Prevalence of Dental Anomalies in Orthodontic Patients

Zastupljenost dentalnih anomalija kod ortodontskih pacijenata

Introduction

Dental anomalies are abnormalities of teeth structure, form, number, location and size. They can be caused by genetic, systemic, traumatic and local factors (1). They are divided in genetic and acquired. Genetic and environmental factors cause dental anomalies mostly during histodifferentiation and morphodifferentiation of teeth (2,3). They occur more frequently in the context of certain syndromes; e.g. their incidence is five times higher in patients with Down’s syndrome than in the general population (4). The study of Jukić et al (5) showed that hypodontia is significantly more frequent in children with developmental disturbances than in healthy children. Oral-facial-digital syndrome 1 (OFDS1) is related to hyperdontia, hypodontia and peg-shaped lateral incisors (6,7).

Dental anomalies are most frequently diagnosed by clinical examinations and panoramic radiographs (8). Recently, cone beam computed tomography (CBCT) has been used more frequently. This technique is, because of its ability to generate three-dimensional representations, more precise, especially in overlapping structures (9). A disadvantage of CBCT is an exposure of the patient to relatively high doses of radiation, even more important because of the fact that children constitute the majority of patients with dental anomalies. Magnetic resonance imaging (MRI) is an alter-

Uvod

Dentalne anomalije su nenormalnosti u strukturi, obliku, broju, položaju i veličini zuba. Uzrokuju ih sistemski, genetski, traumatski i lokalni čimbenici (1). Dijele se na prirođene i stečene. Dentalne anomalije prouzročene su genetskim i okolišnim čimbenicima, posebice tijekom histodiferencijacije i morfodiferencijacije zuba (2,3). Češće se pojavljuju u određenim sindromima, primjerice, kod pacijenata s Downovim sindromom učestalost je pet puta veća nego u općoj populaciji (4). Jukić i suradnici (5) pokazali su u svojem istraživanju da je hipodoncija znatno češća kod djece s teškoćama u razvoju nego kod ona zdrave. S orofaciodigitalnim sindromom 1 (OFDS1) povezani su hiperdoncija, hipodoncija i konični lateralni sjekutići (6,7).

Dijagnoza dentalnih anomalija najčešće se postavlja kliničkim pregledom i ortopantomogramom (8). Posljednjih godina primjenjuje se cone beam – kompjutorizirana tomografija (CBCT) koja je preciznija zbog mogućnosti stvaranja trodimenzionalnoga prikaza, pogotovo u slučaju preklapajućih struktura (9). Nedostatak CBCT-a je izlaganje pacijenata razmjerno visokim dozama zračenja, što je posebno važno zato što su većina pacijenata djeca s dentalnim anomalijama. Alternativa je magnetska rezonancija (MRI) koja također daje trodimenzionalne prikaze struktura, ali bez upotrebe ionizirajućeg zračenja (10).
native, producing three-dimensional representation of structures, without the use of ionizing radiation (10).

Dental anomalies can lead to abnormal positioning of other teeth in the dental arch. Fixed orthodontic appliances are most frequently used to treat patients with hypodontia (11), because the precise and controlled tooth movements are needed (12). In patients with hypodontia, especially in mesiodens cases, which can be functional as well as esthetically problems (13), extraction therapy followed by fixed orthodontic appliance is often indicated. Therapeutic options for treating dental anomalies include implantoprosthetic replacements (14), dental bridges and orthodontic traction; in cases in which the anomaly is neither a functional nor an aesthetic problem, treatment is occasionally not needed (11).

Dental anomalies could result in changed length of the maxilla and mandible resulting in occlusal disturbances which complicate and prolong orthodontic therapy (15). The frequency of impaction in patients with orthodontic anomalies Class II division 1 as well as short or blunt roots in patients with anomalies Class II division 2 is increased compared to eugnathic patients (16).

Understanding the influence of dentofacial genetics on the diagnosis and planning of orthodontic treatment has become an integral part of modern dental care (17). This study focused on the prevalence of dental anomalies in a sample of orthodontic patients in Croatian population.

Material and methods

This study was performed on a sample of 506 orthopantomographs and study casts of orthodontic patients obtained from the archives of the Department of Orthodontics at School of Dental Medicine University of Zagreb. Inclusion criteria were:

1. No history of permanent teeth extraction before the start of orthodontic treatment
2. No history of endodontic therapy or tooth trauma before the start of orthodontic treatment
3. Orthopantomograms were obtained by standardized method using the same X-ray device (Siemens, Orthopos, average voltage 69 kV, constant current strength of 16 mA/s and time of exposition of 16 s).

The study was performed on a sample of 12-16 year-old children with permanent dentition. Based on orthopantomograms and study casts the following teeth anomalies were studied: hypodontia, hyperdontia, invagination, impaction, dilacerations, the presence of peg-shaped lateral incisors, short or blunt roots, thin or pipette-shaped roots and taurodontism. Data were collected and analyzed regarding the incidence, sex, distribution and type of teeth affected by the anomaly. Statistical analysis was performed using the STATISTICA 9.1 program. The research procedures were carried out following the decision of the Ethics Committee of the School of Dental Medicine University of Zagreb. Participation in the research was voluntary, whereas the participants were guaranteed anonymity and confidentiality.

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Results

Out of a total of the 506 studied orthopantomographs and study casts, 278 (54.9%) of them were female and 228 (45.1%) of male patients. There were no statistically significant differences in the frequency of studied anomalies between sexes (p>0.05), hence further statistical analysis could be performed. The results are presented in Figure 1.

| Table 1 | Number of abnormal teeth in the maxillary arch | Tablica 1. | Broj maksilarnih zuba s anomalijom |
|---------|-----------------------------------------------|-----------|----------------------------------|
|         |                                               | 17        | 16                                | 15        | 14        | 13        | 12        | 11        | 21        | 22        | 23        | 24        | 25        | 26        | 27        |
| Hypodontia • Hipodoncija                          | 5         | 7         | 9                                  | 1         | 1         | 6         |
| Teeth impaction • Impakcija                       | 1         | 15        | 2                                  | 11        | 4         |
| Invagination • Invaginacija                        | 4         | 1         | 4                                  | 4         | 1         |
| Taurodontism • Taurodontizam                       |           | 1         |                                    |           |           |
| Hyperdontia • Hiperdoncija                         | 3         | 3         | 2                                  | 1         |
| Dilaceration • Dilaceracija                        | 6         | 7         | 8                                  | 3         |
| Peg-shaped lateral incisors • Pandžasti konični lateralni sjekutići | 2         | 3         | 7                                  | 8         | 3         |
| Short, blunt roots • Kratki ili tupi korijeni     | 3         | 3         | 2                                  | 2         |
| Thin, pipette-shaped roots • Uski ili gracilni korijeni | 1         | 1         |

| Table 2 | Number of abnormal teeth in the mandibular arch | Tablica 2. | Broj mandibularnih zuba s anomalijom |
|---------|-----------------------------------------------|-----------|----------------------------------|
|         |                                               | 47        | 46                                | 45        | 44        | 43        | 42        | 41        | 31        | 32        | 33        | 34        | 35        | 36        | 37        |
| Hypodontia • Hipodoncija                          | 4         | 1         | 4                                  | 3         | 1         | 8         |
| Teeth impaction • Impakcija                       | 4         | 1         | 2                                  | 2         |
| Invagination • Invaginacija                        | 1         | 1         |                                    |           |           |
| Taurodontism • Taurodontizam                       | 1         | 1         |                                    |           |           |
| Hyperdontia • Hiperdoncija                         |           |           |                                    |           |           |
| Dilaceration • Dilaceracija                        | 1         |           |                                    |           |           |
| Peg-shaped lateral incisors • Pandžasti konični lateralni sjekutići |           |           |                                    |           |           |
| Short, blunt roots • Kratki ili tupi korijeni     | 3         | 3         | 2                                  | 2         | 1         |
| Thin, pipette-shaped roots • Uski ili gracilni korijeni | 3         | 3         | 2                                  | 2         | 1         |

Rezultati

Od pregledanih 506 ortopantomograma i modela čeljusti, 278 (54,9 %) bilo je od pacijentica, a 228 (45,1 %) od pacijenata. Od 506 ispitanika, kod njih 122 (24,1 %) zabilježena je barem jedna anomalija. Između spolova nije bilo statistički značajne razlike u učestalosti ispitivanih anomalija. Rezultati istraživanja prikazani su na slici 1.
At least one anomaly was found in 122 (24.1%) patients. In 6 (1.2%) cases, more than 1 anomaly was noted. Five anomalies were combinations of hypodontia with another anomaly. In two cases, hypodontia coexisted with peg-shaped lateral incisors and taurodontism, and in one it coexisted with short or blunt roots. Impaction coexisted with thin or pipette-shaped roots in one patient. Hypodontia of the left upper lateral incisor was most frequent (24%), followed by the left lower second premolar (21%), right upper lateral incisor (18%) and left and right upper premolar (16% and 13% of cases) (Tables 1 & 2). In 30 patients (79%), hypodontia was present on only one tooth, and in 8 (21%) in more than one teeth. Mesiodens was found in three patients (60%) and an additional tooth was found in the molar area in two patients (40%). Invagination occurred most frequently on the upper lateral incisors (4 patients), single, or in combination with other teeth. It occurred on one tooth in six patients (75%), and on more than one in two patients (25%). In all cases, invagination occurred in the upper jaw. Impaction most frequently affected the upper right canine (15 patients), and the upper left canine (11 patients). One tooth was affected in 23 (72%), and more than one in 9 patients (28%). It occurred much more frequently in the upper than lower jaw (23 vs. 8 patients); in one patient (3%), both, the upper and lower jaw, were affected. Dilaceration occurred on the right upper lateral incisor in 3 (30%), and on the right upper central incisor and right upper second premolar in 2 patients (20%) each. In all 10 patients, dilacerations occurred on only one tooth, in 8 patients it occurred in the upper and in 2 patients in the lower jaw. Peg-shaped lateral incisors occurred on one side in 7 (64%), and on both sides in 4 patients (36%); on the left side in 9 patients, and on the right side in 6 patients. Short and blunt roots occurred most frequently on upper median and upper lateral incisors; on one tooth in 2 patients (20%), and on more than one in 8 patients (80%). Maxillary teeth were affected in all cases. Thin or pipette-shaped roots were found in 9 patients, most frequently on lower incisors (67%). In 5 patients, they were present on one (56%), and in 4 patients on more than one tooth (44%). They were located in the lower jaw in eight patients (89%), and in the upper jaw in one patient (11%). Taurodontism was noted in six patients. It occurred most frequently on the first upper right molar, in 4 patients (67%) on single tooth or in combination with other teeth. Taurodontism was noted on one tooth in 5 patients (83%), and on more than one in one patient (17%). It occurred in the upper jaw in 4 patients (67%), and in the lower in 2 patients (33%).

U šest slučajeva (1.2 %) bilo je uočeno više od jedne anomalije. Od toga je pet bilo kombinacija hipodoncije s još jednom anomalijom. U dva slučaja zabilježena je kombinacija hipodoncije s pandžastim lateralnim sjekutićem i taurodontizmom, a u jednome hipodoncija s kratkim ili tupim korijenima. Kombinacija impakcije s uskim ili gracilnim korijenom pronađena je kod jednog pacijenta. Najčešće je bila hipodoncija lijevoga gornjega lateralnega sjekutića (24 %), zatim lijevoga donjega drugoga pretkutnjaka (21 %), desnoga gornjega lateralnega sjekutića (18 %) te lijevoga i desnoga gornjega pretkutnjaka (16 % i 13 % slučajeva). Kod 30 ispitanika (79 %) hipodoncija je bila samo na jednome zubu, a na više zuba pronađena je kod njih osam (21 %). Kod jednoga od tih osam pacijenata prisutna je bila hipodoncija svih drugih pretkutnjaka. Meziodens je bio zabilježen kod tri pacijenta (60 %), a u području krunjaka kod dva (40 %). Invaginacija se najčešće javlja na gornjim lateralnim sjekutićima (4 ispitanika), pojedinačno ili u kombinaciji s drugim zubima. Na jednome zubu pronađena je kod šest ispitanika (75 %), a na više zuba kod dva (25 %). U svim slučajevima invaginacija se pojavila u gornjoj čeljusti. Impakcija je najčešće zahvaćala gornji desni očnjak (15 ispitanika) te gornji lijevi očnjak (11 ispitanika). Jedan zub je bio zahvaćan kod 23 ispitanika (72 %), a više zuba kod njih 9 (28 %). Mnogo češće nastaje u gornjoj čeljusti negoli u donjoj (23 prema 8 ispitanika). Kod jednoga ispitanika (3 %) nađena je u gornjoj i u donjoj čeljusti. Dilaceracija je uočena na desnem gornjem lateralnom sjekutiću kod tri ispitanika (30 %), a na gornje-mu desnom središnjem sjekutiću i desnome drugom gornjim pretkutnjaku kod dva ispitanika (po 20 %). Kod svih deset ispitanika s dilaceracijom bila je sama na jednom zubu, kod njih osam u gornjoj čeljusti, a dva u donjoj. Pandžasti konični lateralni sjekutići pojavljuju se jednaodanprivediom sedam ispitanika (64 %), a obostrano kod četiri (36 %). S lijeve strane bili su prisutni kod devet ispitanika, a desno kod njih šest. Kratki i tupi korijeni najčešće su na gornjim središnjim sjekutićima i gornjim lateralnim sjekutićima. Na jednome zubu zabilježeni su kod dva ispitanika (20%), a na više zuba kod osam (80%). U svim slučajevima bila je riječ o zubima maksile. Uski ili gracilni korijeni nadeni su kod devet ispitanika, najčešće na donjim sjekutićima (67%). Kod njih pet primijećeni su na jednom zubu (56%), a kod četiri na više zuba (44%). U donjoj čeljusti zabilježeni su kod osam ispitanika (89%), a u gornjoj kod jednoga (11 %). Taurodontizam je imalo šest ispitanika. Najčešće je bio na prvome gornjem desnom krunjaku, kod četiri, odnosno 67 % ispitanika, pojedinačno ili u kombinaciji s drugim zubima. Taurodontizam je uočen na jednome zubu kod pet ispitanika (83 %), a na više zuba kod jednoga (17 %). U gornjoj čeljusti je pronađen kod njih četiri (67 %), a u donjoj kod dva (33 %).

Discussion
Different results about the frequency of dental anomalies were found among studies. In the study of Altug Atac and Erdem (18) on 3043 Turkish orthodontic patients, at least one dental anomaly was found in only 5.46% of patients, while in the study of Thongudomporn et al. (19) on 111 Austra-
lian patients, in even 74.8% of them. Between these extremes are the results of Shakeel Khan et al. from Pakistan (20) with 16% and Roslan et al. from Turkey (11) with 28.4%. The latter result is very similar to ours; we found at least one dental anomaly in 24.1% of patients. The reason for such big differences is not completely clear; they might result from real differences in frequency of dental anomalies in different races and populations, but also from differences in indications for orthodontic treatment or diagnostic procedures and criteria for diagnosing dental anomalies. All other studies obtained the results very similar to ours. They failed to find differences in dental anomalies between sexes (21). Only in the study of Thongudomporn et al. were invagination and short or blunt roots somewhat more prevalent in females (19). Hypodontia was the most frequent anomaly in our study, followed by teeth impaction. These two anomalies were also most frequent in all other published studies. Apart from third molars, which were excluded from due to their variability, lateral incisors and second premolars were most frequently missing teeth. This finding is in agreement with Bolk’s theory of terminal reduction according to which, in cases of hypodontia of up to 4 teeth, last teeth in a group are most frequently missing: lateral incisors and second premolars and third molars (22). This finding is explained by the fact that embryonal joining of the maxilla with the medial nasal process occurs in the area of maxillary lateral incisors, while mandibular second premolars are located on the genetically unstable area at the end of the dental lamina (23). Hypodontia is usually treated with orthodontic therapy, prosthetic appliance or multidisciplinary – by combining orthodontics and prosthetics (24). Impacted teeth were the second most frequently found anomaly. Likewise, they were most frequent anomaly in studies by Sella Tunis (25), Roslan (11) and Lagan (26). The frequency of patients with impaction in the study of Prskalo et al. (27) – 4.71%, performed on the general Croatian population, was very similar to our results. Peg-shaped lateral incisors are by definition the teeth that have the mesio-distal diameter in the incisal part bigger than that in the cervical part (28). The frequency of this anomaly in our study corresponds to published results in orthodontic patients: 1.9% - 2.7 % (29). It seems that this anomaly is more frequent in patients of Asian ancestry and least frequent in the USA Caucasian population (29). The frequency of dilacerations, defined as deviations of the linear relationship of the crown relative to the root (30), was in our study as expected higher than in the study of Maličić et al. (31) performed on the general Croatian population (1.2%). Dilaceration was most frequent anomaly in the study of Ezoddini et al. on the Iranian population – even 15% (32). Approximation of root length is an indispensable part of prosthetic, orthodontic and periodontal therapy. Root length abnormalities are thought to be caused by trauma to the area of affected teeth during their development (33). Root morphology abnormalities increase the probability of its resorption during orthodontic therapy (34). The incidence of short and blunt roots varies from 2.7% in Caucasian (35) even to 10 % in Asian (36). Our results are similar to the results of the studies that obtained 2%. Tooth invagination is an anomaly in which one tooth develops in-
side another. It is thought to result from penetration of one enamel organ of one tooth into the area of dental pulp of another (37). Teeth affected by this anomaly have a higher risk of developing caries and dental pulp diseases, and their endodontic treatment is difficult because of atypical morphology of their root channels (38). The prevalence of permanent teeth affected by this anomaly is between 0.3% and 10%; our findings are consistent with such results. Taurodontism is a morphologic anomaly of teeth characterized by apico-oclusal prolongation of the tooth crown and pulp chamber with shortened roots. It is most frequently an incidental finding discovered during X-ray evaluation, because teeth appear to be the same as normal (39). The prevalence of this anomaly is highest in Inuits, persons with Down’s syndrome and the Central European population (40, 41). The larger pulp chamber increases the risk of pulp exposure during therapeutic procedures, thus making planning of orthodontic and prosthetic therapies difficult (42). The prevalence of taurodontism was 1.2% in our patients, similar to findings of the study by Brkić et al. (43) on the general Croatian population (2.65%) and Blumberg et al (44) and Witkop et al (45) on American Caucasians (2.5 and 2.6%). Hyperdontia is defined as an increase in the number of teeth in dental arches. Most frequently, the additional tooth is located between maxillary incisors and called mesiodens (46). If the additional tooth is next to premolars, it is called a parapremolar, and if it is located distally from the third molar, a distomolar (47). If the additional tooth resembles morphologically its normal counterparts, it is called a supplementary tooth, and if it does not, it is called an atypical or accessory tooth (48). Mesiodens is not always clinically visible. It can be impacted and cause diastema between incisors, thus making orthodontic therapy more complicated (49). Similar to our results, some previously published studies reported the prevalence of hyperdontia between 0.2% and 3% (50).

Conclusion

The results of our study on dental anomalies in Croatian orthodontic patients suggest: 24.1% of patients had at least one examined anomaly; Hypodontia was the most frequent anomaly, followed by teeth impaction. The prevalence of investigated dental anomalies was not significantly different between males and females; 1.2% of patients had more than one anomaly. The prevalence of most frequent dental anomalies in orthodontic patients is similar to that in the general population.

Conflict of interest

The authors report no conflict of interest.

Author’s contribution: N. D. B. - designed and wrote the study; B. A. - literature search and data interpretation; S. M. - concept and design of the study; M. L. V. - designed and wrote the study.

cakhlnskoga organa u područje zubne papile (37). Na zubima zahvaćenima tom anomalijom vjerojatnije će se pojaviti karijes i pulpne bolesti, a i njihovo je endodontsko liječenje teže zbog netipične morfološke korijske i pelvine kanala (38). Prevalencija trajnih zuba zahvaćenih tom anomalijom iznosi između 0,3 % i 10 %, a u skladu s tim su i rezultati u ovom istraživanju. Taurodontizam je morfološka anomalija zuba koja karakterizira izdužena zubna kruna i pulpna komorica u apikokooluzalnom smjeru sa skraćenim korijskim. Najčešće se dijagnosticira slučajno tijekom pregleda rendgenske snimke, jer u ustima izgleda jednako kao zdrav zub (39). Najčešće se pojavljuje kod Inuita, osoba s Downovim sindromom i u srednjoeuropskoj populaciji (40, 41). Zbog povećane pulpne komore veća je mogućnost da će se pulp otvoriti pri zahvatima na tim zubima, što otežava planiranje ortodontske i protetičke terapije (42). Udio ispitanika sa taurodontizmom u našem je istraživanju 1,2 %, a to je slično rezultatima istraživanja Brkića i suradnika (43) na općoj hrvatskoj populaciji (2,5 %) i istraživanjima Blumberga i suradnika (44) te Witkopa i suradnika (45) na američkoj bijelackoj populaciji (2,5 i 2,6 %). Hiperdoncija je anomalija povećanog broja zuba. Najčešće je dodatni zub smješten između maksilarnih sjekućica i tada se naziva meziiodens (46). U slučaju da se dodatni zub nalazi uz pretkutnjake, tada ga nazivamo parapremolare, uz kutnjake paramolare, a distalno od trećega kutnjaka – distomolare (47). Ako je dodatni zub morfološki sličan normalnim zubima, nazivamo ga suplementarnim zubom, a ako je netipične morfološke, netipičnim ili dentes accessoria (48). Meziiodens nije uvijek klinički vidljiv – može biti impaktiran te uzrokovati dijasteme među sjekućima i komplicirati ortodontsko liječenje (49). U dosadašnjim studijama prevalencija hiperdoncije je između 0,2 % i 3 % (50), što je slično rezultatima u ovom istraživanju.

Zaključak

Na temelju istraživanja dentalnih anomalija na populaciji hrvatskih ortodontskih pacijenata možemo zaključiti sljedeće: kod 24,1 % ispitanika zabilježena je barem jedna promotrana anomalija, najčešća anomalija je hipodoncija, a slijedi impakcija, nije nadena statistički značajna razlika u učestalosti ispitivanih dentalnih anomalija između muškaraca i žena, kod 1,2 % ispitanika zabilježeno je više od jedne anomalije, učestalost najčešćih dentalnih anomalija slična je u općoj populaciji i u populaciji ortodontskih pacijenata.

Sukob interesa

Autori nisu bili u sukobu interesa.

Doprinos autora: N. D. B. – osmišlila i napisala studiju; B. A. – pretraživanje literature i interpretacija podataka; S. M. – koncept i dizajn studije; M. L. V. – osmišlila i napisala studiju.
Sažetak

Cilj rada: Željela se ustanoviti učestalost hipodoncije, hiperdoncije, invaginacije, impakcije, dilace-racije, pandžastih koničnih lateralnih sijekuća, taurodontizma te kratkih ili tuptih i uskih ili gracinjih korjenova kod hrvatskih ortodontskih pacijenata. Materijali i metode: Analizirano je 506 ortopantomografskih i studijskih modela pacijenata u dobi između 12 i 16 godina liječenih u Zavodu za orodonciju Stomatološkog fakulteta sveučilišta u Zagrebu. Rezultati: Najmanje jedna dentalna anomalija zabilježena je kod 24,1 % pacijenta, a kod 1,2 % više od jedne. Nije uočena razlika u učestalosti među spolovima. Hipodoncija je bila najčešća u 7,5 % slučajeva, a slijedi impakcija u 6,3 %. Zaključak: Distribucija i prevalencija dentalnih anomalija kod ortodontskih pacijenata slična je opisanoj u op-coj hrvatskoj populaciji.

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