



Comparative evaluation of Awareness Regarding External Root Resorption among General Dentists And Orthodontists

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Abstract

Background: External root resorption is a recognized iatrogenic complication of dental treatment that may compromise long-term tooth prognosis if not detected early. Both general dentists and orthodontists play a critical role in identifying risk factors, monitoring radiographic changes, and managing treatment when resorption occurs.

Materials and Methods: A cross-sectional questionnaire-based survey was conducted among 64 dental professionals, comprising of general dentists and orthodontists 32 in each group. A validated structured questionnaire containing 18 items assessed knowledge (8 items), attitude (4 items), and practice (6 items) related to ERR. The survey was distributed electronically using Google Forms. Data were analyzed using Jamovi version 2.6.25. Descriptive statistics and Chi-square tests were applied to compare responses between the two groups, with a significance level set at $p < 0.05$.

Results: General dentists demonstrated comparatively lower knowledge in several domains. Recognition of the strongest risk factor was lower among general dentists (62.5%) compared to orthodontists (96.9%). Awareness of the treatment phase associated with higher risk was lower among general dentists (65.6%) than orthodontists (93.8%). Orthodontists showed a more Positive attitude than general dentist. In practice, routine root condition assessment was reported by 59.4% of general dentists and 96.9% of orthodontists. General dentists were less aware about the mechanics of tooth movement associated with ERR (intrusion 70% and TADS 64%).

Conclusion: General dentists demonstrated lower knowledge, less appropriate attitudes, and less consistent clinical practices regarding external root resorption compared with orthodontists. Education and interdisciplinary collaboration may improve early detection and prevention of ERR.

Keywords: Attitude; External root resorption; General dentist; Knowledge; Orthodontist; Practice.

Introduction

External root resorption (ERR) is a pathological process characterized by the loss of cementum and dentin due to odontoclastic activity on the root surface. External root resorption (ERR) may result from a variety of local and systemic factors, including dental trauma, periapical or periodontal infections, and certain systemic or metabolic conditions that affect

bone and mineral metabolism. Traumatic injuries such as luxation or avulsion can damage the periodontal ligament and cementum, initiating clastic activity and subsequent root resorption. Similarly, chronic infections can lead to inflammatory responses that stimulate odontoclasts, resulting in progressive loss of root structure. Systemic diseases and conditions may

further alter the host response, increasing susceptibility to resorptive processes [1].

However, it is most frequently associated with orthodontic treatment and is commonly referred to as orthodontically induced external apical root resorption (OIEARR). This condition is considered one of the most common iatrogenic complications of orthodontic therapy and may compromise the long-term prognosis of affected teeth if not detected and managed at an early stage [1].

The pathophysiology of ERR involves inflammatory changes within the periodontal ligament caused by orthodontic forces. Excessive or prolonged mechanical stress can result in hyalinization of the periodontal ligament, leading to activation of clastic cells that resorb cementum and dentin on the root surface [2]. Previous studies have reported that microscopic evidence of root resorption can be observed in the majority of orthodontically moved teeth, while radiographically detectable resorption occurs in approximately 48–66% of orthodontically treated patients. Although severe root resorption is relatively uncommon, it remains a clinically significant concern because it can lead to permanent root shortening and compromise tooth stability [3].

Several patient-related and treatment-related factors influence the occurrence and severity of ERR. These include genetic predisposition, root morphology, type of tooth movement, magnitude and duration of orthodontic force, and overall treatment duration [4]. Early diagnosis through periodic radiographic assessment and careful monitoring during orthodontic treatment is therefore essential to minimize the risk and progression of root resorption [5].

In clinical practice, general dentists often identify etiological factors such as trauma and infection, while orthodontists evaluate treatment-related factors, including the magnitude and duration of orthodontic forces. As both groups assess different yet interrelated aspects of external root resorption (ERR), comparing their knowledge and clinical perspectives is essential for early diagnosis, accurate risk assessment, and effective prevention. Orthodontists are primarily responsible for treatment, whereas general dentists play an important role in early detection, patient education, and timely referral.

Previous studies have mainly focused on patient outcomes, with limited emphasis on professional awareness among dental practitioners. This gap highlights the need to evaluate differences in knowledge, attitude, and clinical practices between these groups. Therefore, the present study aims to compare the knowledge, attitude, and practice regarding ERR among general dentists and orthodontists to improve its prevention, early diagnosis, and management.

Materials And Methods

Study design and setting

This study was designed as a cross-sectional, questionnaire-based survey conducted to evaluate the knowledge, attitude, and practice regarding external root resorption (ERR) among general dentists and orthodontists. The study was carried out over a period of three months, from January 2025 to March 2025, using an electronic survey platform that allowed participants to complete the questionnaire remotely.

Sample size calculation

The sample size was estimated using the Cochran formula for cross-sectional studies: $n = \frac{Z^2 pq}{d^2}$ where n represents the required sample size, Z represents the standard normal deviation at a 95% confidence interval (1.96), p represents the estimated prevalence, q represents $(1 - p)$, and d represents the margin of error set at 5%. Based on feasibility and availability of participants during the study period, a total of 64 dental professionals were included in the present study, comprising 32 general dentists and 32 orthodontists

Study population

The study population consisted of licensed dental professionals, including general dentists and orthodontists with active clinical practice. A total of 64 participants were included in the study, comprising 32 general dentists and 32 orthodontists. The participants had a mean clinical experience of 5.63 ± 4.36 years, with a range of 5 to 20 years.

1. Inclusion criteria included dental professionals who were currently practicing as orthodontists or general dentists, had clinical experience, and were willing to participate in the study by providing

informed consent and completing the questionnaire.

2. Exclusion criteria included dental professionals who declined to participate in the study or submitted incomplete questionnaire responses.

Study instrument

The study instrument consisted of a structured, self-administered questionnaire developed to assess the knowledge, attitude, and clinical management practices regarding external root resorption among orthodontists and general dentists. The questionnaire was prepared based on an extensive review of the literature related to root resorption and clinical orthodontic practice. A pilot study was conducted among a group of dental practitioners to evaluate the clarity, relevance, and comprehensibility of the questionnaire items, and necessary modifications were made accordingly. The content validity of the questionnaire was established through evaluation by a panel of experts in the field of orthodontics and dentistry. The reliability of the questionnaire was assessed using Cronbach's alpha following pilot testing. The Cronbach's alpha values were 0.82 for orthodontists and 0.80 for general dentists, indicating good internal consistency and reliability of the study instrument.

Questionnaire (18 items)

1. Section A: Knowledge (8 items)
2. Section B: Attitude (4 items)
3. Section C: Practice (6 items)

Data collection procedure

The questionnaire was distributed electronically to orthodontists and general dentists through Google Forms to facilitate easy access and efficient data collection. The link to the questionnaire was shared with potential participants through email and social media platforms. All responses were collected anonymously and maintained confidentially.

Statistical analysis

Statistical analysis was performed using Jamovi version 2.6.25. Descriptive statistics including frequencies, percentages, means, and standard deviations were calculated for all variables. The Chi-square test was employed to compare categorical variables between orthodontists and general dentists.

A p-value < 0.05 was considered statistically significant.

Results

Knowledge assessment

A total of 64 dental professionals participated in the present study, including 32 orthodontists (50%) and 32 general dentists (50%). The participants had a mean clinical experience of 5.63 ± 4.36 years, ranging from 5 to 20 years. The demographic distribution ensured equal representation of both groups for comparison.

The knowledge section included seven items assessing understanding of the etiology, risk factors, and clinical characteristics of external root resorption (ERR). Although most participants demonstrated general awareness of ERR, several knowledge gaps were observed among general dentists.

Most participants correctly identified maxillary incisors as the teeth most commonly affected by ERR, with similar responses from orthodontists (96.9%) and general dentists (96.9%). However, awareness regarding excessive orthodontic force as the strongest risk factor was lower among general dentists (61.1%) compared to orthodontists (96.9%).

All orthodontists (100%) and 93.8% of general dentists recognized ERR as a sterile inflammatory process within the periodontal ligament.

Lower recognition among general dentists was also observed regarding the space closure phase as the treatment stage associated with higher risk (65.6% among general dentists and 93.8% among orthodontists), the apical region as the most commonly affected area (60% among general dentists and 90.6% among orthodontists), intrusion as the tooth movement most associated with OIERR (62% among general dentists and 90.6% among orthodontists), and fixed orthodontic appliances as a contributing factor (60% among general dentists and 90.6% among orthodontists).

Attitude evaluation

The attitude toward external root resorption (ERR) was assessed using four questionnaire items. A statistically significant difference was observed between orthodontist and general dentists in the management of mild radiographic resorption ($p = 0.025$), only 70% of general dentists preferred continuing treatment with lighter forces or temporarily

pausing treatment, compared with 93.8% of orthodontists ($p = 0.025$).

Similarly, 67.6% of general dentists selected longer treatment pauses (4–8 weeks or 3–6 months) for periodontal ligament healing, whereas 93.8% of orthodontists preferred this approach ($p = 0.025$).

No significant difference was observed regarding the perception of preventability of ERR or medicolegal concern ($p = 0.3643$). Overall, general dentists demonstrated a comparatively less favourable attitude toward the management and prevention of ERR than orthodontists.

Practice patterns

The clinical practice patterns of orthodontists and general dentists regarding the monitoring and management of external root resorption (ERR) were evaluated. Differences were observed in routine monitoring practices during orthodontic treatment, with 96.9% indicating regular monitoring compared with general dentists.

Only 68.8% of general dentists reported using appropriate radiographic methods for monitoring OIERR, compared with 81.2% of orthodontists, although the difference was not statistically significant ($p = 0.3865$). Similarly, recognition of tooth movement using temporary anchorage devices associated with increased resorption risk was reported by 66% of general dentists and 87.5% of orthodontists ($p = 0.0766$).

Reduced agreement among general dentists was also observed regarding the extent of root resorption requiring treatment modification or cessation, reported by 65.6% of general dentists compared with 78% of orthodontists ($p = 0.4042$). Overall, these findings indicate that general dentists demonstrated less consistent clinical practices in the monitoring and management of ERR during orthodontic treatment.

Discussion

External root resorption (ERR) is a recognized complication associated with orthodontic treatment and may compromise the long-term prognosis of teeth if not detected and managed at an early stage. The biological mechanism of ERR involves inflammatory responses within the periodontal ligament triggered by orthodontic forces, leading to clastic cell activity and resorption of cementum and dentin[6]. Previous

studies have reported that radiographically detectable root resorption occurs in a considerable proportion of orthodontically treated patients, emphasizing the importance of early diagnosis and continuous monitoring during treatment [7]. Therefore, both orthodontists and general dentists play an important role in identifying risk factors, recognizing early radiographic changes, and modifying treatment when necessary to prevent the progression of ERR.

The present study evaluated the knowledge, attitude, and practice regarding ERR among orthodontists and general dentists and revealed several gaps, particularly among general dentists. Although most participants demonstrated general awareness that ERR may occur during orthodontic treatment, the present findings demonstrated that general dentists showed comparatively lower knowledge regarding important etiological and risk factors associated with ERR [8]. Recognition of excessive orthodontic force as a major contributing factor was lower among general dentists. Another important observation in the present study was that both orthodontists and general dentists recognized maxillary incisors as the teeth most frequently affected by root resorption. This finding is consistent with previous reports demonstrating that maxillary anterior teeth are particularly susceptible to OIERR because of their root morphology and the orthodontic mechanics commonly used during alignment and retraction phases of treatment [9,10].

In addition, awareness regarding the treatment phase associated with higher risk, the apical region as the most commonly affected site, and certain orthodontic tooth movements associated with increased resorption risk was comparatively limited among general dentists than orthodontists. These findings suggest that while general dentists may possess a general understanding of ERR, their knowledge regarding the biological mechanisms and treatment-related factors contributing to root resorption remains insufficient.

The comparatively lower level of knowledge observed among general dentists in the present study is consistent with previous research findings. Keerthana T., Sindhu Ramesh, and Deepak S. 2020 conducted a knowledge, attitude, and practice survey among general dentists and specialists (endodontists) regarding root resorption and its management and reported that specialists (endodontists) demonstrated better knowledge and clinical practices related to the

management of root resorption compared with general dentists [11]. The authors suggested that the difference in awareness may be related to the advanced training and greater exposure of specialists to complex dental conditions. Similar observations in the present study further highlight the need for improving professional awareness regarding ERR among general dental practitioners.

Differences were also observed in the attitude toward the management of ERR. In the present study, fewer general dentists reported adopting appropriate clinical measures when mild radiographic root resorption was detected. Management strategies such as reducing orthodontic force or temporarily pausing treatment to allow periodontal ligament healing were less frequently selected by general dentists. Previous literature has emphasized that early detection followed by appropriate modification of orthodontic mechanics is essential for limiting the severity of root resorption [12,13]. Therefore, inadequate awareness regarding appropriate management approaches among general dentists may potentially contribute to delayed clinical intervention.

The findings of the present study are also supported by the study conducted by Fakhri DC, Tarabai A, and Osman A. 2024 who evaluated the knowledge, attitude, and clinical management of orthodontically induced external root resorption among Lebanese orthodontists and reported that orthodontists demonstrated reasonable knowledge regarding the condition and its clinical management [14]. Although their study primarily assessed orthodontists, the present study compared orthodontists and general dentists and demonstrated that knowledge gaps were more evident among general dentists. This finding underscores the importance of strengthening continuing dental education programs aimed at improving awareness and management of ERR among general dental practitioners.

The present study also demonstrated variations in clinical practice patterns related to the monitoring and management of ERR. Routine radiographic monitoring and assessment of root morphology during orthodontic treatment were reported less frequently among general dentists compared with orthodontists. Radiographic evaluation, particularly during active orthodontic treatment phases, is considered essential

for the early detection of ERR and prevention of severe root shortening [15].

Similar findings have been reported in other studies. Alhammadi *et al.*, 2018 concluded that general dentists possess only moderate knowledge regarding orthodontic complications, including root resorption, with noticeable gaps in clinical management and monitoring practices [16]. Sharpe *et al.* 2019 similarly reported that General dentists showed significantly lower awareness and monitoring practices for orthodontic root resorption compared to orthodontists, emphasizing the need for continuing dental education programs [17].

Previous studies investigating knowledge and awareness related to root resorption have frequently focused on patient populations or assessed root resorption in a general context. Consequently, limited studies have specifically evaluated professional awareness of ERR among different groups of dental practitioners. In contrast, the present study specifically evaluated external root resorption and compared the knowledge, attitude, and practice between orthodontists and general dentists. By identifying areas in which general dentists demonstrate comparatively lower awareness and less consistent clinical practices, this study provides clinically relevant insights that may contribute to improved prevention, early diagnosis, and management of ERR in orthodontic patients.

Certain limitations should be considered when interpreting the results of this study. The questionnaire-based design relies on self-reported responses and may be subject to response bias. Additionally, the sample size and geographic distribution of participants may limit the generalizability of the findings.

Future studies involving larger populations and multicenter participation are recommended to further evaluate clinicians' awareness and management strategies related to orthodontically induced root resorption.

Conclusion

General dentists exhibited comparatively lower knowledge, less favorable attitudes, and less consistent clinical practices regarding ERR compared with orthodontists.

These findings highlight the need for enhanced continuing dental education and interdisciplinary collaboration between orthodontists and general dentists to improve awareness, early diagnosis, and appropriate management of ERR. As general dentists often perform initial patient evaluation and radiographic assessment, increasing their awareness may facilitate early detection and timely referral to orthodontic specialists. Regular radiographic monitoring, careful control of orthodontic forces, and appropriate modification of treatment mechanics remain essential strategies to minimize the risk and severity of root resorption during orthodontic treatment.

Future studies involving larger sample sizes and multicenter participation are recommended to further evaluate clinicians' knowledge and clinical decision-making related to ERR and to develop standardized guidelines for its prevention and management.

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TABLE

Table 1: Study Questionnaires for Assessment of Knowledge, Attitude and Practice regarding Orthodontically Induced External Root Resorption between Orthodontists and General Dentist

Section A: Knowledge Section
1. Profession: A) Orthodontist; B) General Dentist
2. Which of the following teeth are most commonly affected by orthodontically induced external root resorption? A) Maxillary incisors; B) Mandibular molars; C) Premolars; D) All teeth equally
3. Which factor is most strongly associated with increased risk of orthodontically induced external root resorption? A) Excessive orthodontic force; B) Bracket type; C) Patient’s age; D) Retention duration
4. Root resorption during orthodontic treatment is primarily caused by: A) Bacterial infection of pulp; B) Sterile inflammatory process in the periodontal ligament; C) Lack of fluoride exposure; D) Occlusal trauma
5. Which stage of orthodontic treatment carries the highest risk for orthodontically induced external root resorption? A) Initial alignment phase; B) Space closure phase; C) Finishing and detailing; D) Retention phase
6. orthodontically induced external root resorption is most commonly associated with: A) Apical region; B) Cervical region; C) Middle Third of root; D) Furcation area
7. Which of the following tooth movement is most likely to cause orthodontically induced external root resorption? A) Intrusion; B) Extrusion; C) Bodily movement; D) Tipping
8. Which orthodontic appliance type has been most commonly associated with external root resorption? A) Removable appliance; B) Functional appliance; C) Fixed appliance; D) Clear aligner
Section B: Attitude Section
9. Do you consider orthodontically induced external root resorption a preventable complication? A) Yes entirely; B) Partially preventable; C) Not preventable; D) Unsure
10. How concerned are you about the medico-legal implications of orthodontically induced external root resorption? A) Very concerned; B) Moderately concerned; C) Slightly concerned; D) Not concerned
11. When a patient shows mild radiographic resorption, you believe treatment should: A) Continue as planned; B) Continue with lighter forces; C) Pause for a few months; D) Stop immediately
12. When External root resorption is detected during orthodontic treatment, how long should active treatment be stopped to allow repair and healing? A) 1-2 weeks; B) 4-8 weeks; C) 3-6 months; D) continue treatment
Section C: Practice Section
13. Which radiographic method do you most commonly use to monitor orthodontically induced external root resorption during treatment? A) OPG; B) Periapical radiograph; C) CBCT; D) None routinely used
14. How often do you assess root condition during orthodontic treatment? A) Every 3–6 months; B) Every 6–12 months; C) Only when symptoms arise ; D) Never
15. Which adjunctive appliance is more associated with increased external root resorption risk? A) Headgear; B) Temporary anchorage device; C) Lip bumper; D) Palatal expander

16. Which type of tooth movement using Temporary Anchorage Devices is most likely to increase the risk of external root resorption? A) Intrusion; B) Extrusion; C) Bodily movement; D) Rotation
17. At what extent of external root resorption should orthodontic treatment be stopped to prevent further damage? A) Less than 10% of root length; B) 10-20% of root length; C) 20-30% of root length; D) More than 30% of root length
18. What is your preferred retention protocol for teeth affected by significant orthodontically induced external root resorption? A) Fixed retainer; B) Removable thermoplastic retainer; C) Combination of both; D) Same as standard retention

Table 2: Knowledge Comparison Between Orthodontists and General Dentists

Parameter	Category	N	Orthodontists n (%)	General Dentists n (%)	p-value
KNOWLEDGE DOMAIN					
Profession	Orthodontist	32			
	General Dentist	32			
Most affected teeth	Maxillary Incisors	62	31 (96.9%)	31 (96.9%)	1.000
	Mandibular Molars	2	1 (3.1%)	1 (3.1%)	
	Premolars		0 (0%)	0 (0%)	
	All teeth equally		0 (0%)	0 (0%)	
Strongest Risk Factor	Excessive Orthodontic Force	51	31 (96.9%)	20 (62.5%)	0.0019
	Bracket type	7	1 (3.1%)	6 (18.8%)	
	Patient age	4	0 (0%)	4 (12.5%)	
	Retention duration	2	0 (0%)	2 (6.3%)	
Primary etiologic process	Sterile inflammatory PDL response	62	32 (100%)	30 (93.8%)	0.047
	Bacterial infection	1	0 (0%)	1 (3.1%)	
	Lack of fluoride exposure	1	0 (0%)	1 (3.1%)	
	Occlusal Trauma		0 (0%)	0 (0%)	

Highest risk treatment phase	Space closure	51	30 (93.8%)	21 (65.6%)	0.0129
	Initial Alignment phase	6	1 (3.1%)	5 (15.6%)	
	Finishing and detailing Phase	6	1 (3.1%)	5 (15.6%)	
	Retention phase	1	0 (0%)	1 (3.1%)	
Region most affected	Apical region	48	29 (90.6%)	19 (59.4%)	0.0009
	Cervical region	8	2 (6.3%)	6 (18.8%)	
	Middle third	6	1 (3.1%)	5 (15.6%)	
	Furcation	2	0 (0%)	2 (6.3%)	
Tooth movement causing highest risk	Intrusion	49	29 (90.6%)	20 (62.5%)	0.0182
	Extrusion	8	2 (6.3%)	6 (18.8%)	
	Tipping	5	1 (3.1%)	4 (12.5%)	
	Bodily movement	2	0 (0%)	2 (6.3%)	
Appliance most associated	Fixed appliance	48	29 (90.6%)	19 (59.4%)	0.009
	Removable appliance	8	2 (6.3%)	6 (18.8%)	-
	Functional appliance	6	1 (3.1%)	5 (15.6%)	
	Clear aligner	2	0 (0%)	2 (6.3%)	

Chi-square test; significance at $p < 0.05$

Table 3: Attitude Comparison Between Orthodontists and General Dentists

ATTITUDE DOMAIN					
Parameter	Category	N	Orthodontists n (%)	General Dentists n (%)	p-value
OIEARR Preventability	Yes entirely	18	10 (31.3%)	8 (25%)	
	Partially preventable	39	20 (62.5%)	19 (59.4%)	0.4231

	Not preventable	4	1 (3.1%)	3 (9.4%)	
	Unsure	3	1 (3.1%)	2 (6.2%)	
Medicolegal concern	Very concern	50	27 (84.4%)	23 (71.9%)	0.3643
	Moderately concern	8	3 (9.4%)	5 (15.6%)	
	Slightly concern	3	1 (3.1%)	2 (6.2%)	
	Not concern	3	1 (3.1%)	2 (6.2%)	
When mild resorption occurs	Continue as planned	5	1 (3.1%)	4 (12.5%)	
	Continue with lighter forces	52	30 (93.8%)	22 (70%)	0.025
	Pause for few months	5	1 (3.1%)	4 (12.5%)	
	Stop immediately	2	0 (0%)	2 (5%)	
Duration of treatment pause	1-2 weeks	6	1 (3.1%)	5 (15.6%)	
	4-8 weeks	52	30 (93.8%)	22 (67.7%)	0.025
	3-6 months	4	1 (3.1%)	3 (9.4%)	
	Continue treatment	2	0 (0%)	2 (6.3%)	

Table 4: Practice Comparison Between Orthodontists and General Dentists

Parameter	Category	N	Orthodontists n (%)	General Dentists n (%)	p-value
PRACTICE DOMAIN					
Radiographic method used	OPG	8	3 (9.4%)	5 (15.6%)	
	Periapical radiograph	7	2 (6.3%)	5 (15.6%)	
	CBCT	48	26 (81.2%)	22 (68.8%)	0.3865
	None routinely used	1	1 (3.1%)	0 (0%)	

Frequency of root assessment	Every 3-6 months	8	1 (3.1%)	7 (21.9%)	
	Every 6-12 months	50	31 (96.9%)	19 (59.4%)	0.0009
	Only when symptoms arise	6	0 (0%)	6 (18.8%)	
	Never		0 (0%)	0 (0%)	
Adjunctive appliance associated	Headgear	4	1 (3.1%)	3 (9.6%)	
	Temporary anchorage device		30 (93.8%)	23 (70.4%)	0.0468
	Lip bumper		1 (3.1%)	3 (10.0%)	
	Palatal expander		0 (0%)	3 (10.0%)	
Tooth movement causing highest risk with TADS	Intrusion	49	28 (87.5%)	21 (66%)	0.0766
	Extrusion	7	2 (6.3%)	5 (15.6%)	
	Bodily movement	4	1 (3.1%)	3 (9.4%)	
	Rotation	4	1 (3.1%)	3 (9.4%)	
Extent of resorption requiring treatment stoppage	Less than 10% root length	7	2 (6.3%)	5 (15.6%)	
	10-20 % root length	10	4 (12.5%)	6 (18.8%)	
	20-30% root length	46	25 (78%)	21 (65.6%)	0.4042
	More than 30% root length	1	1 (3.1%)	0 (0%)	
Preferred retention protocol	Fixed retainers	7	2 (6.3%)	5 (15.6%)	
	Removable thermoplastic retainer	7	1 (3.1%)	6 (18.8%)	
	Combination (fixed+ removable)	50	29 (90.6%)	21 (65%)	0.0343

	Same as standard retention		0 (0%)	0 (0%)	
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Chi-square test; significance at $p < 0.05$.