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Predviđanje ageneze trećega donjeg kutnjaka prema razvoju drugog kutnjaka

Predicting Mandibular Third Molar Agenesis from Second Molar Formation

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Sažetak
Svrha rada: Svrha rada bila je opisati kod djece razvoj kripte trećega donjeg kutnjaka (M3) i istražiti može li se prema razvoju korijena drugoga donjeg kutnjaka (M2) predvidjeti njegova ageneza. **Materijali i načini: m**andibularni M2 i M3 svrstani su u razvojne faze prema Moorreesu i suradnicima (1963.). Zatim je izračunat raspon srednje dobi faze kripte M3 te izabrane radiografske snimke s trećim donjim kutnjakom u fazi kripte (N = 150) i opisan raspon faze razvoja M2. Broj i vjerojatnost razvoja M3, kad se znao razvoj M2, izračunata je na temelju 1749 radiografskih snimki. Omjer vjerojatnosti razvoja M3 - ako je M2> u fazi razvoja R1 / 2 - izračunat je logističkom regresijom. **Rezultati:** prosječna dob faze kripte M3 bila je 8,84 godine, u rasponu od 5,47 do 12,55 godina. Nisu bile uočene znatne spolne ili etničke razlike. Kada je M3 bio u fazi kripte, raspon faza M2 bio je od polovice krune do tri četvrtine korijena, najčešće s potpunom krunom i jednom četvrtinom korijena. Kada je M2 bio u fazi razvoja R1 / 2, 99 posto pojedinaca imalo je vidljivu kriptu M3. Omjer vjerojatnosti ageneze M3 - kada je bio u fazi razvoja M2 R3 / 4 ili u kasnijoj - bio je 0,03 [95 % CI 0,02;0,05]. **Zaključak:** prosječna dob kripte M3 jest tijekom osme godine i najčešće se događa kada je susjedni M2 u fazi potpune krune ili u početnoj fazi korijena. Dok se je razvijao korijen M2, smanjila se vjerojatnost razvoja kripte M3. Nakon M2 u fazi razvoja R1 / 2, razvoj kripte M3 bio je malo vjerojatan.
Ključne riječi: treći kutnjak, ageneza, predviđanje M3 ageneze

Uvod

U kliničkom radu s djecom ponekad je dobro znati hoće li donji treći kutnjak početi nicati vrlo kasno, ili se možda uopće neće razviti. Nekoliko autora predložilo je da se ageneza donjega trećeg kutnjaka može potvrditi samo u dobi od 14 godina (1,2). Svrha ovog istraživanja bila je opisati prvi radiografski dokaz (razvoj kripte) donjega trećeg kutnjaka (M3) u vezi s dobi, zatim razvoj susjednoga drugog donjeg kutnjaka te istražiti agenezu M3 u čeljusti, ako znanje o stadiju razvoja drugoga donjeg kutnjaka (M2) može u tome pomoći.

Introduction

In the clinical management of child patients, it is sometimes desirable to know if the mandibular third molar is very late initiating, or whether it is likely to develop at all. Several authors have suggested that agenesis of the mandibular third molar can only be confirmed at 14 years of age (1,2). The aim of this study is to describe the first radiographic evidence (crypt formation) of the mandibular third molar (M3) in terms of age as well as adjacent second molar formation and investigate if knowledge of root formation stage of second molar (M2) can help predict M3 agenesis in the mandible.

Materijal i metode

Radiografske snimke koje su se koristile za istraživanje bile su izabrane iz velikog arhiva panoramskih snimki uzetih tijekom postavljanja dijagnoza i liječenja lokalnih pacijenata (bijelaca i bangladeške populacije) u Stomatološkom institutu. Kriterij za uključivanje bila je kripta trećega donjeg kutnjaka u čeljusti (N = 150). Raspon srednje dobi faze razvoja kripte M3 bio je izračunat za dječake i djevojčice u dvjema etničkim skupinama (bijeloj i bangladeškoj) i uspoređen T-testom. Osim toga, faza razvoja susjednoga M2 bila je svrstana u razvojna razdoblja prema Moorreesu, Fanningu i Huntu (3). Za one nakon razvoja polovice korijena, procjenjivao se distalni korijen. Reproducibilnost procijenjenih faza objavljena je i drugdje (4).

Postotak uzoraka s vidljivom kriptom M3 opisan je prema razvojnim fazama M2 i vjerojatnosti razvoja M3 u svakoj fazi razvoja M2.

Na temelju tih parametara pregledana je veća skupina radiografskih snimki (minimalna razvojna faza M2 - C 1/2 do 22 godine, N = 1749). Omjer vjerojatnosti i intervali pouzdanosti u razvoju M3 izračunati su logističkom regresijom. Ishod procjene za omjer vjerojatnosti bio je nedostatak M3 (ageneza ili nije još razvijen), a kao granicom koristili smo se fazama razvoja M2, R 1/2 i R 3/4.

Rezultati

Mala razlika u prosječnoj dobi kripta M3 između dječaka i djevojčica te između etničkih skupina, prikazana je u Tablici 1. Prosječno se kripta M3 kod bangladeških dječaka javljala u nešto ranijoj dobi nego kod bijelih dječaka, a kripte su bile vidljive kod bijelih djevojčica nešto ranije nego kod dječaka. Dobivene razlike nisu bile statistički znatno različite. Prosječna dob kombiniranih skupina za fazu razvoja kripte M3 iznosi 8,84 godine, s rasponom od sedam godina. Razvojna faza M2, kada je treći donji kutnjak bio u fazi kripte, prikazana je na Slici 1. Faza M2 bila je u rasponu od polovice izniknule krune do tri četvrtine korijena, a najčešće s potpunom krunom do četvrtine korijena. Slika 2. prikazuje kumulativni postotak faze M2 kod M3 u fazi kripte. Dok je M2 bio u početnoj fazi korijena, više od 50 posto pojedinaca imalo je vidljivu sjenu M3; dok je M2 bio R1/2 [definirano kao visina krune jednaka dužini korijena], 99 posto pojedinaca imalo je vidljivu kriptu M3 ili su zubi bili u kasnijoj fazi. Križno tabeliranje na prisutnost / odsutnost M3 prema M2 fazi, prikazano je u Tablici 2. Kako je

Materials and Methods

Radiographs studied was selected from a large archive of dental panoramic radiographs taken during diagnosis and treatment of local patients (White and Bangladeshi) attending the Dental Institute. Inclusion criteria was the presence of a third molar crypt in the mandible (N=150). The range and mean age of M3 crypt stage was calculated for boys and girls and two ethnic groups (White and Bangladeshi) and compared with a t-test. In addition, the formation stage of the adjacent M2 was categorised into developmental stages of Moorrees, Fanning and Hunt (3). For stages after root one half, the distal root was assessed. Reproducibility of stage assessment has been reported elsewhere (4).

The percentage of this sample with M3 crypt visible was described by M2 stage and the probability of M3 developing at each M2 stage.

With this knowledge, a larger group of radiographs (minimum developmental stage M2 stage C1/2 up to 22 years of age, N=1749) was examined. Probability, odds ratio and confidence intervals of M3 developing were calculated using logistic regression. The outcome measure for the odds ratio was absence of M3 (agenesis or not yet formed) using cut off M2 stage R1/2 and R3/4.

Results

Small differences in the average age of M3 crypt between boys and girls and between ethnic groups are shown in Table 1. The average age of M3 crypt in Bangladeshi boys were slightly earlier than white boys, whilst White girls were marginally earlier than White boys although none of these differences was significant. The average age of the combined groups for M3 crypt stage was 8.84 years with a range of seven years. The formation stage of M2 when the mandibular third molar was at crypt stage is shown in Figure 1. The stage of M2 ranged from crown half up to root three quarters, the most common being from crown complete to root one quarter. Figure 2 shows the cumulative percentage of M2 stage at M3 crypt. By the time M2 was initial root stage, just more than 50% of individuals had a visible M3 visible; by the time M2 was R1/2 [defined as crown height equal to root length], 99% of individuals had a visible M3 crypt or later stage. Cross tabulation of the presence/absence of M3 by M2 stage is shown in Table 2. As the M2 tooth matured, the probability of a third molar crypt developing decreased. If M2

Tablica 1. Srednja dob kripte trećega donjeg kutnjaka
Table 1   Mean age of the mandibular third molar crypt.

Spol • Sex	Etnička grupa • Ethnic group	N	Srednja dob • Mean age	SE	SD	Minimum	Maximum
Muško • Male	Bijelci • White	46	9.02	0.22	1.52	5.65	12.47
Muško • Male	Bangladeshi	40	8.65	0.16	1.04	6.66	11.37
Žensko • Female	Bijelci • White	30	8.84	0.33	1.81	5.68	12.55
Žensko • Female	Bangladeshi	33	8.79	0.29	1.69	5.47	11.29
Oboje • Both	Bijelci • White	76	8.95	0.19	1.63	5.65	12.55
Oboje • Both	Bangladeshi	74	8.74	0.16	1.37	5.47	11.37
Muško • Male	Zajedno • Combined	86	8.85	0.14	1.33	5.65	12.47
Žensko • Female	Zajedno • Combined	63	8.81	0.22	1.73	5.47	12.55
Oboje • Both	Zajedno • Combined	150	8.84	0.12	1.51	5.47	12.55

Tablica 2. Križno tabeliranje faze kripte M3 ili kasnije i M2 te vjerojatnost razvoja trećeg kutnjaka N = 1749 radiografskih snimki od najranijeg razvoja kripte M3 do dobi 22. Vjerojatnost se izračunava samo za faze M2 kada je kripta M3 uočena.
Table 2   Cross tabulation of M3 crypt stage or later and M2 and probability of third molar developing. N=1749 radiographs from earliest M3 crypt formation up to age 22. Probability only calculated for M2 stages when M3 crypt was observed.

Faze razvoja (M2) • M2 Stage	Broj osoba s M3 kriptom • Number of individuals with M3 crypt stage or later	Broj osoba s M3 koji nije vidljiv • Number of individuals with M3 not visible	Vjerojatnost M3 razvoja • Probability of M3 developing
Kruna • Crown 1/2	1	116	0.991
Kruna • Crown 3/4	6	95	0.940
Potpuna kruna • Crown complete	47	58	0.552
Početak korijena • Initial root	54	25	0.316
Razmeđe korijena • Root cleft	59	20	0.253
Korijen • Root 1/4	114	27	0.191
Korijen • Root 1/2	108	19	0.150
Korijen • Root 3/4	102	3	0.029
Potpuni korijen • Root complete	68	3	
Vrh pola zatvoren • Apex half closed	80	8	
Vrh zatvoren • Apex closed	722	14	
Ukupno • Total	1361	388	

zub M2 sazrijevao, smanjivala se mogućnost razvoja kripte trećeg kutnjaka. Ako je M2> R1/2, omjer vjerojatnosti razvoja M3 iznosi 0,03 [95 % interval pouzdanosti 0,02; 0,05]. Što je razvijeniji distalni korijen drugoga donjeg kutnjaka, to je manja vjerojatnost da će se razviti treći kutnjak, tako da je ona doista vrlo niska do R 3/4 drugog kutnjaka.

Rasprava

Srednja dob razvoja M3 u fazi kripte u čeljusti (tijekom osme godine) također je prosječna dob kada počinju faze razvoja korjenova i njihova račvišta M2 (5). Jedna od dosadašnjih nepoznanica danas objašnjava varijabilnost u razvoju zuba i zašto se zubi počinju razvijati u različito vrijeme u odnosu prema susjednim zubima. Na primjer, kod neke djece faza M3 počinje u kasnoj fazi razvoja krune M2;

> R1/2 the odds ratio of M3 developing was 0.03 [95% confidence interval 0.02, 0.05]. The more advanced the distal root of the second mandibular molar, the less likely the third molar is to develop, so that by R3/4 of the second molar, the likelihood is very low indeed.

Discussion

The mean age of M3 crypt formation in the mandible (during 8th year) is also the average age when initial root and root cleft stages of M2 occur (5). One of the unanswered questions explaining variability in dental formation is why teeth initiate at different times relative to adjacent teeth. For instance, some children initiate M3 during late M2 crown formation; others, who mature late, initiate M3 well into M2 root growth.
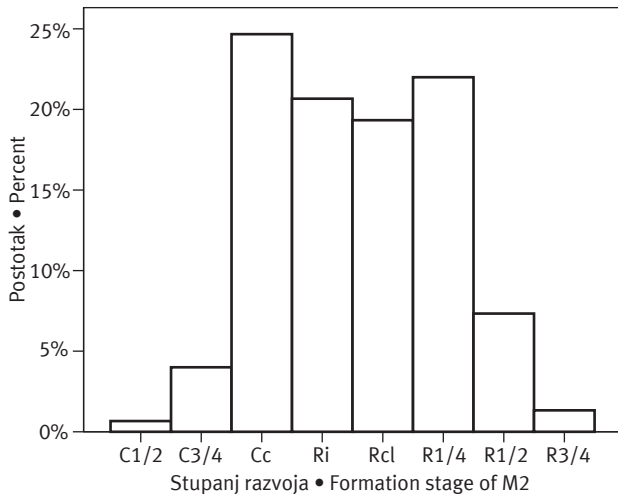
Slika 1. Raspodjela (u postocima) faze razvoja drugoga donjeg kutnjaka kod faze razvoja kripte trećega donjeg kutnjaka (N = 150). C1 / 2 polovici krune, C3 / 4 tri četvrtine krune, Cc potpuna kruna, Ri početni korijen Rcl „cleft" korijen, R1 / 4 četvrtina korijena, R1 / 2 polovica korijena, R3 / 4 tri četvrtine korijena.

Figure 1 Distribution (percentage) of mandibular second molar formation stage at mandibular third molar crypt stage (N=150). C1/2 crown one half, C3/4 crown three quarters, Cc crown complete, Ri initial root, Rcl root cleft, R1/4 root one quarter, R1/2 root one half, R3/4 root three quarters.
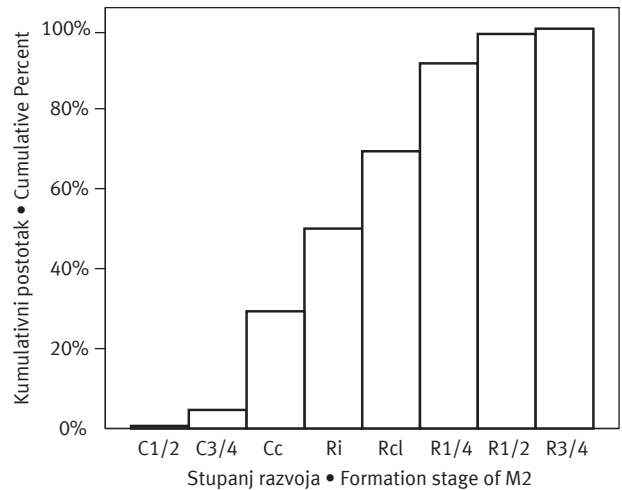

Slika 2. Raspodjela (kumulativni postotak) faze razvoja drugog donjeg kutnjaka kod faze razvoja kripte trećega donjeg kutnjaka (N = 150). M2 faze, vidi zapis Slika 1.

Figure 2 Distribution (cumulative percentage) of mandibular second molar formation stage at mandibular third molar crypt stage (N=150). M2 stages see Figure 1 legend.

Kratice • Abbreviations:
M2 - drugi donji kutnjak • Mandibular second molar
M3 - treći donji kutnjak • Mandibular third molar
R1 / 2 - polovica dužine korijena [definirana kao visina krune = dužina korijena] • Root length one half [defined as crown height=root length]
R3 / 4 - tri četvrtine dužine korijena • Root length three quarters
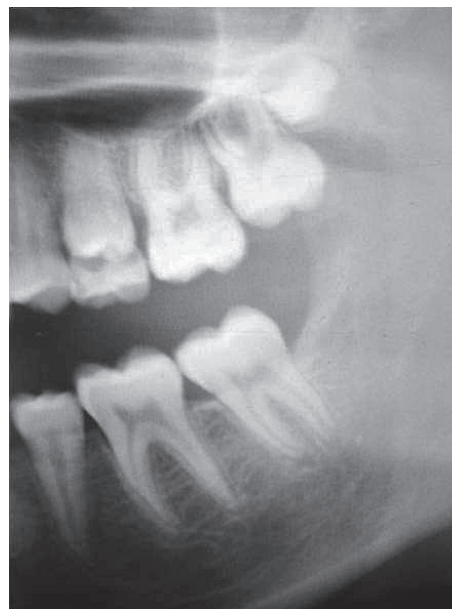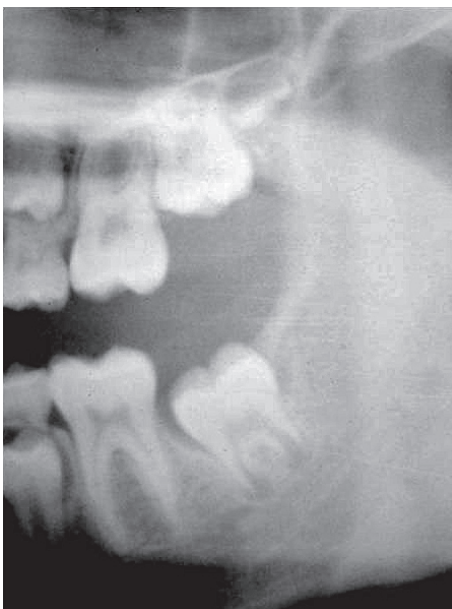
Slika 3a, 3b. Lijevo, djevojčica u dobi od 10,2 godine i ista djevojčica u dobi od 11,9 godina.
Figure 3a, 3b Left, girl aged 10.2, same girl aged 11.9.

kod drugih, ako kasno sazrijevaju, M3 počinju nica-
ti znatno kasnije tijekom rasta korijena M2.

Srednja dob razvoja kripte donjega trećeg kut-
njaka postignuta u ovom istraživanju slična je pri-
jašnjim rezultatima iz manjih uzoraka - Garn i nje-
govi kolege (2) daju u izvješću 8,6 i 9,1 za male i
velike folikule, N = 70 i 90, odnosno na srednjem
zapadu SAD-a; Baba-Kawano i suradnici (6) daju
8,6, N = 31 japanskoj djeci; Bolaños i suradnici (7)
daju 8,83 i 9,06 za lijevo i desno, odnosno na 89
djece u južnoj Španjolskoj; Nyström i suradnici (8)
9,41 u izvješću daju 9,04 za 52 dječaka i 61 djevoj-
čicu u Finskoj. Prosječna dob, kao što je prikazano
u ovom istraživanju, klinički je korisna za plan te-
rapije kada se razmatra ekstrakcija pretkutnjaka ili
prvih kutnjaka. Prosječna dob djece "u sklopu faze
razvoja 'razlikuje se od uobičajenih mjera zrelosti
koje se koriste u ljudskoj auksologiji, tj. od prosječ-
ne dobi kada je 50 posto pripadnika skupine dose-
gnulo ili prošlo tu fazu razvoja, iako su obje izrazito
korisne. Sazrijevanje trećega donjeg kutnjaka istra-
živali su mnogi stručnjaci (4), no njihovi rezultati
pokazuju znatne razlike u vremenu faze kripte.

Modalna faza M2, kada je donji M3 u fazi kripte,
u ovom je istraživanju bio Cc s većinom pojedinaca
u fazi razvoja R1/4. Choi i Kim (9) ističu da je mo-
dalna faza M2 korejskoj djeci početna korijenska
faza (N = 270). Clow (1984.) izvješćuje o modalnoj
fazi M2 s R1 / 4 u Velikoj Britaniji (N = 161), ia-
ko je njegov kriterij uključivao obje faze kripte M3
i početnu mineralizaciju vrha kvržice koja bi mo-
gla objasniti kasniju modalnu fazu u odnosu prema
ovom istraživanju.

Prema rezultatima ovog istraživanja može se re-
ći da bi razvoj susjednoga drugog kutnjaka mogao
biti više biološka mjera od dobi za predviđanje age-
neze trećeg kutnjaka. Ako je dijete dentalno napred-
no, mogućnost ageneze M3 može se predvidjeti ne-
koliko godina prije njegove 14. godine. Slika 3. na
lijevoj strani pokazuje dio panoramske rendgenske
snimke djevojčice u dobi od 10,2 godine s fazom ra-
zvoja M2 R1/2 i u fazi razvoja krune gornjega M3.
Slika 3. desno pokazuje istu djevojčicu u dobi od
11,9 godina s gotovo potpuno završenom dužinom
donjega distalnog korijena M2, što potvrđuje age-
nezu M3. Dva ranija istraživanja, koja imaju tabli-
ce razvoja zuba M2 i M3, podupiru to tumačenje
(9, 10). Clow (10) je spojio prve dvije faze (krip-
tu M3 i početak mineralizacije) te opisao najkasni-
ju fazu M2 kao R3/4. Choi i Kim (9) nisu uočili ni-
kakvu kriptu M3 u donjoj čeljusti nakon M2 faze
R1/4. Baba-Kawano i suradnici (6) naveli su da 80

The mean age of mandibular third molar crypt
formation from the present study is similar to previ-
ous findings of smaller samples (Garn et al. (2) re-
port 8.6 and 9.1 for small and large follicle, N=70
and 90 respectively in Midwest USA, Baba-Kawa-
no et al. (6) give 8.6, N=31 Japanese children, Bo-
laños et al. (7) give 8.83 and 9.06 for left and right
respectively for 89 children in southern Spain, Nys-
tröm et al. (8) reports 9.41 and 9.04 for 52 boys and
61 girls in Finland. The average age, as presented
in this study, is useful clinically to plan treatment
when considering extraction of premolars or first
molars. The average age of children 'within a for-
mation stage' differs to the usual maturity measure
used in human auxology i.e. average age when 50%
of a group has reached/passed this formation stage,
although both are useful. Maturation of mandibu-
lar third molars has been reviewed elsewhere (4),
and illustrates considerably large variation between
studies in the timing of the crypt stage.

The modal stage of M2 when mandibular M3 is
at crypt stage from the present study was Cc with
most individuals were between this and R1/4 stage.
Choi and Kim (991) report the modal stage of M2
being initial root in Korean children (N=270). Clow
(1984) reports modal stage of M2 being R1/4 in
English children (N=161), although his inclusion
criterium included both M3 crypt and initial cusp tip
mineralisation which might explain the later modal
stage compared to the present study.

Results from the present study suggest that for-
mation of the adjacent second molar might be a
more biological measure than age to predict agene-
sis of the third molar. If a child is dentally advanced,
the probability of M3 agenesis can be predicted sev-
eral years prior to age 14. Figure 3 left shows part
of a panoramic radiograph of a girl aged 10.2 with
mandibular M2 stage R1/2 and the maxillary M3
crown forming. Figure 3 right shows the same girl
aged 11.9 with the mandibular M2 distal root length
almost complete confirming agenesis of M3. Two
previous studies that tabulate M2 and M3 tooth for-
mation support this interpretation (9, 10). Clow (10)
combined the first two stages (M3 crypt and initial
mineralisaion) and reports latest M2 stage as R3/4.
Choi and Kim (9) observed no mandibular M3 crypt
after M2 stage R1/4. Baba-Kawano et al. (6) report
the probability of missing mandibular third molars
in a small longitudinal radiographic study from Ja-
pan as 80% when the adjacent second molar was
Demirjian stage F (equivalent to R1/2 in the pres-
ent study) and 100% when M2 was Demirjian stage

posto mogu manjkati donji treći kutnjaci na intraoralnim rendgenskim snimkama ispitanika iz Japana kada je susjedni drugi kutnjak u Demirjianovoj fazi F (faza F jednaka je R1/2 fazi u ovom istraživanju) i 100 posto kada M2 je u Demirjianovoj fazi G (faza G jednaka je kasnoj fazi R3/4 ili Rc u ovom istraživanju).

Rezultati iz ovog istraživanja imaju važne implikacije na minimalnu dob kada se odlučuje koliko je česta ageneza trećeg kutnjaka. Minimalna razvojna dob može se odrediti prema stadiju korijena M2, ako su dostupne radiografske snimke. Ako je minimalna dob manja od 14, učestalost hipodoncije M3 ima odstupanja zbog uključivanja pojedinaca koji bi mogli biti u kasnijem razvoju kripte trećeg kutnjaka od prosjeka.

G (equivalent to late stage R3/4 or Rc in the present study).

Findings from the present study have important implications for the minimum age when determining prevalence of third molar agenesis. The minimum developmental age might be determined from M2 root stage if radiographs are available. If the minimum age is less than 14, the prevalence of M3 hypodontia is biased by the inclusion of individuals who might be later than average in the formation of third molar crypt.

Zaključak

Razvoj kripte M3 u prosjeku se vidi na panoramskim radiografskim snimkama tijekom osme godine života, ali bi se mogao javljati već u petoj godini ili kasno – tek u dvanaestoj. Vjerojatnost razvoja kripte M3 smanjuje se dok sazrijeva susjedni korijen M2 i faza toga korijena može pomoći predvidjeti vjerojatnost ageneze donjih M3. Do faze razvoja polovice korijena drugog kutnjaka, 99 posto pojedinaca razvilo je kriptu ili su u kasnijoj fazi trećeg kutnjaka, što znači da - ako drugi kutnjak dosegne polovicu korijena (dužina korijena jednaka visini krune) - vjerojatnost razvoja trećeg kutnjaka je vrlo niska, a mogućnost ageneze trećeg kutnjaka vrlo visoka.

Conclusions

Crypt formation of M3 on average appeared on panoramic radiographs during the eighth year but could be as early as during the 5th or as late as the 12th year. The probability of M3 crypt developing decreases as the adjacent M2 root matures and M2 root stage can help predict the probability of mandibular M3 agenesis. By root half of the second molar, 99% of individuals had developed a crypt or later stage of third molar, suggesting that if the second molar has reached root half (root length equal to crown height) the probability of third molar formation is very low and the likelihood of third molar agenesis is very high.

Abstract
Objective: to describe the age of mandibular third molar (M3) crypt formation and investigate if root formation of the mandibular second molar (M2) can predict M3 agenesis. **Materials and Methods.** Mandibular M2 and M3 were categorised into developmental stages of Moorrees et al. (1963). The range and mean age of M3 crypt stage was calculated. Radiographs with M3 at crypt stage (N=150) were selected and the range of M2 formation stage described. The number and probability of M3 developing given M2 stage was calculated using 1749 radiographs. The odds ratio of M3 developing if M2 > R1/2 was calculated using logistic regression. **Results.** The average age of M3 crypt stage was 8.84 years [range 5.47 to 12.55]. No significant sex or ethnic differences were observed. When M3 was at crypt stage, the range of M2 stages was from crown half up to root three quarters, the most common being from crown complete to root one quarter. By the time M2 was R1/2, 99% of individuals had a visible M3 crypt. Odds ratio of M3 absence at M2 R3/4 or later stage was 0.03 [95% c.i. 0.02, 0.05]. **Conclusion.** The average age of M3 crypt was during the eighth year and most commonly occured when the adjacent M2 was at crown complete or early root stage. As the root of M2 developed, the likelihood of M3 crypt formation decreased. After M2 stage R1/2, the development of the M3 crypt was unlikely.

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