Prevalence and distribution of hypodontia in a Turkish orthodontic patient population: results from a large academic cohort

Aim Purpose of this study is to investigate the prevalence and distribution of congenitally missing permanent teeth (CMT) in a Turkish orthodontic patient population.

Materials and methods Panoramic radiographs, intraoral photographs and dental casts of 2761 patients (females 1677, males 1084) aged from 9 to 46 who underwent orthodontic treatment at Selcuk University Department of Orthodontics from 1990 to 2005 were retrospectively reviewed for CMT. A comprehensive chart review was conducted in all subjects. Patient and treatment-related data were registered in a computer database for comparative analysis.

Results When missing third molar data were included, prevalence of CMT in the overall population was 30.64% with no significant differences between male and female patients (p=0.546). On the other hand, prevalence of CMT excluding third molars was 6.77% with a significantly higher prevalence in females compared to male patients (7.63% vs. 5.44%, p=0.030). The most commonly congenitally missing tooth types in decreasing order were the third molars followed by maxillary lateral incisors and mandibular second premolars. The majority of missing third molars were located in the maxilla (55.7%) with no significant gender differences (p=0.334). 58.4% of CMT excluding third molars in females were located in the maxilla compared to only 40.8% in males (p=0.001). In both gender groups, majority of CMT excluding third molars were located in the anterior segment (55.6% and 58.4% in male and female patients respectively, p=0.713).

Conclusion The most commonly congenitally missing tooth type is third molars followed by maxillary lateral incisors and mandibular second premolars in our population. Although there were no gender differences in prevalence and anatomical distribution of missing third molars, CMT excluding third molars was significantly more prevalent in females with predominantly maxillary distribution in our population.

Keywords: Agenesis; Congenitally missing teeth, Hypodontia; Prevalence; Third molars.

Introduction

Hypodontia or agenesis is defined as congenital absence of one or multiple teeth and remains the most common anomaly of the human dentition [Vastardis, 2000]. This anomaly may result in dental malpositioning, periodontal damage, as well as reduction in alveolar bone height, and therefore has significant functional and aesthetic consequences. Previous studies suggested that genetic factors may play a role in the development of congenitally missing teeth (CMT) [Hartsfield, 2005]. Although certain genetic syndromes are well-known to be associated with hypodontia [Lucas, 2000], CMT is also seen in otherwise healthy individuals [Polder et al., 2004]. There is considerable amount of data regarding the prevalence and distribution of hypodontia, excluding the third molars and percentages were reported to range from 0.3% to 11.3% in different series [Endo et al., 2006; Grahnen, 1956; Magnusson, 1977; O’Dowling and Mc Namara, 1999; Rosenzweig and Garbarski, 1965]. Nevertheless, large population-based studies have shown that hypodontia excluding third molars occurs in 6.1% to 8.0% of the population [Endo et al., 2006; Grahnen, 1956; Haavikko, 1971; Rolling and Poulsen, 2009]. Some of these reports suggested that hypodontia is observed more frequently in females compared to males, however gender distribution has shown some variation [Magnusson, 1977; Rolling, 1980; Pinho et al., 2005]. On the other hand, prevalence of CMT including the third molars is not consistently reported in the literature and varies from 3.3% to 43.8% in different series [Cuairan and Hernandez, 1996; Goren et al., 2005; Meza, 2003]. Second to missing third molars, the most common form of CMT involves the upper lateral incisors and lower second premolars, although regional differences are present [Endo et al., 2006; Magnusson, 1977; Rolling, 1980; Sisman et al., 2007].

The purpose of the present study is to investigate the prevalence and distribution of CMT either including or excluding third molars in a large cohort of orthodontic patient population from a single academic institution.

Materials and method

Panoramic radiographs, intraoral photographs and dental casts of 2761 caucasian patients (1677 females and 1084 males) aged aged from 9 to 46 (mean age 14.1 years), who underwent orthodontic treatment at Department of Orthodontics of the Faculty of Dentistry of the Selcuk University in Konya, Turkey, from 1990 to 2005 (over 15 years) were retrospectively reviewed. Patients with developmental anomalies such as ectodermal dysplasia, cleft lip and/or palate were excluded from the study.

The prevalence of CMT was calculated based on the chronological age of the patient, follicle formation, calcification level and eruption time of the teeth. Teeth were classified as developmentally missing when there was no evidence in the records that they had been extracted and lack of follicle formation or mineralisation of the tooth crown was observed on the panoramic radiographs. Patient records from serial visits were longitudinally evaluated and all missing teeth information
was recorded based on a predefined criteria. Clinical and radiographic data were cumulatively entered in a custom-designed computer database. CMT assessment was performed separately by including and excluding third molars. Given that radiolucent areas observed in panoramic radiographs from children at early ages could be misinterpreted as congenitally missing teeth thereby leading to false positive results, we excluded patients aged 8 and below from the current study. The rationale for this decision was based on previous studies demonstrating 8-year as the peak age for third molar crypt formation as well as relatively low incidence of late mineralisation in orthodontic patients beyond 9 years of age [Banks, 1934; Aasheim and Ogaard, 1993].

The data were presented as means and proportions. Groups were compared using Chi-square and Fisher's exact tests for categorical variables respectively, as indicated. For all tests, a two-tailed p value of < 0.05 was considered statistically significant.

**Results**

**CMT prevalence in overall population excluding third molar information**

When third molar information was excluded, prevalence of CMT in the overall patient population was 6.77% (187 out of 2761 patients). Prevalence of CMT was found to be significantly lower in male patients compared to females (5.44%, n=59 versus 7.63%, n=128, respectively, p=0.025) (Fig. 1). The most common CMT type was congenitally missing maxillary lateral incisors, which was present in 88 patients (3.19%). Prevalence of congenitally missing maxillary lateral incisor cases were found to be significantly lower in males (n=25, 2.31%) compared to females (n=63, 3.76%) (p=0.034). Prevalence of bilateral congenitally missing maxillary lateral incisors in the overall cohort was 1.63% (n=45), which accounts for 51.14% of all congenitally missing maxillary lateral incisor cases.

The second most common CMT type was congenitally missing lower second premolars, which was observed in 61 patients (2.21%). There were no significant differences in the prevalence of congenitally missing lower second premolars between male (n=26, 2.40%) and female patient groups (n=35, 2.09%) (p=0.586). Bilateral congenital missing lower second premolars were observed in 31 patients (1.12%), which accounts for half of all congenitally missing lower second premolar cases (50.82%).

**CMT prevalence including missing third molar information**

The prevalence of CMT including missing third molar data was 30.64% (n=846), with no significant differences between male (29.98%, n=325) and female patients (31.07%, n=521), (p=0.546). At least one missing third molar was seen in 769 patients (27.85%), and the prevalence was not significantly different for male (28.78%, n=312) and female patients (27.25%, n=457), (p=0.381), (Fig. 1). When the number of missing third molars per patient was investigated, we found that 187 patients (6.77%) had only one missing third molar, 257 patients (9.31%) had two missing third molars, 58 patients (2.10%) had three missing third molars, and 267 patients (9.67%) had four missing third molars. Prevalence of patients with at least one missing maxillary third molar (22.56%, n=623) was higher than the prevalence of patients with at least one missing mandibular third molar (17.93%, n=495) (p<0.001). Prevalence of patients with congenital absence of bilateral maxillary third molars was 5.87% (n=162) and prevalence of patients with congenital absence of bilateral mandibular third molars was 2.57% (n=71).

When we investigated prevalence of missing third molars with or without concomitant CMT, we found that 659 patients had congenitally missing third molars alone (without concomitant CMT), whereas the remaining 110 patients had congenitally missing third molars in combination with another missing tooth type (Fig. 2).

**CMT prevalence based on missing tooth counts**

Missing third molar data based on gender and anatomical distribution is summarised in Table 1. As
shown, a total of 1943 third molars were missing in 769 patients. The majority of missing third molars (n=1082, 55.7%) were in maxillary location. When gender groups were comparatively analysed, we did not find any significant differences in maxillary missing third molars between female and male patients (54.8% and 57.0% respectively, p=0.334).

Counts and anatomical distribution of congenitally missing teeth data excluding third molars for each gender groups in the overall population is summarised in Table 2. As shown, 250 teeth were congenitally missing in 128 female patients compared to 125 missing teeth in 59 male patients. In female patients, the number of maxillary CMT was higher than the number of mandibular CMT with a maxillary/mandibular CMT ratio of 1.40 (146/104). However, in male patients, the number of maxillary CMT was lower than the number of mandibular CMT with a maxillary/mandibular CMT ratio of 0.69 (51/74) (p=0.001). In both gender groups, the number of CMT in the anterior segment was higher than the number of CMT in the posterior segment with an anterior-posterior ratio of 1.25 in females (139/111) and 1.36 in males (72/53), (p=0.713) (Fig. 3).

Discussion

Congenitally missing teeth remains one of the most common human developmental anomalies and have important functional, aesthetic, as well as psychological consequences. Even though hypodontia is associated with a large number of various genetic diseases including ectodermal dysplasia and Down Syndrome [Lucas, 2000], it may also manifest as a non-syndromic trait [Polder et al., 2004]. Hypodontia is frequently associated with other oral anomalies including cleft lip/palate, microdontia, crowding, and malposition of other teeth, and therefore poses a challenge for a successful orthodontic treatment. Aetiology of hypodontia seems to be multifactorial, and both genetic and environmental factors such as infection, chemotherapy, and radiotherapy play an important role in the pathogenesis of this condition. Regional differences exist in terms of prevalence and distribution of hypodontia in various populations, and exact reasons for this discrepancy remains poorly understood.

Our study demonstrated that the prevalence of hypodontia (excluding the third molars) in a large Turkish orthodontic population was 6.77%, which falls within the...
range of 6.1%-8.0% reported in other large population-based studies [Endo et al., 2006; Grahnén, 1956; Haavikko, 1971; Rolling and Poulzen, 2009]. It is important to note that each one of these studies represent patients with different genetic background and have unique patient selection criteria. The prevalence of CMT was indicated as between 2.63%-7.54% in a limited number of studies from Turkish patient population, which are in agreement with our findings [Altug-Atac and Erdem, 2007; Celikoglu et al., 2010; Sari et al., 2003; Sisman et al., 2007].

In our cohort, female patients exhibited a significantly higher prevalence of CMT (7.63%) compared to male patients (5.44%), which is in agreement with some previous reports [Magnusson, 1977; Rosenzweig and Garbarski, 1965]. Magnusson [1977] and Sisman et al. [2007] suggested higher prevalence rates for female patients (8.9% and 8.09%) compared to males (6.7% and 6.54%). Other authors failed to demonstrate such relationship [Celikoglu et al., 2010; Endo et al., 2006]. Interestingly, Ng'ang'a and Ng'ang'a [2001] showed that the frequency of hypodontia was higher in males (7.2%) then in females (5.3%) in an African orthodontic population, suggesting that both regional and genetic factors may lead to differences in gender distribution of CMT prevalence. When the third molars were excluded, the most frequently missing teeth in our population were the maxillary lateral incisors, followed by mandibular second premolars, mandibular central incisors, maxillary second premolars, mandibular premolars, and mandibular central incisors. The frequency order of CMT varies among studies [Celikoglu et al., 2010; Endo et al., 2006; Magnusson, 1977; Ng'ang'a and Ng'ang'a, 2001; Polder et al. [2004] stated that the maxillary lateral incisors and the mandibular second premolar were the most frequently affected teeth in a Caucasian population, which is in accordance with our results. The results of three independent studies from Turkey also suggested that the maxillary lateral incisors were the most commonly affected congenitally missing teeth [Altug-Atac and Erdem, 2007; Celikoglu et al., 2010; Sisman et al., 2007]. Other authors have reported permanent upper lateral incisors [Gomes et al., 2010; Meza, 2003] or mandibular second premolars [Endo et al., 2006; Magnusson, 1977; Ng'ang’a and Ng’ang’a, 2001] as the most commonly affected tooth. On the other hand Chung et al. [2008] suggested that mandibular incisors were the most common CMT in Korean population. Combined, these findings suggest that geographic and genetic factors may play an important role in the anatomical distribution of CMT.

In the present study, hypodontia excluding third molars was more common in the maxilla than in the mandible in the overall population. This finding agrees with most of the previous studies [Atac and Erdem, 2007; Celikoglu et al., 2010; Meza, 2003; Sisman et al., 2007]. On the contrary, Chung et al. [2008] and Endo et al. [2006] noted that mandibular hypodontia was more common than maxillary hypodontia in Korean and Japanese populations.

In our patient population hypodontia was also more common in the anterior than in the posterior segment. Celikoglu et al. [2010] also indicated the same finding with similar ratios in a different Turkish orthodontic population. However, Endo et al. [2006] reported that the percentage of CMT was higher in the posterior region than in the anterior in all Japanese children with hypodontia included in the investigation.

We have not noticed a major difference in bilateral versus unilateral absence of maxillary lateral incisors (51.14% bilateral, 48.86% unilateral) or lower second premolars (50.82% bilateral, 49.18% unilateral). Other investigators have also failed to demonstrate a difference in bilateral vs. unilateral CMT prevalence [Magnusson, 1977; Rolling, 1980; Pinho et al., 2005].

**Congenital absence of third molars**

When missing third molar information was incorporated, the CMT prevalence in our study was found to be 30.64% without any gender predisposition. A limited number of previous studies investigated prevalence of hypodontia including third molar data, however these studies differ significantly with regards to age of patients studied [Cuairan and Hernandez, 1996; Goren et al., 2005; Meza, 2003; Uslu et al., 2009]. A study by Meza et al. [2003] using the same minimum age cut-off criterion (9-year-old and above) has reported that the prevalence of CMT in a Mexican orthodontic population was 27% with
to achieve a successful functional and aesthetic outcome. A multidisciplinary team approach is of utmost importance for males. Early detection of this prevalent condition with a prevalence of CMT excluding third molars was more frequent in female patients, whereas Rozkovcova [2004] reported a higher prevalence in males in the Czech population.

In the present analysis, frequency of number of missing third molars in descending order is 4, 2, 1 and 3 molars. However different order patterns were published in the literature suggesting higher prevalences for single or double missing third molars [Banks, 1934; Celikoglu et al., 2010; Kazanci et al., 2010]. With regards to the anatomical location of missing third molars, we demonstrated that the congenitally absent of third molars was higher in the maxilla compared to mandible location in both gender groups. Similarly, Kazanci et al. [2010] indicated that absence of third molars was more common in the maxilla compared to the mandible among Eastern Anatolian Turkish patients and the difference was statistically significant. This finding also agrees with the previous reports [Grahnen, 1956; Sandhu and Kaur, 2005]. Our study also demonstrated that absence of third molars represents the majority (90.9%) of hypodontia cases, when incorporated in calculations. Bredy et al. [1991] indicated a similar frequency, of 81.5%, for third molar agenesis found in all agenesis patients. Chung et al. [2008] reported that there was a minimum of one third molar missing in nearly half of (48.2%) the patients with hypodontia. Moreover, it is important to note that 13.0% of hypodontia cases involved congenitally missing third molar with another concomitant CMT.

**Conclusion**

Prevalence of CMT was found to be 30.64% including third molars and 6.77% excluding third molars in a large Turkish orthodontic population, which is in agreement with previous published reports on Caucasian patient populations. The most frequently missing teeth were maxillary third molars followed by mandibular third molars, maxillary lateral incisors and lower second premolars. Prevalence of congenitally missing third molars was similar in both gender groups. On the other hand, prevalence of CMT excluding third molars was more prevalent in female orthodontic patients compared to males. Early detection of this prevalent condition with multidisciplinary team approach is of utmost importance to achieve a successful functional and aesthetic outcome.

**References**