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Short Communication

Duration and rate of clinical eruption of third molars

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ABSTRACT

Objectives: The aim of the current paper was to present norms of clinical duration and rate of eruption for upper and lower 3rd molars utilizing recently published data for a Jordanian population.

Methods: Duration of Clinical Eruption (CDE) in years and Clinical Eruption Rates (CER) in mm/year were calculated from recently published median ages at emergence and functional eruption of 3rd molars for a Jordanian population.

Results: Third molars clinically erupt at a rate between 1.45 to 1.85 mm/year, being slightly faster in the lower jaw. The average CDEs were 2.95 and 2.75 years for upper and lower 3rd molars respectively. Upper 3rd molars of males needed a slightly longer CDE than lower 3rd molars did while, in females, there was no difference in CDE across arches. The average CERs were 1.53 and 1.82 mm/year for upper and lower 3rd molars respectively. In contrast to males, females exhibited slightly faster CER for the upper 3rd molar and slightly slower CER for the lower 3rd molar. CERs are steadier and more linear in the upper than in the lower 3rd molar.

Conclusions: This study has reported the first norms of duration and rate of clinical eruption specific to upper and lower 3rd molars. Normally, third molars remain around 3 years in clinical eruption, which render them more vulnerable to recurrent pericoronitis and other local pathologies than the rest of the teeth. The availability of these norms will help dentists and auxiliaries identify and diagnose delayed and slow eruption cases and make their clinical decision upon removing or keeping 3rd molars.

Introduction

Although timing of 3rd molar eruption is genetically determined, it can be affected by a variety of developmental, environmental and iatrogenic factors such as insufficient jaw space, malalignment of other teeth, premolar / first molar extraction for orthodontic treatment, second molar extraction, rapid maxillary expansion and loss of mesio-distal arch space due to caries [1-10]. Since 3rd molars are the last permanent teeth to emerge in the arch, they are more commonly vulnerable to delayed eruption and malalignment than other teeth, particularly when jaw space is insufficient. This leads to a higher chance for the development of localized pathologies such as impaction, crowding and malalignment of other teeth, cystic changes, pathologic tooth resorption, pericoronitis and periodontitis [11-13].

The duration of time a 3rd molar needs from gingival emergence to functional eruption and the clinical rate of its eruption are very significant, and ideally, should be fast enough to reduce the frequency of recurrent episodes of pericoronitis and reduce the chance of occurrence of other pathologies associated with long-standing partially-erupting 3rd molars. Moreover, dentists should be able to periodically assess whether an emerged 3rd molar is clinically erupting at a normal eruption rate

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before making any decision upon removing or keeping the tooth. In this regard, population-specific norms on clinical duration and rate of 3rd molar eruption would be very useful guides.

A very limited number of studies have been published about clinical eruption rates of permanent teeth and most of them are dated [14-17]. To the best of the author's knowledge, and apart from only a 40-year-old paper presenting the eruption rate of upper 3rd molars, the dental literature is devoid of any publications specifically reporting the eruption rate of upper and lower 3rd molars [18]. The aim of the current paper was to present norms of clinical duration and rate of eruption of upper and lower 3rd molars utilizing recently published data on a Jordanian population.

Materials and Methods

The current work is part of an extended project titled "chronology of eruption of permanent dentition in the Jordanians" that received the ethics approval from the Deanship of Research at Jordan University of Science and Technology (ID# 13/2007). Several data on timing of permanent tooth eruption and its correlates have been published out of this project including the one on timing of third molar eruption [19]. The current study used the data on eruption timing of third molars to investigate the rate and clinical duration of eruption of third molars in a Jordanian population.

The published data on the timing of eruption of upper and lower 3rd molars were derived from a sample of 571 Jordanian adolescents and young adults aged 15 – 27 years (275 males and 296 females) [19]. All participants provided signed consent to take part in the study. None of the participants had presented any clinical signs of 3rd molar impaction or agenesis and those who had showed radiographic evidence were excluded. In addition, participants confirmed to have had skeletal / growth disorders, obesity, moderate to severe crowding, spacing and tooth malalignment or received oral or jaw surgeries, trauma or orthodontic treatment had been excluded as well [19]. Probit regression analysis was used to calculate the median ages at which upper and lower 3rd molars reach four clinical eruption stages (Gingival Emergence - GEM, Occlusal Surface Eruption - OSE, Half Crown Eruption - HCE and Full Functional Eruption – FFE).

In the current study, Clinical Duration of Eruption (CDE), which is the duration of time while a tooth is being clinically visible commencing from gingival emergence up until full functional eruption, was calculated by subtracting the median age at GEM from the median age at FFE [20]. The Clinical Eruption Rate (CER) was given when the height of the clinical crown (the part of the tooth that is clinically visible) was divided by CDE. The average heights of the anatomical crown (the part of the tooth covered with enamel) in the upper and lower 3rd molars are 6.5 and 7.0 mm respectively [21]. Considering the average healthy gingival sulcus depth of 2.0 mm, this gives clinical crown heights of 4.5 and 5.0 mm for the upper and lower 3rd molars respectively [22]. Therefore, CERs for the upper and lower 3rd molars were calculated accordingly and expressed in the unit of mm/year.

The full clinical eruption from GEM to FFE could also be divided further into three segments; the first segment marks the eruption of the occlusal ¼ of the clinical crown height (GEM to OSE = 1.125 mm or 1.25 mm for upper and lower 3rd molars respectively), the second marks the eruption of the second ¼ (OSE to HCE = 1.125 mm or 1.25 mm for upper and lower 3rd molars respectively) and the 3rd marks the eruption of the cervical ½ of the clinical crown height (HCE to FFE = 2.25 mm or 2.5 mm for upper and lower 3rd molars respectively). Consequently, CDEs and CREs were calculated per each of the clinical crown segment accordingly.

Results

(Table 1) presents the CDEs in years and the CERs in mm/year for the upper and lower 3rd molars, and for males and females. (Table 1) also present the inter-arch and gender differences. In males, full CDEs were 3.10 and 2.70 years for upper and lower 3rd molars respectively, with an inter-arch difference of 0.40 years. In females, CDE for lower 3rd molar was close to that in males (2.80 years) although in the upper 3rd molar it was slightly shorter (2.80 years). In other words, upper 3rd molars of males needed a slightly longer duration of time for clinical eruption than lower 3rd molars did while, in females, there was no difference in clinical duration of eruption across arches. Regardless of gender, the average CDEs were 2.95 and 2.75 years for upper and lower 3rd molars respectively.

The rates of clinical eruption were slightly slower in the upper 3rd molar (1.45 and 1.61 mm/yrs. in males and females respectively) than in the lower (1.85 and 1.79 mm/yrs. for males and females respectively). In contrast to males, females exhibited slightly faster CER for the upper 3rd molar (1.61 vs. 1.45 mm/yrs.) and slightly slower CER for the lower 3rd molar (1.79 vs. 1.85 mm/yrs.). Regardless of gender, the average CERs were 1.53 and 1.82 mm/year for upper and lower 3rd molars respectively.

Since none of the gender and inter-arch differences in the median ages of GEM and FFE of upper and lower 3rd molars were statistically significance, it is assumed that such small differences in CDE and CER across arches and genders are non-statistically significant as well [19].
(Table 2) presents the segmented CDEs and CERs for both sexes and arches. It is generally noticed that CERs are steadier and more linear in the upper than in the lower 3rd molar with the CER of the 2nd occlusal ¼ of upper 3rd molar being the fastest somehow. In contrast lower 3rd molars showed faster CER during the eruption of the cervical ¾ of the clinical crown and slightly slower CER during the eruption of the occlusal ¼.

Discussion

To the best of the author's knowledge, this paper has presented the first standards for duration and rate of clinical eruption of upper and lower 3rd molars. The term "clinical" was used in the context to designate the eruption period during which the tooth is "clinically" visible in the mouth [19]. Since the term "eruption" alone would also include the intra-osseous stages of tooth movements, it was more appropriate to use the term "clinical eruption" to avoid any confusions.

The current study followed a different approach to what other studies about tooth clinical eruption rates have followed. While Burke & Newell devised a photographic method for measuring active clinical eruption rates of maxillary central incisors, Berkovitz & Bass and Smith observed dental casts sequentially over a period of time and measured clinical

eruption of permanent teeth manually [16-18]. The longitudinal approach and the need to take photographs or take impressions and make dental casts limited the number of subjects studied. In the present study, the duration and rate of tooth eruption were provided upon utilizing recently published standards on median ages at different clinical eruption stages, which were calculated by clinical examination of a large number of participants.

The precision in determining the clinical eruption stage at which a given tooth presents at examination constitutes an important point to address here [19]. Obviously, there were no problems in recording GEM and FEE stages as these are readily identified upon clinical examination. GEM marked the first moment of gingival penetration and FEE the occlusal contact or functional eruption, which could be confirmed by biting on an articulating paper when the opposing tooth was present or when the tooth's occlusal surface was level with the occlusal plane taking to consideration the curves of Spree and Wilson. There might have been a greater challenge in detecting OSE and HCE at the same level of precision compared to GEM and FFE since these were determined subjectively by the examiner according to the criteria described by Shaweesh [19]. Nevertheless, the calculated clinical eruption rates in this paper relied on the median ages at reaching GEM and FEE (Table 1), which assumes linearity and steadiness in eruption rate. The median ages at reaching OSE and HCE were only used to describe the slight difference in linearity of clinical eruption rates between upper and lower 3rd molars (Table2).

Clinical eruption rates of 3rd molars were calculated in reference to the average clinical crown height reported in Dental Anatomy textbooks [21]. In the absence of norms on occulso-cervical crown diameters of 3rd molars of Jordanians, it was necessary to use the ones reported by Nelson & Ash Jr and assume that Jordanians were not significantly different in this regard from the populations Nelson & Ash Jr reported the norms on.

Shaweesh paid all efforts to ascertain the normality of clinical eruption among the subjects examined [19]. All suspicious cases of delayed eruption due to crowding, malalignment of 3rd molars and other adjacent teeth, malocclusion and other relevant pathologies and cases of accelerated eruption due to excessive spacing or obesity were all excluded. Besides, Shaweesh excluded potential subjects who reported receiving orthodontic treatment, which is anticipated to affect the eruption timing and clinical eruption rates of 3rd molars [1-4, 23]. Moreover, in order not to mistaken cases of 3rd molar impaction or agenesis for yet-to-erupt 3rd molars, such cases were excluded as well.

In the present paper, the CDEs of upper and lower 3rd molars were 2.95 and 2.75 years on average, which are significantly longer than those for other permanent teeth of the same population [20]. According to Shaweesh, the permanent tooth with the longest CDE was the lower second molar which needed one year on average during clinical eruption. This was followed by upper first premolar, upper canine, lower canine and upper second molar with CDEs ranging approximately from 0.94 down to 0.72 years, respectively. It is obvious in the present paper that the clinical duration of eruption in a 3rd molar is at least three folds those of other permanent teeth with long CDEs. Interestingly, Shaweesh reported an average CDE of nearly 0.18 years for first permanent molars rendering the CDE of 3rd molar nearly 15 times longer [20].

Population-specific data on CDEs for 3rd molars have not been published purposefully. However, in few studies mean / median age at FEEs and GEMs have been provided for some populations [24-28]. Consequently, CDEs could be generated from these studies and compared to the CDEs of Jordanians (Table 3). It is apparent in Table 3 that CDEs of Jordanians are generally longer than those in other populations although CDE of upper 3rd molar in German females was longer than its corresponding Jordanian CDE and the CDEs of 3rd molars in the First Nation People of Canada (except in upper 3rd molars of males) were comparable to the corresponding ones in the Jordanians [27, 28]. The Japanese and to a lesser extent Northern Chinese showed the shortest CDEs [25, 26]. Generally, except for Jordanians (current study), Croatians and Japanese, CDEs were not consistent between sexes and across arches [24]. In fact, it is not guaranteed whether these studies have followed the same strict exclusion criteria followed by Shaweesh which may explain their different CDEs compared to Jordanians and the inconsistent CDEs between sexes and across arches.

Table 1: Clinical Duration of Eruption (CDE) in years and Clinical Eruption Rate (CER) in mm/year for the upper and lower 3rd molars, and for males and females. Inter-gender differences in CDE and CER are also presented.

	Upper 3rd Molar		Lower 3rd Molar		Inter-arch difference	
	CDE	CER	CDE	CER	CDE	CER
Males	3.10	1.45	2.70	1.85	0.40	-0.40
Females	2.80	1.61	2.80	1.79	0.00	-0.18
Gender difference	0.30	-0.16	-0.10	0.06		

Table 2: Clinical Duration of Eruption (CDE) in years and Clinical Eruption Rate (CER) in mm/year per eruption segment, for upper and lower 3rd molars, and for males and females.

		Upper 3rd Molar			Lower 3rd Molar		
Eruption segment		GEM - OSE	OSE - HCE	HCE - FEE	GEM - OSE	OSE - HCE	HCE - FEE
Distance erupted (mm)		1.125	1.125	2.25	1.25	1.25	2.50
Males	CDE	0.90	0.70	1.50	1.10	0.50	1.10
	CER	1.25	1.61	1.50	1.14	2.50	2.27
Females	CDE	0.80	0.60	1.40	1.20	0.60	1.00
	CER	1.41	1.88	1.61	1.04	2.08	2.50

GEM: Gingival Emergence, OSE: Occlusal Surface Eruption, HCE: Half Crown Eruption. FEE: Full Functional Eruption.

Table 3: CDEs (in years) in Jordanians and other populations.

Population	Males	Females	Males	Females
	Upper 3rd molar	Lower 3rd molar	Upper 3rd molar	Lower 3rd molar
Jordanians	3.1	2.7	2.8	2.8
Northern Chinese	2.1	0.8	1.1	1.4
Japanese	0.9	1.2	1.1	1.0
Germans	1.3	1.0	3.7	1.7
First Nation People of Canada	0.6	3.0	2.3	2.8
Croatians	1.7	1.4	1.7	1.6

On average, upper and lower 3rd molars showed CERs of 1.53 and 1.82 mm/year respectively, with the rate of lower 3rd molars being relatively faster. However, this was not consistent between sexes. Moreover, upper 3rd molars showed steadier rate of clinical eruption across segments compared to lower 3rd molars. The latter showed slower eruption of occlusal ¼ and faster eruption of the cervical ¾ of the clinical crown. In contrast to upper, lower 3rd molars may possibly need to cut through much denser overlying bone and mucosa first to clear off the occlusal surface completely from the overlying soft-tissue before they would proceed occlusally more passively. However, this topic prompts for further investigations.

Berkovitz & Bass reported a maximum clinical eruption rate in upper 3rd molars of 1 mm/2 months, which is much faster than the corresponding rate reported in the present study [18]. However, Berkovitz & Bass also reported a much slower rate of less than 1 mm/6 months which is consistent with the corresponding rate shown here. The different approach, populations and sample size and the fact that Berkovitz & Bass did not seem to have followed any exclusion criteria must be taken to consideration in comparing the results. In the absence of literature on clinical eruption rates of lower 3rd molars, only those of upper 3rd molars have been discussed in light of relevant literature.

Conclusions

This study has purposefully reported the first norms of duration and rate of clinical eruption specific to upper and lower 3rd molars. Third molars clinically erupt at a rate between 1.45 to 1.85 mm/year, being slightly faster in the lower jaw. Normally, third molars remain around 3 years in clinical eruption, which render them more vulnerable to recurrent pericoronitis and other local pathologies than the rest of the teeth. The availability of these norms will help dentists and dental auxiliaries identify and diagnose delayed and slow eruption cases and make their clinical decision upon removing or keeping 3rd molar.

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