External root resorption of second molars caused by impacted third molars: an observational study in panoramic radiographs

Reabsorção radicular externa de segundos molares ocasionadas por terceiros molares impactados: estudo observacional em radiografias panorâmicas

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Resumo

Objetivo: Esta pesquisa investigou a presença de reabsorção radicular externa (RRE) em segundos molares ocasionada pelos terceiros molares impactados em radiografias panorâmicas, relacionando com a posição dos terceiros de acordo com a classificação de Winter e de Pell e Gregory. **Material e método:** Um estudo transversal, retrospectivo, por meio de radiografias panorâmicas obtidas no período de janeiro de 2014 a dezembro de 2015. Adotou-se como critério de inclusão, a presença um segundo molar adjacente a um terceiro molar impactado. Os dados foram analisados por meio de estatística descritiva e inferencial. Foram realizados o Teste Qui-Quadrado de Pearson e Teste Exato de Fisher (p≤0,05). **Resultado:** A amostra foi composta por 584 radiografias panorâmicas, sendo 356 (60,95%) do gênero feminino e 228 (39,05%) do masculino, a média de idade foi de 25,31 anos. A prevalência de RRE foi de 12,5%, e a faixa etária de 14-24 anos foi mais acometida (p=0,46). A presença de RRE foi estatisticamente maior na mandíbula (42,1%) com p=0,01. As RRE localizadas nos terços cervical (57,1%) e médio (58,8%) foram proporcionalmente maiores nos dentes nas posições B2 (p=0,02), e mesioangular (p=0,26). **Conclusão:** A prevalência de RRE em segundos molares causada por terceiros impactados se mostrou estar de acordo com a média existente na literatura mundial, sem predileção por gênero, acometendo mais pacientes jovens, frequentemente ocorre nos dentes da mandíbula e apresenta um maior grau de severidade no terço cervical e médio. As posições B2 e mesioangular apresentaram maior propensão à RRE.

Descritores: Dente impactado; terceiro molar; radiografia panorâmica; reabsorção.

Abstract

Objective: This research investigate the presence of external root resorption (ERR) in second molars caused by impacted third molars in panoramic radiographs, relating to the position of third molars according to classification of Winter, Pell and Gregory. **Material and method:** A cross-sectional, retrospective study using panoramic radiographs obtained from January 2014 to December 2015. The inclusion criterion was the presence of a second molar adjacent to an impacted third molar. Data were analyzed using descriptive and inferential statistics. Pearson's Chi-Square Test and Fisher's Exact Test (p≤0.05) were performed. **Result:** The sample consisted of 584 panoramic radiographs, 356 (60.95%) of women, and 228 (39.05%) of men, the mean age was 25.31 years. The prevalence of ERR was 12.5%, and the group of 14-24 year olds was the most affected (p = 0.46). The presence of ERR was statistically higher in the mandible (42.1%) with p=0.01. The ERR located in the cervical (57.1%) and medium (58.8%) thirds was proportionally higher in the teeth with B2 (p=0.02) and mesio-angular positions (p=0.26). **Conclusion:** The prevalence of ERR in second molars, caused by impacted third molars, was shown to be similar to results found in the literature, with no gender preference, this affects young patients, occurring frequently in mandible teeth, and presents greater severity in the cervical and middle thirds. The B2 and mesio-angular positions were more prone to ERR.

Descriptors: Impacted tooth; third molar; panoramic radiography; reabsorption.

INTRODUCTION

The third molars are the last teeth to erupt in the oral cavity[1]. Root formation usually starts at age 15, and eruption usually occurs in the 20s[2]. Generally, due to the later development of these roots[2], lack of space, or physical barrier in the trajectory of eruption, the third molar is the most impacted dental element[1,3]. This impaction can cause several pathologies such as per

icoronitis[4], carious lesions, odontogenic cysts or tumors[5], periodontal disease[1] and external root resorption (ERR) of adjacent teeth[6-8].

ERR in permanent teeth is a pathological process, early diagnosis, and knowledge of its causes, are necessary for defining treatment, however, in most cases, it results in dental loss[9,10]. Root resorption occurs when the cementoblasts are removed, exposing the mineralized root surface, so that the bone cells promote root resorption[6,11], this process is asymptomatic, silent, and free of microorganisms[6]. In addition to the impaction of third molars, resorption of dental roots can be induced by the strength of orthodontic appliances[6,9,12,13], chronic periapical periodontitis[6,13], dental trauma[6,9,10,12,13], and cysts or tumors[8].

Several studies have investigated the incidence of root resorption in second molars by impacted third molars and other conditions associated with these teeth[1,2,4,14,15]. A study shows that the ERR location and the position of the third molar can influence the level of severity of resorption[4].

ERR prevalence in second molars due to the impaction of third molars, observed in panoramic radiographs, is low[4,5,9,16]. Comparing the presence of this condition, shown in panoramic radiographs and cone beam computed tomographies (CBCT), the number observed was 4.3 times higher in the radiographs than was observed in the tomographies[4]. The 3D images do not show image overlay, as do the 2D exams, providing more accurate information about the root resorption[13]. Despite this technological advance and the quality of the image obtained, CBCTs present a higher exposure to X radiation[15] as a disadvantage (45 µSv and 477 µSv) when compared with simpler alternative exams like the periapical (1-8.3 µSv) and panoramic (3.85-30 µSv) radiographs, they should, therefore, be carefully prescribed and only in specific cases[17]. In addition, since the CBCT exam has a high cost and considering the socioeconomic conditions of developing countries, the use of panoramic radiography is justified in the preoperative assessment of third molars[15].

The present study aimed to investigate ERR in second molars caused by impacted third molars, relating it to the position of the third molars according to the Winter[18] and Pell, Gregory[19] classification, using panoramic radiography.

MATERIAL AND METHOD

This study was duly approved by the Research Ethics Committee of the Integrated University of Patos (CEP-FIP), Patos, Paraíba, Brazil, under CNAAE No. 51098415.0.0000.5181.

This cross-sectional, retrospective study was conducted using panoramic radiographs obtained from the database of a private radiological clinic located in João Pessoa, Paraíba, Brazil. The radiographs were produced between January 2014 and December 2015.

From a total of 2,174 images, 584 images were included in this study. The inclusion criterion was that a second molar be adjacent to an impacted third molar. Excluded from the sample were radiographs presenting evidence of a cystic or tumoral pathological process, third molars with less than two thirds of the root formed, large caries in the second molars and materials of high density.

The radiographs were obtained using a Kodak 9000C (Kodak Dental Systems, Atlanta, EUA) appliance, usually operated at 70 kvp and always at 10 mA. The images were exported in *Tagged Image File Format* (TIFF), analyzed by a single examiner, previously trained, and experienced. The radiographs were assessed in random order on a computer (Core I7, Intel®), with a 23.6", *High Definition*, 1,920x1,080-pixel LED monitor, under low light conditions, with the aid of Microsoft Office Picture Manager (Windows 7®).

ERR in the second molar was diagnosed when the loss of structure in the root surface was observed visibly. The region affected by ERR was classified according to its location (cervical, medium or apical third, or in the apex of the root)[20]. The following situations regarding the severity of ERR were considered; a) Light resorption: resorption extended to half of the distance of the dentin to the root canal; b) Moderate resorption: resorption extended to more than half of the distance of the dentin to the root canal, but the root canal was intact; c) Severe resorption: resorption reached the root canal[21]. The Winter[18] and Pell, Gregory[19] classifications were adopted to describe the position of the third molar.

Pell, Gregory[19] classified the inferior third molars according to the relation of the embedded tooth with the anterior margin of the mandibular ramus and occlusal plan. The anterior margin of the mandibular ramus was classified as: class I, when the space between the anterior border of the ramus and the distal face of the second molar was bigger than mesio-distal diameter of the crown of the embedded tooth; class II, when this space was less than the mesio-distal diameter of the crown of the impacted third molar; or, class III, when the ramus was embedded in the second molar and, therefore, the third molar was entirely within the ramus. The classification of the third molar, regarding the occlusal plan, was: position "A", when the higher portion of the embedded tooth was level with or above the occlusal plan; position "B", when the higher portion was between the occlusal and cervical plans); or, position "C", when it was below the cervical line.

Winter's classification[18] assesses the long axis of the retained third molar in relation to the long axis of the second molar, in the following positions: vertical, when the long axis of the third molar is parallel to the long axis of the second molar; mesio-angular, when the long axis of the molar is tilted toward the long axis of the second molar in a mesial direction; disto-angular, when the long axis of the third molar is tilted toward the long axis of the second molar in a distal direction; horizontal, when the long axis of the third molar is perpendicular to the long axis of the second molar; linguo-version, when the long axis of the third molar is lingual to the long axis of the second molar; bucco-version, when the long axis of the third molar is buccally impacted regarding the second molar; and, inverted, when the crown of the third molar is tilted toward the mandibular margin and the root is tilted toward the occlusal plan).

The data were analyzed using the statistical program SPSS (Statistical Package for Social Science), version 20.0, through analytical

statistics. Absolute and percentage distributions were analyzed through inferential statistics.

Based on the inferential statistics, the Pearson's Chi-Squared test was used to identify the age range factor, associations with an arch, severity, location, classification of Pell and Gregory and Winter, and, for the gender factor, the Fisher's Exact Test was used. Results of these tests were considered significant when p≤0.05.

RESULT

The sample comprised 584 panoramic radiographs, 356 (60.95%) of women and 228 (39.05%) of men, and the mean age was 73 years. The prevalence of ERR was 12.5%, corresponding to 73 exams of the total sampled. It was proportionally higher in women (14%) and in the age group of 14-24 years (13.7%), with no statistical difference, p= 0.19 and p = 0.46, respectively (Table 1).

The presence of ERR was statistically higher in the mandible (42.1%) when compared to the jaw (26.1%) and both the arches (1.3%) (p= 0.01) (Table 2).

A significant association between the severity and the location of ERR (p= 0.01) was observed. The cervical third was found to be more affected at the light (71.2%) and moderate (50%) levels, and the apical third was more affected at the severe (60%) level (Table 3).

ERR located in the cervical (57.1%) and medium (58.8%) thirds was proportionally higher in the teeth classified as B2, according to Pell and Gregory; and, in the apical third, was higher in the teeth classified as B1 (50%) and C2 (50%). These differences were

Table 1. Association of ERR presence with gender and age group

Gender	ERR		Total	p
	No	Yes		
Female	306 (86.0%)	50 (14.0%)	356 (100%)	
Male	205 (89.9%)	23 (10.1%)	228 (100%)	0.19
Total	511 (87.5%)	73 (12.5%)	584 (100%)	
Age group				
14-24	284 (86.3%)	45 (13.7%)	329 (100%)	
25-35	171 (88.1%)	23 (11.9%)	194 (100%)	0.46
<36	56 (91.8%)	5 (8.2%)	61 (100%)	
Total	511 (87.5%)	73 (12.5%)	584 (100%)	

Note: the gender was analyzed by the Fisher's exact test and the age group by the Pearson's Chi-Squared test.

Table 2. Association of the presence of ERR with the dental arch

ERR	No	Yes	Total	p
Jaw	65 (73.9%)	23 (26.1%)	88 (100%)	
Mandible	62 (57.9%)	45 (42.1%)	107 (100%)	0.01
Both the arches	384 (98.7%)	5 (1.3%)	389 (100%)	
Total	511 (87.5%)	73 (12.5%)	584 (100%)	

Note: analyzed by Pearson's Chi-Squared test.

statistically significant (p= 0.02). However, there was no statistical difference (p= 0.26) when associated with Winters classification. ERR located in the analyzed thirds was observed to be proportionally higher in the mesio-angular classification (Table 4).

The light (53.5%), moderate (66.7%) and severe (50%) ERR were proportionally higher in the teeth classified as B2 according to Pell and Gregory, but with no statistical difference (p= 0.50). There was also no statistical significance (p= 0.22) when associated with Winters classification. This shows that the different levels of severity analyzed were proportionally higher in the mesioangular classification.

DISCUSSION

The prevalence of ERR in second molars found in the present study was consistent with the literature (12.5%), which varies from 0.9% to 16%[4,5,7,16,22]. Similar studies carried out using CBCT have shown a higher prevalence of ERR, when compared with panoramic radiographs, varying from 20.17% to 74%[8,14,23]. ERR can be explained according to the theory that root resorption of the second molars can arise from mechanical forces entirely formed occurring during the eruption phase of the third molars[7]. However, it is believed that dental movements do not stop with the end of rhizogenesis, therefore, an entirely formed tooth can continue putting pressure on the adjacent tooth, stimulating ERR[14].

In the present study, no significant difference was observed between the genders regarding ERR[8,14,16,22]. However, a study that assessed ERR caused by impacted teeth showed a higher prevalence in male patients, these authors report that this result may be related to sex hormones[5].

In the present study, no significant difference was observed between the age groups and the presence of ERR. However, the literature showed that patients up to 30 years old presented a higher prevalence of ERR[5,7,14,22,23] when compared to older age groups. A possible explanation for this finding is that tissue metabolism in younger people is higher than in older people[5].

ERR was found to be more prevalent in the mandible[4,7,16], possibly due to the anatomical characteristics of the mandible and the lack of space in the arch, mandible teeth tend to erupt more distally in the arch[3], characterizing more frequent impaction of the mandible third molars.

In the present study, ERR was found more frequently in the cervical third[8,14,22]. A study that assessed external root resorption in 199 impacted teeth showed that the inflammatory reaction is more likely to occur in the exposed area. In other words, in the region of cemento-enamel junction[5].

Analyzing the relationship between the level of severity and the location of ERR, light and moderate resorptions were observed to occur more frequently in the cervical third, and severe resorptions in the apical third. According to criteria established in the methodology to analyze ERR severity, this result can be explained by the conical format of the root, where the cervical third presents more dental structure than the apical third. Studies conducted using CBCT have obtained similar results, showing light ERR in the cervical third[14,23].

Table 3. Association between ERR severity and its location

Severity	Resorption site				Total
	Cervical	Medium	Apical	Apex	
Light	42 (71.2%)	15 (25.4%)	2 (3.4%)	0 (0.0%)	59 (100%)
Moderate	10 (50.0%)	8 (40.0%)	2 (10.0%)	0 (0.0%)	20 (100%)
Severe	0 (0.0%)	2 (40.0%)	3 (60.0%)	0 (0.0%)	5 (100%)
Total	52 (61.9%)	25 (29.8%)	7 (8.3%)	0 (0.0%)	84* (100%)

Note: analyzed by Pearson's Chi-Squared test; *Value of total quadrants with ERR.

Table 4. Association between the ERR Location and the Classifications of Pell and Gregory and Winter

Location of RRE	Pell e Gregory							p
	A1	A2	B1	B2	C1	C2	Total	
Cervical	1 (2.9%)	10 (28.6%)	3 (8.6%)	20 (57.1%)	0 (0.0%)	1 (2.9%)	35 (100%)	
Medium	1 (5.9%)	4 (23.5%)	1 (5.9%)	10 (58.8%)	1 (5.9%)	0 (0.0%)	17 (100%)	0.02
Apical	0 (0.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	2 (100%)	
Total	2 (3.7%)	14 (25.9%)	5 (9.3%)	30 (55.6%)	1 (1.9%)	2 (3.7%)	54* (100%)	

	Winter					p
	Vertical	Mesio-angular	Disto-angular	Horizontal	Total	
Cervical	8 (15.4%)	37 (71.2%)	1 (1.9%)	6 (11.5%)	52 (100%)	
Medium	2 (8.0%)	14 (56.0%)	1 (4.0%)	8 (32.0%)	25 (100%)	0.26
Apical	1 (14.3%)	6 (85.7%)	0 (0.0%)	1 (50.0%)	7 (100%)	
Total	11 (13.1%)	57 (67.9%)	2 (2.4%)	14 (16.7%)	84 (100%)	

Note: analyzed by Pearson's Chi-Squared test; *Value of total quadrants with ERR in the mandible.

According to this study, the ERR located in the medium and cervical thirds was more frequent in the Pell and Gregory B2 classification. In this classification, the height of the crown of the third molar can favor ERR in the medium and cervical thirds. No statistical significance was observed regarding severity, but all levels of severity analyzed were more prevalent in the B2 classification. Similar studies using CBCT have noted a higher prevalence of the A and B classifications[14,23].

There was no statistical difference, regarding the location and severity of ERR, according to Winter's classification. However, the mesioangular position presented a higher prevalence of resorption in the different thirds, and levels of severity, analyzed. A study carried out in Mexico, using medical records of patients who had orthodontic treatment, showed that most women patients presented third molars in a vertical position, while the mesioangular position was the most frequent in men[3]. Other studies have shown that the mesioangular and horizontal[4,8,16] positions were the ones found most frequently in the mandible, while the vertical and mesioangular positions were more frequent in the jaw[16].

In the present study, as well as in the literature, no ERR was found in the root apex. This is probably because it needs a quite specific position, like the C classification of Pell and Gregory, a position that was not present in this study[14].

Papers comparing two-dimensional with three-dimensional exams have found a higher rate of ERR in the three-dimensional exams[8,14]. In two-dimensional exams, the initial stages of small ERR lesions are not usually perceptible due to overlapping anatomical structures[13]. However, in three-dimensional exams, these initial lesions were more frequently observed due to the higher reliability in the assessment of dental structures[5].

The results of the present study could be used in clinical arguments, to advise patients with impacted third molars on the possible problems of leaving them retained. Thus, these results could be useful in advising these patients on prophylactic exodontia. It is worth noting that if the third molar is well positioned and exercising its masticatory function, it should not be extracted.

CONCLUSION

The present study found the prevalence of ERR in second molars, caused by impacted third molars, to be similar to the results found in the literature. It also found no no predilection for gender, affecting more young patients (up to 24 years), occurring frequently in mandible teeth, and presenting a higher level of severity in the medium and cervical thirds. The B2 and mesioangular positions showed a higher propensity for ERR.

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CONFLICTS OF INTERESTS

The authors declare no conflicts of interest.

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