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KNOWLEDGE, ATTITUDE AND CLINICAL MANAGEMENT OF ORTHODONTICALLY – INDUCED EXTERNAL ROOT RESORPTION AMONG LEBANESE ORTHODONTISTS

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Objective: The aim of this study was to assess the knowledge, attitude, and clinical management orthodontically induced external root resorption (OIERR) among Lebanese orthodontists of varying years of experience.

Methods: An online validated survey of 22 questions regarding OIERR was done among a randomly selected registered sample of 145 male and female Lebanese orthodontists.

Results: Significant differences were found among orthodontists with different years of experience for: the factors leading to further investigation, the stage at which additional screening measures were taken, the periodic follow up assessment method, and the clinical management in case of generalized root loss of one-third or more than 4 mm, with p-values 0.035, 0.001, 0.007 and 0.024 respectively.

Conclusions: Lebanese orthodontists had knowledge on potential risk factors, screening methods and period for OIERR. Those with more experience should depend on evidence based literature for clinical management of OIERR

Keywords: External root resorption, diagnosis, orthodontics, classification, risk factors, clinical management

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Conflicts of interest:
The authors declare no conflicts of interest.

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CONNAISSANCES, ATTITUDE ET GESTION CLINIQUE DE LA RÉSORPTION RADICULAIRE EXTERNE INDUITE PAR TRAITEMNT ORTHODONTIQUE, CHEZ LES ORTHODONTISTES LIBANAIS.

Objectif: Le but de cette étude était d'évaluer les connaissances, l'attitude et la prise en charge clinique des résorptions radiculaires externes induites orthodontiquement (OIERR) parmi les orthodontistes libanais ayant diverses années d'expérience.

Méthodes: Une enquête validée en ligne de 22 questions concernant l'OIERR a été effectuée parmi un échantillon enregistré sélectionné au hasard de 145 hommes et femmes Orthodontistes libanais.

Résultats: Des différences significatives ont été constatées entre les orthodontistes ayant différentes années d'expérience pour : les facteurs conduisant à une enquête plus approfondie, le stade auquel des mesures de dépistage supplémentaires ont été prises, la méthode d'évaluation du suivi périodique et la prise en charge clinique en cas de perte radiculaire généralisée, d'un tiers, ou de plus de 4 mm, avec des valeurs p de 0,035, 0,001, 0,007 et 0,024 respectivement.

Conclusions: Les orthodontistes libanais avaient des connaissances sur les facteurs de risque potentiels, méthodes de dépistage et période pour l'OIERR. Ceux qui ont plus d'expérience devraient dépendre de la « evidence based litterature » pour la prise en charge clinique de l›OIERR.

Mots-clés: Résorption radiculaire externe, diagnostic, orthodontie, classification, facteurs de risque, prise en charge clinique

Introduction

Orthodontics is a dental specialty that uses an inflammatory-driven tooth movement to resolve esthetic and functional dental problems. Similar, to other dental fields, certain adverse effects may be associated with the treatment [1]. In 2002, Brezniak and Wasserstein [2] recommended the use of orthodontically induced inflammatory root resorption (OIIRR) as a specific term to orthodontics. OIIRR is a frequent pathological complication of orthodontic tooth movement that could occur as internal or external resorption [3]. External root resorption is multifactorial and complex. It can be caused by several patient related factors such as age, gender, ethnicity, root morphology, and history of previous trauma. In addition to orthodontic treatment related factors such as force magnitude, direction and duration [4].

In addition to the limited knowledge on orthodontic induced external root resoprtion (OIERR) etiology and pathology, there is no clear-cut preorthodontic and periodic diagnostic radiographic method [5].

Most often, two-dimensional (2D) conventional imaging were used to assess OIERR. Such methods include periapical (PA) and orthopantogram radiography (OPG) [6]. Two-dimensional radiographs may not be sufficient to evaluate OIERR location and severity [7]. In a literature review on OIRR, 2D imaging underestimated the amount of root resorption because it cannot evaluate the buccal and lingual resorptions [8]. Therefore, a cone-beam computed tomography (CBCT) would properly assess the extent of the resorptive condition in the three spatial levels, leading to proper diagnosis and management [9].

Furthermore, no definite screening and follow up was reported [1]. Identifying the OIERR at 6-12 months from the beginning of orthodontic treatment allowed the orthodontist to take early precautions, and thus reducing the extent of resorption [10]. Furthermore, a six-month radiographic follow-up allowed to assess the severity of previously noted resorption, and applying modifications in the treatment plan to contain the condition ahead of extensive progression [11].

Regarding clinical management, no definite method for managing OIERR exists. Treatment is dependent on case-by-case basis [5]. Upon treatment resolution, the use of fixed retention was recommended [12].

According to authors knowledge, there is no enough data available on awareness, approach, and clinical management of OIERR in Lebanon.

Therefore, the aim of the study was to assess the knowledge, attitude, and clinical management of OIERR in Lebanon among orthodontic specialists.

Materials and Methods

Before conducting the study, the proposal was approved by the scientific

and ethical review committee and institutional research review board at Beirut

Arab University, Faculty of Dentistry (IRB Code: 2023-H-0114-D-M-0505).

The sample size was calculated through a free online calculator

(http://www.raosoft.com/samplesize). Consequently, a total of 150 randomly selected orthodontists were participated in this study. Certified orthodontic specialists who are registered in the Lebanese Dental Association (LDA) and whose contact information were available (phone number/email) were included in the study. An online survey regarding orthodontically induced external root resorption was done among Lebanese orthodontists using Google Forms (Google LLC, 1600 Amphitheatre Parkway, Mountain View, CA 94043, USA). It was carried out based on a specially prepared validated questionnaire [5] assessing the knowledge, attitude, and clinical management. The questionnaire had 22 questions and was composed of four parts. Part one included six demographics questions such as gender, affiliation status to the Lebanese Orthodontic Society (LOS), current orthodontic position, geographic location of primary practice, location of completion of specialist orthodontic training, and years of experience since graduation from orthodontic training.

Part two contained eight questions based on the orthodontists' knowledge. Such questions included the method orthodontists used to classify OIERR (in millimeter/inches, percentage, severity, diagram, or mobility). In addition, a question about the possible risk factor perceived by orthodontists before initiation of orthodontic treatment to increase the risk of OIERR occurrence (history of trauma, previous root resorption, transplanted tooth, root shape and position, family history, medical condition, or patient ethnicity) was asked. Furthermore, the risk factor that may be detected during treatment that would lead to further investigation for OIERR (hypermobility, pain, tooth discoloration, treatment duration extended beyond estimated treatment time, or force magnitude and direction) was tackled. Moreover, questions about the screening and follow-up method (PA, OPG, CBCT) and period used for OIERR before and during treatment, respectively, for patients at risk and those who are not were asked. Part three contained three questions based on the orthodontists attitude. The time of informing the patient (immediately, only if it becomes worse, at the end of treatment, or never) in cases of mild, moderate and severe OIERR was questioned. Part four contained five questions based on the orthodontists' clinical management approach. Different

treatment modalities were given for a case of generalized loss of one-third or more than 4 mm of the tooth roots due to resorption. Treatment options included interrupting the treatment for a while and then continuing at a later stage, compromising treatment outcome and promptly completing it, using light wires/ forces to finish treatment, and finishing the treatment immediately. Another case was about the orthodontist management in a case of generalized root resorption where there is need for extraction and full-fixed orthodontic appliances. Treatment modalities given were not recommending treatment indefinitely, not recommending treatment for now and planning for a future recall assessment, offering non-extraction and camouflage, offering extraction and waiting for teeth migration before orthodontic force application, extracting and continuing as a routine case, and offering extraction while creating a compromised treatment outcome.

Furthermore, description of the orthodontic participants management strategy of a case with severe root resorption in the presence of remaining extraction spaces to be closed was requested. The treatment modalities included stopping treatment immediately and removal of all appliances, interrupting treatment for a period of time then continuing, proceeding with the treatment while adapting treatment mechanics to only involve light forces, and continuing to space closure and ceasing treatment after. Furthermore, a question regarding their choice of post-orthodontic retention (fixed wire retention, removable Hawley or Begg type, and thermoplastic retainer) in a case of severe root resorption was given. The participants were asked whether the retainer of choice was used as routine protocol or not. After attaining a list of 200 LDA certified orthodontists, each participant was given a number from 1 to 200. A computerized random number generator was used (GIGAcalculator) to choose randomly sample of 150. The numbers chosen by the program were referred back to the sample frame. Accordingly, a consent form and questionnaire were sent by e-mail to these 150 participants. Data were collected, tested for normality and analyzed using SPSS software (version 28). A p-value <0.05 was considered statistically significant. The descriptive statistics were used to determine the frequencies and percentage of the responses given by the participants. The association between questionnaire items was assessed using Chi-square test.

Results

From the 150 contacted orthodontists, 147 agreed to participate in the study.

Out of these 147, 145 fully completed the questionnaire according to which responses were analyzed. Table 1 includes

Table 1: Demographics and professional characteristics of orthodontic professionals in Lebanon

		n	%
Gender	Male	83	57.2%
	Female	62	42.8%
Affiliation status to Lebanese Orthodontic Society	Member	120	82.8%
	Non-member	25	17.2%
Current orthodontic position	Private practice	114	78.6%
	University	14	9.7%
	Public/Hospital Practice	17	11.7%
Primary place of practice	Beirut	49	33.8%
	South Lebanon	12	8.3%
	North Lebanon	18	12.4%
	Mount Lebanon	29	20.0%
	Al Nabatiyeh	12	8.3%
	Beqaa	8	5.5%
	Baalbek-Hermel	9	6.2%
	Aakkar	8	5.5%
Location of completion of specialist orthodontic training	Mediterranean & Middle East.	118	81.4%
	Asia	0	0.0%
	Central and Eastern Europe	21	14.5%
	Western Europe	6	4.1%
	Africa	0	0.0%
Years since graduation from specialist orthodontic training (years of experience)	< 1 to 5 years	27	18.6%
	6 to 10 years	19	13.1%
	11 to 20 years	35	24.1%
	> 20 years	64	44.1%

the demographics and professional characteristics of orthodontic professionals in Lebanon.

The study population of the present study classified root resorption mainly quantitively; in millimeters/ inches (44.1%). Twenty-four-point-eight percent, 16.6%, 9% and 5.5% classified in terms of severity, percentage, mobility and diagrams, respectively. The p-value of 0.598 indicated no statistical significance for different classification methods among orthodontists of different experience levels. Previous root resorption (48.3%) was reported as the most situation perceived by orthodontists to raise concern on orthodontic root resorption. History of trauma (13.8%), root shape and position (13.1%), transplanted teeth (9%), patient ethnicity (7.6%), family history (4.1%), and medical condition(4.1%) were also reported by orthodontists. Moreover, none of the situations differed with years of experience (p= 0.698). Force magnitude and direction required during treatment (68.3%) was the main factor indicative for further investigation for orthodontic root resorption during treatment. Treatment duration extended beyond estimated treatment time (13.1%), hypermobility (11.7%), tooth discoloration (3.5%), and pain (3.4%) were also reported. Moreover, factors indicative for further investigation showed statistical significance among orthodontists of different experience levels (p= 0.035) (Table 2). The most commonly used pre-treatment risk assessment strategy by Lebanese orthodontic professionals was OPG (49.7%). Previous dental history (10.3%), clinical examination (7.6%), CBCT (6.2%), and PA (26.2%) were also reported. The majority of those who used OPG worked in private practice (53, 46,5%). No significant difference was confirmed for the pretreatment risk assessment practices among different years of experience (p= 0.295). Throughout active treatment, the most common screening method in a patient with no risk of root resorption was PA (40.7%). Clinical examination (13.1%), CBCT (22.8%) and OPG (23.4%) were also reported. Additional measures for root resorption screening were introduced predominantly during the 10–12 month period. The majority of participants that answered "10-12months" worked in private practice. Screening methods used for ORR displayed no statistical significance among orthodontists of different years of experience (p= 0.06). The p-value of less than 0.001, confirmed a significant difference regarding the stage at which additional screening was done among orthodontists of varying years of experience (Table 2). CBCT was reported as the most used (35.2%) periodic follow-up assessment method if orthodontic root resorption was noted during initial consultation or any stage of orthodontic treatment. Clinical examination (17.9%), OPG (17.2%), and PA (29.7%) were also reported. Moreover, the p-value of 0.007 confirmed statistically significant differences in periodic follow-up assessment methods based on experience levels (Table 2). The periodic follow-up assessment period was mostly reported to be done "every six months" (42.1%). Every three months (23.4%), approximately half way through the treatment (9%), yearly (8.3%), end of treatment (7.6%), monthly (4.8%) and no follow-up (4.8%) were also reported. For a patient with risk, the adaptation of screening methods did not differ between orthodontists experience level (p= 0.628). Preference for informing the patient/ parent(s) was mainly "immediately" for of mild (80.7%), moderate (80.7%) and severe (97.2%) root resorption. Informing the patient/ parent(s) in case of mild (p= 0.187), moderate (p= 0.541) and severe (p= 0.157) did not confirm a statistical significance among orthodontists of different years of experience. The most common treatment modality for an orthodontic patient where there was generalized loss of one-third or more than 4 mm of the tooth roots due to resorption was compromising treatment outcome and promptly completing it (45.5%). Using light wire force (31%), interrupting treatment for a while and then continuing (14.5%), and immediately finishing the treatment (9%) were also reported. The adaptation of such clinical management modalities differed significantly with orthodontists experience level (p= 0.024) (Table 3). Regarding the clinical management of a patient presenting with generalized root resorption, and in need of extraction treatment with full-fixed orthodontic appliance, most management strategies offered a non-extraction orthodontic treatment and camouflage discrepancy where possible (45.5%). Twenty-five-point-five percent of the respondents would not recommend treatment indefinitely, 15.2% would offer an extraction treatment and wait for teeth migration before orthodontic force application, 4.9% would not recommend treatment for now and plan for future recall assessment, and 4.1% would extract and continue as a routine case. Moreover, there was no statistical significance in orthodontists' responses by years of experience (p= 0.204). The most commonly used treatment modality for a patient with severe root resorption and remaining extraction spaces to be closed was interrupting the treatment for a period and then continuing (48.3%). Continue, adapting to treatment mechanics to only involve light forces (21.4%), stopping treatment immediately and removing all appliances (15.2%), and continuing only to space closure and ceasing treatment after (115.1%) were also recorded. The p-value of 0.708 did not confirm a statistical significant difference among orthodontists

Table 2: Variables on knowledge among orthodontists with varying years of experience

	Years of experience								*p*-value
	< 1 to 5 years		6 to 10 years		11 to 20 years		> 20 years		
	n	%	n	%	n	%	n	%	
Factors that would lead to further investigate for the presence of ORR during treatment									
Hyper-mobility	8	29.6%	2	10.5%	3	8.9%	4	6.2%	.035*
Pain	2	7.4%	1	5.3%	1	2.7%	1	1.6%	
Tooth discoloration	1	3.7%	0	0.0%	2	5.8%	2	3.1%	
Treatment duration	6	22.3%	4	21%	4	11.1%	5	7.8%	
Force magnitude and direction	10	37.0%	12	63.2%	25	71.5%	52	81.3%	
The stage at which additional measures to screen for ORR were taken in a patient were no risk of root resorption initially detected									
< 3 months	1	3.7%	1	5.4%	1	2.9%	5	7.8%	<.001*
3-6 months	15	55.6%	1	5%	1	2.7%	5	8%	
7-9 months	2	7.4%	1	5.1%	2	5.6%	13	20.3%	
10-12 months	6	22.2%	12	63.2%	26	74.3%	29	45.2%	
13-15 months	2	7.4%	2	10.3%	3	8.6%	7	10.9%	
> 15 months	1	3.7%	2	11%	2	5.9%	5	7.8%	
Periodic follow-up assessment method if orthodontic root resorption was noted									
Clinical examination	3	11.1%	3	15.8%	7	20.0%	13	20.3%	.007*
OPG	2	7.4%	2	10.5%	7	20.1%	14	21.9%	
PA	4	14.8%	4	21.1%	10	28.5%	25	39.1%	
CBCT	18	66.7%	10	52.6%	11	31.4%	12	18.7%	

*Statistically significant at p<0.05

Table 3: Clinical management of cases presenting with root resorption among orthodontists with varying years of experience

	Years of experience								*p*-value
	< 1 to 5 years		6 to 10 years		11 to 20 years		> 20 years		
	n	%	n	%	n	%	n	%	
Interrupt treatment then continue	1	3.7%	6	31.6%	7	20.0%	7	10.9%	.024*
Compromise outcome of treatment and promptly complete it	16	59.3%	3	15.8%	12	34.3%	35	54.8%	
Use light wires/forces	9	33.3%	7	36.8%	14	40.0%	15	23.4%	
Finish treatment immediately	1	3.7%	3	15.8%	2	5.7%	7	10.9%	

*Statistically significant at p<0.05

of different years of experience. The most commonly used post-orthodontic retainer was fixed wire retention (46.9%). Twenty-point-seven percent of the participants would use a removable Hawley retainer, 17.2% a thermoplastic retainer, and 15.2% would use a removable Begg retainer, following the standard retention protocol. The p-value of 0.295 confirmed no significant difference among orthodontists of varying experience levels. Regardless which retainer was chosen, the standard retention protocol was followed by 116 participants (80%). The p-value of 0.328 confirmed lack of statistical significant difference among orthodontists of different experience levels.

Discussion

In our study, Lebanese orthodontists showed variation in their preference to classify root resorption where the majority quantitatively described (millimeter/inches) the severity of OIERR. This could be explained by the fact that there is no standardized method to classify OIERR. Both quantitative and qualitative methods have been used in the literature according to Malmragen's index for root resorption classification [6]. Furthermore, a recent questionnaire study, noted that it was necessary to assess root resorption in a quantitative manner [7]. Such unit of measurement would allow for consistency in individual clinics for ideal time-based comparison, which is needed to record progression in an appropriate way [5]. In our study, force magnitude and direction (intrusion/torque) was chosen by the majority of participants of varying experience level as the main factor leading to further investigate for the presence of ORR during treatment. This indicated that Lebanese orthodontists were aware of the effect of force magnitude and direction on the teeth especially in those that are more experienced. The findings of this study showed that the majority of participants who screened for ORR after 10-12 months in a patient where no risk of root resorption was initially detected were mainly those with more than 20 years of experience. Whereas those with less than 1-5 years of experience preferred to screen after 3-6 months.

This could be attributed to the anxious state that fresh graduates are in to know the effect of the force magnitude and direction being applied due to their limited experience level. The use of CBCT as a periodic follow-up assessment method if orthodontic root resorption was noted during initial consultation or any stage of orthodontic treatment was significant among different years of experience with the majority being fresh graduates, and the minority those with more than 20 years of experience who preferred PA. A possible explanation could be that orthodontists with a higher practice level depend on their experience more than recent evidence based literature when compared to fresh graduates.

The most common clinical management of an orthodontic patient where there was generalized loss of one-third or more than 4 mm of the tooth roots due to resorption was compromising on treatment outcome and promptly completing treatment with significant difference among orthodontists of different years of

experience. The majority of those with 20 years of experience chose to compromise treatment outcome and promptly completing it, or to use light wire forces, whereas the minority among them followed recent evidence based literature to interrupt treatment or finish it immediately. A possible explanation could be the high confidence trait orthodontists with more experience acquire.

Conclusion

The following clinical aspects should be considered before and during orthodontic treatment:

- Since OIERR is unpredictable in its occurrence, the patient/parent(s) should be informed of its potential risk.
- Pretreatment OPG is an important diagnostic tool to screen for root resorption.
- For patients with no risk of root resorption, the use of PA is recommended 10-12 months after starting active tooth movement.
- In patients at risk, progress radiographs are recommended to be taken every 6 months.
- Radiographic follow-up and clinical management decisions for cases with generalized root resorption should be based on recent evidence based literature mainly for orthodontists with more experience.
- Fixed wire retention is preferred post-orthodontic treatment with severe root resorption.

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