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ORIGINAL ARTICLE

Distribution of congenitally missing teeth and treatment options for the lower second premolars in patients referred to special care

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ABSTRACT

Objective: The aim was to evaluate the distribution of congenitally missing teeth and the treatment provided for congenitally missing lower second premolars in an eleven-year cohort of patients referred to a publicly funded source of specialist care.

Material and methods: This was a retrospective, register-based cohort study. Search for patients referred to a publicly funded source of specialist care based on ICD10 diagnosis code K00.00 (partial anodontia) and treatment codes EBA00, EBA05, EBA10, EBA12, EBB10 and EBB20 during the period 1.1.2009–27.10.2019 yielded 232 patients (151 females, 81 males), of whom 218, born in 1941–2009, were eligible. Data collected from medical files were presented in the form of descriptive statistics and analysed using Fisher's exact test.

Results: The 218 subjects possessed 876 congenitally missing teeth (males 307, females 569) (third molars excluded). The most common missing teeth were upper second premolars and lateral incisors, and lower second premolars and central incisors. No difference in laterality was found. Statistically significant associations were found between the choice of treatment and both the patient's age at referral and the patient's year of birth. Most common treatment for adult patients (age 18–56 years) was placement of an implant (67%), while autotransplantation (11%) was the preferred option for children at the mixed dentition stage (age 9–15 years).

Conclusions: The congenitally missing teeth most commonly involved in referrals of patients to publicly funded specialist care were lower second premolars. The most frequent treatment was insertion of an implant for adults and autotransplantation at the mixed dentition stage.

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Introduction

Hypodontia, or missing teeth, is the most common among all the developmental tooth anomalies [1], impairing masticatory function and affecting oral health and the quality of life [2]. The most commonly missing teeth (excluding the third molars) are the lower second premolars, followed by the upper lateral incisors or second premolars [3]. Polder et al. [1] found that third molars are congenitally missing in 20% of the population, whereas permanent lower second premolars are congenitally missing in 3%, upper second premolars in 1.7% and upper lateral incisors in 1.5%. No clear difference has been identified between the jaws [4–6]. Unilateral hypodontia is more common than bilateral, and the anterior segment is more likely to be affected than the posterior one [6]. In some Scandinavian studies, the left side of the jaw has been reported to have more missing teeth than the right side [7].

Females have a higher incidence of missing teeth than males [5,6,8]. Epidemiological surveys conducted in the Scandinavian countries have reported the prevalence of missing premolars in school children to be in Norway 4.5% [9], Sweden 7.4% [7], Denmark 7.8% [10], Finland 8% [11] and Iceland 9.5% [12].

Unless the remaining deciduous teeth maintain the occlusion and prevent alveolar bone resorption, there may also be a lack of bone for implantation as a treatment for congenitally missing teeth, so that surgical bone remodelling will be needed. Early infraocclusion is detrimental to the prognosis for deciduous second molars [13], and infraocclusion of a deciduous tooth will be much more severe in patients with a hyperdivergent growth pattern than in those with deficient vertical growth [14]. Infraocclusion in adulthood has been reported in 45–52% of cases of a lower deciduous molar lacking a successor [15,16]. Also, although restorations have previously been used as indicators of the condition of deciduous teeth [15,17], infraocclusion and periodontal bone loss may cause the loss of a tooth more often than does caries [18].

When orthodontic treatment for missing premolars is planned, a decision must be made as to whether the spaces

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should be closed or optimised for replacing the teeth with implants or conventional tooth-supported prostheses. Closing a space can be difficult, especially if there is extra space in the dental arch. Autotransplantation of teeth as a treatment for congenitally missing lower second premolars can be a good option when the dentition is not crowded and mesial movement of the first permanent molar is not needed, and/or if there is no room for all the teeth in the upper jaw. Autotransplantation is defined as transplantation of a tooth from its developmental position into a surgically prepared socket at another site in the same oral cavity. Autotransplantation will preserve the alveolar bone, so that implant prosthetic intervention will remain an option later in life.

Rohof et al. concluded in their meta-analysis of autotransplantation of teeth with incomplete root formation that survival and success rates were high (>95%) and complications were rare (<5%) [19]. In one long-term follow-up of 33 transplanted teeth conducted in Norway, a survival rate of 90% and a success rate of 79% were reported after a mean follow-up period of 26.4 years (range 17–41 years) [20].

Edentulous spaces can also be restored by means of implant-supported restorations, fixed dental prostheses (FDPs) or removable partial dentures (RPDs) [18]. Dental implants can be placed only after cessation of skeletal growth [21], and the need for bone augmentation before or during placement of an implant should be assessed. Insertion of the implant is best carried out soon after the time of extraction or exfoliation of the deciduous tooth to achieve maximal preservation of the height and width of the alveolar bone [22]. It has been shown that the alveolar ridge narrows by 25% in the four years following extraction of a retained lower primary second molar [23].

A conventional tooth-supported FDP is recommended as an alternative to an implant-supported single crown when a crown is indicated for the adjacent tooth, as is most often the case in elderly patients. Similarly, RPDs are most often recommended for elderly patients in cases of several missing/extracted teeth.

In Finland the Ministry of Social Affairs and Health has published nationally applicable uniform criteria for access to non-emergency dental care, including the treatment of congenitally missing teeth [https://julkaisut.valtioneuvosto.fi/handle/10024/161496 (abstract in English)], and dental care based on these uniform criteria is free of charge in local primary health care for persons under 18 years of age and highly subsidised for all ages in government-funded specialist care.

Objectives

Specialist dental care with a multidisciplinary approach is often needed to treat hypodontia patients, and the aim of this work was to evaluate the distribution of congenitally missing teeth and the prevalence of different options for treating missing lower second premolars in patients in an eleven-year cohort referred to publicly funded specialist care.

Material and methods

Study design

The protocol followed here was retrospective and register-based, permission to conduct the study having been given by the Northern Ostrobothnia Hospital District (project number 130/2019).

The material consisted of patients from the Northern Ostrobothnia Hospital District who had been referred to the Oral and Maxillofacial Department of Oulu University Hospital due to congenitally missing teeth and treated between 1 January 2009 and 27 October 2019.

Inclusion and exclusion criteria

The patients had been identified by searching the data of Oulu University Hospital for the ICD10 (International Classification of Diseases-10) diagnosis code K00.00 partial anodontia (hypodontia, oligodontia), together with the procedure codes EBA00 (extraction of tooth), EBA05 (difficult extraction of tooth), EBA10 (operative extraction of tooth), EBA12 (difficult operative extraction of tooth), EBB10 (implantation) and EBB20 (autotransplantation). The whole sample consisted of 232 patients (151 females, 81 males) born during the years 1941–2009. The records for 14 patients did not provide accurate information on congenitally missing teeth and were thus excluded, so that the number of patients actually included in the series was 218 (third molars excluded). Other exclusion criteria adopted in the analyses of treatment options for lower second premolars were syndromes, cleft lip, or cleft palate.

Study variables

The data collected from the medical files applied to referrals, patient records and radiographic files as well as procedures performed by an experienced orthodontist (MO-A) before and after the treatment period. Data on the distribution of congenitally missing teeth were gathered by tooth type, and the treatment performed for congenitally missing lower second premolars was analysed for non-syndromic patients.

Bias

The potential source of bias could be a diagnosis code for a missing tooth other than that of a ‘congenitally missing tooth’, or a referral based on some reason other than a congenitally missing tooth while the patient still had congenitally missing teeth.

Statistical analysis

Descriptive statistics and bar charts were used to present the data. Fisher’s exact test was used to study associations between the choice of treatment for a congenitally missing lower second premolar and the patient’s year of birth, gender and age at the time of referral for specialist care. The

software used was Microsoft Excel 2010 version 14.0.7268.5000 and IBM SPSS Statistics 27. *P*-values <.05 were considered significant.

Results

Distribution of congenitally missing teeth

A total of 218 patients had 876 congenitally missing teeth altogether (307 in males, 569 in females). Oligodontia (6 or more missing teeth) was diagnosed in 50 patients (23%) and hypodontia (1–5 missing teeth) in 168 patients (77%). The most common situation was 1–2 missing teeth, found in 95 patients (44%). The most common missing teeth were second premolars and lateral incisors in the upper jaw and second premolars and central incisors in the lower jaw (Figure 1). The females had more missing teeth than the males.

A total of 129 patients had 219 non-syndromic congenitally missing lower second premolars on the right or left side or on both sides. The mean age of these patients was 25.5 years (range 7–56 years). Altogether 106 patients (69 females and 37 males) had a missing right lower second premolar and 113 (70 females and 43 males) a missing left lower second premolar, and 90 in all (70% of the 129 patients; 56 females and 34 males) had congenitally missing lower premolars on both sides, while 16 patients (13 females and 3 males) had only a right lower second premolar missing and 23 (14 females and 9 males) only a left lower premolar missing.

Treatment of congenitally missing lower second premolars

The treatments provided for the congenitally missing lower second premolars were an implant-supported single crown, orthodontics (fixed appliances; orthodontic space closure), prosthodontics (a removable partial denture, RPD, or fixed dental prosthesis, FDP), autotransplantation, retention of the deciduous tooth or no treatment (Figure 2). The most common of these was placement of an implant ($n = 146/219$, 66.7%) (Figure 2), while in 30/219 instances (13.7%) the deciduous tooth was still in position at the time of

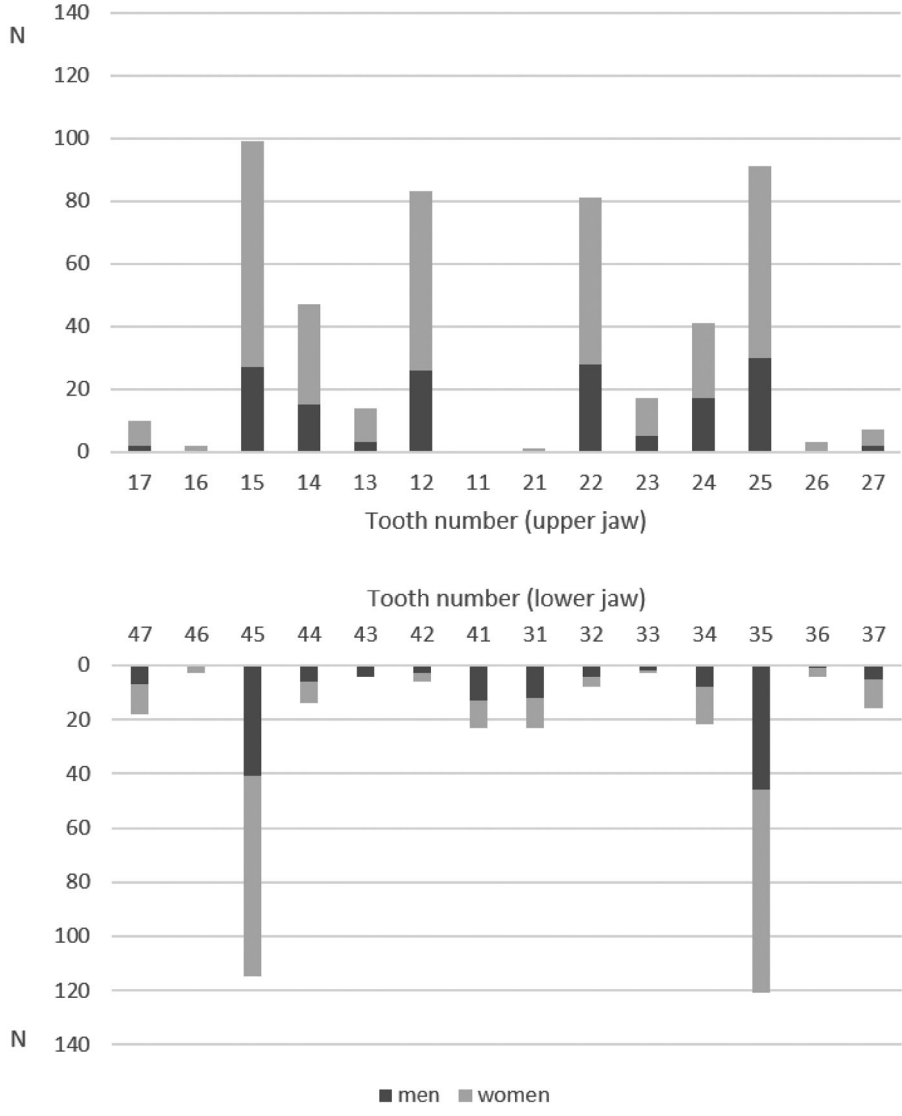

Figure 1. Distribution of congenitally missing teeth ($n = 876$) in 218 patients referred to specialist care.

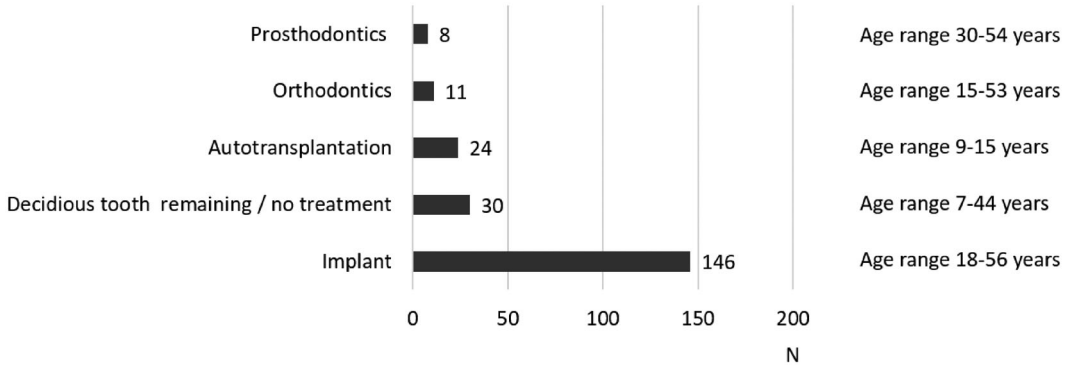

Figure 2. Treatment provided for cases of congenitally missing lower second premolars ($n = 219$) in patients referred to specialist care and in relation to age when referred to the hospital.

Table 1. Age distribution of the patients at the time of implantation for the replacement of a non-syndromic congenitally missing lower second premolar.

Age	Female	Male	Total
Years	*N* (%)	*N* (%)	*N* (%)
18–20	10 (6.9%)	7 (4.8%)	17 (11.7%)
20–29	33 (22.6%)	24 (16.4%)	57 (39%)
30–39	26 (17.8%)	11 (7.5%)	37 (25.3%)
40–49	18 (12.3%)	5 (3.4%)	23 (15.7%)
50–56	9 (6.2%)	3 (2.1%)	12 (8.3%)
Total	96 (65.8%)	50 (34.2%)	146 (100%)

the referral visit and/or no treatment had been performed, and in 24/219 instances (11.0%) an autotransplantation procedure had been performed. A total of 8/219 (3.6%) congenitally missing teeth were replaced with a prosthesis, and in 11/219 (5.0%) instances, the area of the missing tooth was treated with orthodontic closure. A large proportion of the patients underwent orthodontic treatment in the form of implantation and prosthetic treatment.

Statistically significant associations were found between year of birth and the choice of treatment for a congenitally missing lower second premolar on either the left or right side ($p = .001$ in both cases). The age ranges of the patients at the time of referral are presented in Figure 2 and statistically significant associations were found between the age at which the patient was referred for specialist care and the choice of treatment (left side $p = .009$ and right side $p < .001$). In contrast, the choice of treatment did not have any statistically significant association with gender (left side $p = .856$ and right side $p = .125$).

The mean age of the patients receiving an implant was 30.5 years and the median age 29 years (range 18–56 years, women 18–56 years, men 18–50 years) (Table 1), the most popular implantation age range being 20–29 years. Implantation was most prevalent among females aged 20–39 years.

The patients who underwent autotransplantation were aged 9–15 years, mean age was 11.4 years and the median age was 11 years at the time of the procedure (Figure 3). The treatment plans for autotransplantation entailed no clear formula for the donor tooth to be transplanted, a missing lower right second premolar being replaced with the upper right second premolar in five cases, the upper left second premolar in three cases, the upper left first premolar in four cases and the lower left second premolar in one case (crowding left side), and a missing lower left second premolar with the upper left second premolar in five cases, the upper right second premolar in one case, the upper left first premolar in one case, the upper right first premolar in three cases and the lower right second premolar in one case (both premolars missing left side).

Discussion

In this work, the distribution of congenitally missing teeth was evaluated among patients referred to a publicly funded specialist care unit and treated during the period 2009–2019 and assessed the treatment provided for non-syndromic congenitally missing lower second premolars. Multidisciplinary dental treatment is often needed in cases of congenitally missing teeth in order to achieve a successful outcome, and treatment combining primary and specialist dental care is therefore recommended. Since Oulu University Hospital is a centre for senior and specialising dentists, treatment choices are discussed in meetings attended by oral and maxillofacial surgeons, specialists in orthodontics, prosthodontics, periodontology, pedodontics and cariology. The meetings are also attended by specializing dentists, who also treat the patients under the guidance of their seniors. Patients x-rays are usually pronounced upon by dental radiologists when the patient arrives for specialist care.

The most frequent congenitally missing teeth in the present group of patients (third molars excluded) were the lower second premolars, which is in accordance with the overall relative prevalences reported in various populations [3]. The results also confirmed the previously noted predominance of women in terms of the prevalence of congenitally missing teeth [6,8]. However, the similarity in prevalence between the right and left sides was noted in this study.

The majority (66.7%) of the congenitally missing lower second premolars in these patients referred for publicly funded specialist care were replaced with an implant, that is, dental implants were used for adults in whom no further facial growth could be expected and the treatment was in most cases part of a larger programme of oral rehabilitation. Both the males and females were mostly 20–29 years of age, the youngest being 18 years old and the oldest 56 years, figures which correspond to current treatment guidelines.

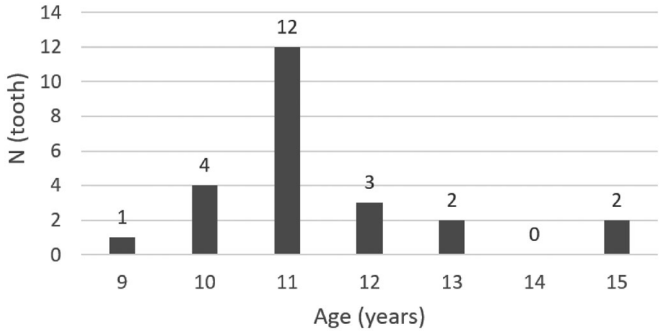

Figure 3. Age distribution of the patients referred to specialist care who received autotransplantation treatment for congenitally missing lower second premolars.

Implants and implant-supported prostheses have proved to be a successful treatment option with high long-term survival (86–100%) and there have also been reports of high patient satisfaction in the case of congenitally missing teeth [18,24]. Preprosthetic orthodontic treatment is needed in nearly all implant cases involving hypodontia patients in order to optimize the horizontal and vertical space available for the implant-supported prosthesis. In addition, the timing of the extraction of any deciduous teeth should be optimized in order to preserve the alveolar bone volume. Bone grafts may also be used, and other prosthetic options should be chosen in the case of limited space.

Autotransplantation can be considered for patients with orthodontic indications for tooth extraction when potential donors are available [25], and when extraction of the upper premolars is needed as a part of the orthodontic treatment plan. In addition, when lower second premolars are concurrently missing, an opportunity exists for utilising those upper premolars. In the present series, 11% of the congenitally missing lower premolars were treated with autotransplantation, most of the patients being 11 years old, given that the ages of the children and adolescents in the series varied between 9 and 15 years, and all of them were in the mixed dentition stage. Autotransplantation was referred to a publicly funded specialist care unit to be performed by an oral surgeon who was familiar with the method. Other factors leading to a good prognosis were an open apex, minimal extraoral time, atraumatic extraction of the donor tooth and gradual application of occlusal loading during healing. Many investigators have contended that optimal results will be obtained if the operation is performed when root formation is one-third to three-fourths complete [26], as pulp revascularization and vitality can then be preserved and the tooth will retain its potential for erupting and inducing alveolar bone growth [27]. A retained deciduous tooth is not removed until the time of autotransplantation.

Most often the donor teeth chosen to replace missing lower second premolars have been upper second premolars of similar dimensions, and this was also found here. In the meta-analysis of Rohof et al. [19], the survival rates for autotransplantation were 97.8% after five years, 96.3% after 10 years, and still as high as 79% even after a mean of 26 years [20]. For older patients with complete development of their teeth, an implant-supported single crown is the treatment of choice. The present study also showed a significant association between the choice of treatment and both the patient's age at referral and year of birth.

No treatment was performed for congenitally missing lower premolars or a residual deciduous tooth in 13.7% of the present cases (age range of the patients 7–44 years). Some patients were still young and it was decided to insert an implant at a later stage, when the vertical growth of the face and jaws was complete. Similarly, procedures were performed for some patients only on the upper jaw during the period studied here, e.g. for congenitally missing lateral incisors, although they also had a congenitally missing lower premolar. There were also patients for whom the planned procedures could not be performed due to poor co-operation. For one patient tooth extractions were planned at the beginning of the treatment but this was abandoned, so that the teeth that did not erupt normally had to be removed later on and a functional deciduous second molar was saved. For another patient, the plan was to carry out an autotransplantation of the upper first premolars to replace the lower deciduous second molars, but the planned treatment did not prove possible. Afterwards the upper first premolars were removed due to crowding.

A few patients in this series had undergone only orthodontic treatment or had received prosthetic FDPs or RPDs to replace congenitally missing lower second premolars, although pre-restorative orthodontic treatment is often needed prior to tooth replacement [28,29]. No resin-bonded or glass fibre-reinforced FDPs were used to replace congenitally missing lower second premolars in this series, although Allen et al. [28] concluded that resin-bonded FDPs provide a reliable and minimally invasive solution in the short-to-medium term for replacing missing teeth in patients with hypodontia, including lower second premolars. Resin-bonded FDPs may be most recommendable for the replacement of upper lateral incisors or lower incisors [29].

The present evaluation of congenitally missing teeth and the treatment provided for them concerned patients treated in Northern Ostrobothnia, Finland, during the period 2009–2019. Particular strengths of this study are the long period and the comprehensive body of data on the treatment of a wide age range of patients who had been referred to publicly funded specialist dental care on account of congenitally missing teeth. Although the results cannot be generalised to apply to the whole Finnish population, the distribution of congenitally missing teeth is comparable to that found in the systematic review and meta-analysis of Khalaf et al. [3], and thus, the prevalence of treatments performed among these patients may be regarded as comprehensive. Further studies are needed to evaluate the prognoses for the common treatment modalities of implant-supported single crowns and autotransplantation, and to determine the most appropriate schedule and timing of treatment for congenitally missing lower premolars.

Deciduous teeth substituted for missing permanent teeth are commonly restored, and it has been shown that root resorption in deciduous molars increases from the first to the second decade of life and remains stable until the third

decade [13,16]. Concerning the type of deciduous tooth, the lower deciduous canines have the most predictable prognosis and deciduous molar teeth the least predictable [18]. As a lower premolar is the most common missing permanent tooth (except for a third molar) this leads to a clinical problem and a lifelong need for treatment. In Finland, the national criteria for access to publicly funded non-emergency dental care for a missing second premolar are accepted only when this is justifiable as part of a complete programme of occlusal treatment. This is an option for a missing second lower premolar when the upper premolars are to be extracted at the mixed dentition stage and the same person has one or more missing lower second premolars. In such cases autotransplantation should always be the treatment of choice for replacing missing lower premolars.

The background to the patient records studied here is that the decision reached regarding the treatment option was not always the initial one, as some patients had already been treated in basic oral health care, for example, for caries, and orthodontic treatments had been carried out before referral to special oral care, and in many cases, there had been a follow-up period to allow for proper timing of the treatment for which the patient had been referred.

This work provides an insight into the options available for treating cases of congenitally missing second premolars in a publicly funded university hospital. Unlike the upper second incisors, these teeth are not treated in publicly funded non-emergency health care organizations in Finland. Instead, the treatment plan for a congenitally missing second premolar needs to be part of a programme of occlusal rehabilitation. In the case of children with ongoing development of their dentition, autotransplantation can be part of such an orthodontic treatment plan, but such procedures need to be centralised and carried out in a university hospital, as they call for an experienced oral surgeon.

Limitations

Since the medical files were systematically reviewed by one person, human miscalculations could have occurred, even though re-checkings were carried out for several reasons during the work. Also, as the patients had been referred from basic health care to specialist care for the treatment of congenitally missing teeth, no data on caries could be studied, nor was the degree of root resorption etc. known, since the follow-ups, evaluations of treatment needs, diagnoses and possible treatments had been conducted in primary care before the referral.

Conclusions

The congenitally missing teeth that are most frequent in referrals to a publicly funded specialist care unit are the lower second premolars. The treatment for these in the case of the adults in the present series was most often implant placement, while the treatment option in most cases of a developing dentition was autotransplantation. A lifetime perspective needs to be adopted when providing treatment for missing lower second premolars.

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Disclosure statement

No potential conflict of interest was reported by the author(s).

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