year following debonding?	153	42.78	26.12
Percentage of patients compliant with retention protocols 5 years following debonding?	139	18.42	21.50

Table 3 - Retention checks and post-retention protocols in the maxillary and mandibular arches.

Question	Response, n (%)
Retention checks protocol	
The first retention check appointment is scheduled, how long after the debonding appointment?	<4 weeks after debonding appointment = 31 (19.6) 1-2 months after debonding appointment = 67 (42.4) >2 months after debonding appointment = 44 (27.8) There are no retention appointments = 16 (10.1)
The second retention check appointment is scheduled, how long after the debonding appointment?	<3 months after the first appointment = 25 (15.5) 3-5 months after the first appointment = 67 (41.6) 6 months or greater after the first appointment = 55 (34.2) No second appointment = 8.7% (n=14)
The third retention check appointment is scheduled, how long after the debonding appointment?	<6 months after the second appointment = 37 (23) 6-11 months after the second appointment = 52 (32.3) >1 year after the second appointment = 41 (25.5) No third appointment = 31 (19.3)
The fourth retention check appointment is scheduled, how long after the debonding appointment?	<6 months after the third appointment = 10 (6.3) 3-5 months after the third appointment = 21 (13.1) >1 year after the third appointment = 57 (35.6) No fourth appointment = 72 (45)
The fifth retention check appointment is scheduled, how long after the debonding appointment?	<6 months after the fourth appointment = 10 (6.3) 3-5 months after the fourth appointment = 14 (8.8) >1 year after the fourth appointment = 32 (20.1) No fifth appointment = 103 (64.8)
Do you charge for retainer checks?	Yes = 20 (12.9) No = 135 (87.1)
Post-retention protocol	
Do you practice a post-retention phase of retainer wear? (Do you have patients continue to wear retainers after the hard and soft tissues have completed remodeling following orthodontic therapy?)	Yes = 99 (63.9) No = 56 (36.1)
How long does your post-retention phase last?	3-6 months = 6 (5.7) 1-2 years = 20 (18.9) 3-5 years = 15 (14.2) Lifetime = 55 (51.9) Depends on the case = 10 (9.4)

Table 5 - Comparison of different retention protocols in different countries.

Countries	Maxilla	Mandible
Present study (Saudi Arabia)	Hawley	Fixed lingual
Pratt et al [3] (United States)	Hawley	Fixed lingual
Vandevska-Radunovic et al[4] (Norway)	Combination (fixed + removable)	Fixed lingual
Meade and Millett[5] (Ireland)	VFR	VFR + fixed lingual
Lai et al[6] (Switzerland)	Combination (fixed + removable)	Fixed lingual
Renkema et al[13] (Netherlands)	Fixed lingual	Fixed lingual
Rahman et al[27] (Malaysia)	VFR	VFR

VFR - vacuum formed retainer

amount of settling. It is worth stating that 21.4% of the respondents in our study were graduates of North American orthodontic programs and, therefore, might have adapted the same retainer choices used there. In Ireland,[5] they preferred to use VFR combined with fixed retainer in the mandibular arch.

In this study, 83.6% of the orthodontists reported that they recommend keeping the fixed lingual retainer in place for a long period of time. Of those, more than one-third instruct removal 2-5 years after debonding. This is consistent with the recommendations of Wong and Freer[18] who suggested that a period of retention for more than 2 years is preferred. Although there is no consensus in previous literature on removal times of bonded retainers,[19] Zachrisson[8] recommended extended use of fixed lingual retainers until after the third molars erupt due to post-pubertal growth and maxillomandibular dental changes that occur during that time,[20,21] but only if the patient maintains optimal oral hygiene practices.

Our study found that participants with high extraction rates were more likely to choose the Hawley retainer, while orthodontists with low extraction rates tend to use fixed retainers. This was similar to results from the United States.[15] The differences in settling, however, between extraction and non-extraction cases were found to be insignificant.[1,3] Similar to the findings of Valiathan and Hughes (84%),[7] almost 78% of orthodontists who prescribed lifetime retention in this study used removable retainers in the maxilla.

Most of orthodontists in our study advised full-time removable retainer wear both in the maxilla and the mandible, a smaller percentage did recommend part-time wear. The rational behind instructing full-time versus part-time wear is not known and may need to be explored in future studies. Nonetheless, recent evidence suggested that the 2 year protocols have similar effectiveness in maintaining stability.[22]

According to the respondents, patients' compliance was greater with the Hawley compared to the VFR. The occlusal coverage of the VFR may have resulted in speech impairment and, therefore, a lower compliance rate. This factor seemed to have overpowered the demand for an aesthetics appliance, which is one of the advantages of VFR.

Among the available adjunct procedures to enhance retention, IPR was performed more commonly among the orthodontists in Saudi Arabia. It was not clear, however, if IPR was carried out only in the maxillary or mandibular arches, or both. Interproximal enamel reduction has several advantages, including broadening of the interdental contacts, increasing fill of the gingival papilla,[23] improving aesthetics, as well as maintaining incisal inclination in non-extraction cases. Aasen and Espeland[24] in an earlier study suggested that IPR could be an alternative method to mandibular retainers to maintain lower incisor stability. Our study did not examine whether the IPR was carried out serially, or at one point in time after appliance removal, nor did it investigate the types of cases where IPR was performed. Boese[25] recommended the procedure be carried out serially over a 4-6 month period after debonding. In our study, 26.8% reported that no adjunct procedures were practiced, those respondents also tended to prescribe lifetime retention as compared with those who used adjunct methods. This may be explained by their need to compensate for maximum retention. Unexpectedly, 19.1% of the orthodontists stated that they routinely use CSF as an adjunct procedure. The CSF surgical procedure was first described by Edwards,[26] and it involves severing of the supra-alveolar fibers to prevent rotational relapse in maxillary and/or mandibular anterior teeth. More studies are needed to determine the sites where this procedure is conducted. Edwards[26] found CSF to be less successful in the mandibular anterior region. As well, the long-term stability of the procedure warrants future exploration.

There are a lot of similarities noticed when comparing the current findings to previously published data in the literature. Although orthodontists in the

countries reviewed agreed to the use of fixed retention in the mandibular arch with the exception of Malaysian orthodontists who preferred VFR,[27] they seem to vary regarding retention in the maxillary arch (**Table 5**). This reinforces the need for guidelines regarding orthodontic retention in the maxilla.

Study limitations. The response rate was low, consequently threatening the validity of the inferences. However, since the questionnaire was sent through the SOS list serve, which is the largest orthodontic association in the country, there is no reason to believe that non-responders differed substantially from responders in this study. Also, there was no information regarding the type of phase-I treatments practiced. Future studies may want to investigate the phase-I treatment practices of orthodontists in the region. Also, the types of retainers prescribed for different malocclusions, such as anterior open bite, warrant future investigation. Finally, since there was no similar study carried out previously in Saudi Arabia, we were not able to learn whether, or not there was a shift in retention practices in the country.

In conclusion, orthodontists in Saudi Arabia reported the most common retention protocol used was Hawley (61.3%) in the maxilla and fixed lingual (58.5%) in the mandible. Respondents who extracted less used fixed retention, while those who extracted more used removable retainers. Lifetime retention was the most common choice for participants who used removable retainers, especially when extractions were carried out. The decline in the use of adjunctive retention procedure was paired with lifetime post-retention.

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