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ORIGINAL ARTICLE

Dentoalveolar oral surgery in children and adolescents: organization and surgical treatment in a large, Danish municipal dental service

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ABSTRACT

Objective: To describe a population-based organization of dentoalveolar surgical service for 0 to 18-year old subjects in a Danish municipal dental service, and analyze the type of dentoalveolar surgical interventions needed.

Material and methods: The study was conducted in the Municipality of Aarhus, Denmark during five consecutive school-years. An internal referral system was established within the municipality where patients could be referred to colleagues with a higher level of competencies and more experiences with paediatric dentoalveolar surgery. The analysis includes a total of 1812 children and a total of 2854 surgical interventions.

Results: Almost 80% of the patients, representing more than 80% of the dentoalveolar surgical interventions needed, were referred internally. Denudations were the most frequent treatment type (40.3%) carried out, followed by removal of third molars (18.0%). Furthermore, 22 odontomas and 100 supernumerary teeth were removed.

Conclusions: The need of dentoalveolar surgery in children and adolescents is relatively low, but includes a wide range of interventions. An organizational system, where dentists can refer to colleagues who have developed special competencies in this field, results in most of these surgical patients being referred and treated internally.

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Introduction

Dentoalveolar surgery is defined as 'the surgical treatment of disorders of the teeth and their supporting hard and soft tissues (excluding restoration of the teeth, such as dental fillings, crowns and bridges)' [1], and is described in major current textbooks on Paediatric Dentistry [2–5] and maxillofacial surgery [6,7]. Childhood and adolescence are characterized by eruption and shedding of primary teeth and eruption of permanent teeth. These complicated processes may require surgical interventions in order to secure a normal dentoalveolar development [8]. Dental anomalies (e.g. supernumerary teeth and odontomas) also often require surgical corrections during childhood and adolescence. Other examples of conditions requiring surgical intervention are soft tissue anomalies and oral mucosal lesions. Dentoalveolar paediatric surgery is also faced with the challenge of psychological management of the young patient. Expertise in modern methods of pain control, and in particular, use of sedation is an absolute requirement for a successful outcome. The organization of such surgical treatment units, integrated internally in municipal dental services, may also diminish the need for referral to treatment under general anaesthesia (GA). A literature search of PubMed for studies on the need for dentoalveolar surgery in children and adolescents identified 47 studies.[1] None of these studies gave any population-based information on how frequent dentoalveolar surgery is needed in children and adolescents, and no suggestions for organization of such services could be found. Hence, it is largely unknown in a global perspective, how and where paediatric patients in need of dentoalveolar surgery are treated.

In Denmark, free comprehensive dental services for children and adolescents (from birth to 18 years of age) are provided by the municipal dental service. As this service includes dentoalveolar surgery, analysis of data on surgical treatment carried out in this organization could give valuable information on the need for this type of service in children and adolescents on a population basis.

The aim of the present study was to describe the organization of dentoalveolar surgical services for children and adolescents in a large, Danish municipal dental service, and the type and frequency of dentoalveolar surgical interventions needed.

Material and methods

The study was conducted in the Municipality of Aarhus, Denmark. In Denmark, free preventive and restorative dental

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services are offered to all children from birth to the age of 18 years. The participation rates are high (>95%), and in the municipality of Aarhus, Denmark, approximately 66,000 children and adolescents are enrolled each year (Table 1). The Municipal Dental Service, Aarhus has recently been reorganized in seven networks, each of which includes three to eight clinics. The purpose of the reorganization was to generate larger clinics with better possibilities for professional sparring and sub-specialization. The total number of dentists employed by The Municipal Dental Service, Aarhus varied between 46 and 59 full-time positions during the five-year period this study covered. A referral system has been established according to which children with need of dentoalveolar surgical interventions, which dentists did not feel competent to perform, could be referred to colleagues with higher competencies within this field (called 'internal referral' in the remaining of this paper). No general guidelines were issued on internal referral. Both before and after the establishment of the internal referral system, the decision was left to the dentist responsible for the child's dental care. One of the senior dentists was appointed as 'subspecialist' to whom the other dentists could refer. This dentist had participated in several continuing education courses in dentoalveolar oral surgery and had been following sessions at the Department of Maxillo-facial Surgery at the University Hospital of Aarhus. Later, as the number of internal referrals increased due to an increased awareness of the possibility to refer, two more dentists were assigned to this function. Some cases were referred to maxillo-facial surgeons outside the municipal dental service, due to the complexity of the treatment, or because the resources did not allow the child to be treated internally within an acceptable time period (called 'external referral' in the remaining of this paper).

Data were obtained from electronic patient records for the school-years (each school-year running from 1st August to 31st June the following year): 2010/2011, 2011/2012, 2012/2013, 2013/2014 and 2014/2015 (TM-Care®; Theilgaard-Mortensen, Inc., Niels Hemmingsens Gade 9, DK-1153 Copenhagen). The following data were extracted from the electronic data-base: name, cpr-number (a unique 10-digit number, identifying all persons in Denmark), the child's own clinic, date for referral (if not treated in its own clinic), referring dentist, cause of referral, date of treatment, clinic where the child was treated, treating dentist and the kind of treatment performed.

Data were extracted as Excel files and transferred for analysis in SPSS Version 13.0 for Windows (SPSS Inc, Chicago, IL). Differences between means were assessed using 95% confidence intervals (CI). The study was approved by the Danish Data Protection Agency (record # 2014-41-3244).

Table 1. Number of children and adolescents enrolled in the dental service according to school-year.

School-year	Number of children
2010/2011	66,166
2011/2012	66,163
2012/2013	66,411
2013/2014	66,514
2014/2015	66,548
Total	331,801

Results

A total of 1812 children and adolescents needed dentoalveolar surgical interventions during the five school-years covered by this study, corresponding to 5.5 children per 1000 (1812 * 1000/331,801).

The majority of the children (1341 or 74.0%) were treated after internal referral, and one single dentist (ABG) treated 994 (74.1%) of these patients. A total of 341 children were treated by the dentist in the child's own clinic. Only 21.7% of the dentists treating the children in the child's own clinic treated more than 10 children during the five school-years this study covered. During the 5-year study period, 115 (6.3%) had to be referred to surgical care outside the organization. A total of 2854 dentoalveolar surgical interventions were made.

A slight overweight of girls over boys was seen (932 vs. 861) (Table 2). Mean age of the patients at the time of treatment was 14.2 yrs (SD = 3.9), and more than half of the patients (54.0%) were 12–16 years of age. Mean age at the time of the treatment was 13.6 yrs (SD = 3.5) for girls and 14.6 yrs (SD = 4.1) for boys. This difference was statistically significant ($p < .05$; 95% CI for the difference: 0.4–1.1 yrs).

The distribution of those children treated after internal referral according to a waiting time (i.e. the time elapsed from referral until treatment was received) showed that 54.0% experienced waiting times of ≤8 weeks, and 90.4% experienced waiting times of ≤16 weeks (Figure 1). The mean waiting time was 9.2 weeks (SD = 6.9). Half (52.0%) of the children received treatment before they had waited eight weeks.

Of the 1812 children with need of dentoalveolar surgery, 40 (2.2%) children were treated in GA. None of these children had more than one session in GA. Mean age for children treated in GA was slightly lower (164.3 months) than for children treated without GA (171.4 months), but this difference was not statistically significant ($p > .05$, 95% CI for the difference: [−18.2 to 3.9]). Infiltration and block analgesia were used in 86.7% and 51.5% of the surgical interventions, respectively. N_2O/O_2 (Linde Gas Therapeutics, AGA, Kolding,

Table 2. Distribution of 1793 children and adolescents in the Municipal Dental Service of Aarhus, Denmark 2010–2015 needing dentoalveolar surgery, according to gender and age (data missing from 19 patients).

Age in years	Male	Female	Total
<7	16 (1.9%)	12 (1.3%)	28 (1.6%)
7	14 (1.6%)	18 (1.9%)	32 (1.8%)
8	23 (2.7%)	26 (2.8%)	49 (2.7%)
9	26 (3.0%)	33 (3.5%)	59 (3.3%)
10	29 (3.4%)	58 (6.2%)	87 (4.9%)
11	58 (6.7%)	113 (12.1%)	172 (9.5%)
12	73 (8.5%)	136 (14.6%)	208 (11.7%)
13	106 (12.3%)	131 (14.1%)	237 (13.2%)
14	98 (11.4%)	100 (10.7%)	198 (11.0%)
15	99 (11.5%)	80 (8.6%)	179 (10.0%)
16	79 (9.2%)	66 (7.1%)	145 (8.1%)
17	84 (9.8%)	58 (6.2%)	142 (7.9%)
>17	156 (18.1%)	101 (10.8%)	257 (14.3%)
Total	861 (100%)	932 (100%)	1793 (100%)

Denmark) inhalation was used for sedation in 46.7% of the surgical interventions, while triazolobenzodiazepine (Halcion®, Pfizer Italia S.r.l, Via del Commercio, 63046, Località Marino del Toronto, Ascoli Piceno (AP), Italy) were used in only 5.3% of the cases.

Of the total 2854 dentoalveolar surgical interventions carried out, denudations were the most frequent, accounting for 40.3% of all interventions, followed by removal of third molars (18.0%), extraction of permanent teeth (5.4%), treatment of oral mucous lesions (5.3%) and amotio of premolars and incisors (4.6%) (Figure 2). A total of 22 odontomas and 100 supernumerary teeth were removed. The remaining interventions covered a wide range of different treatment needs, all individually representing 3% or less of the interventions.

A separate analysis of the denudations showed that upper canines were the most frequent (61.4%), followed by upper and lower molars (11.1% and 10.6%, respectively) (Table 3).

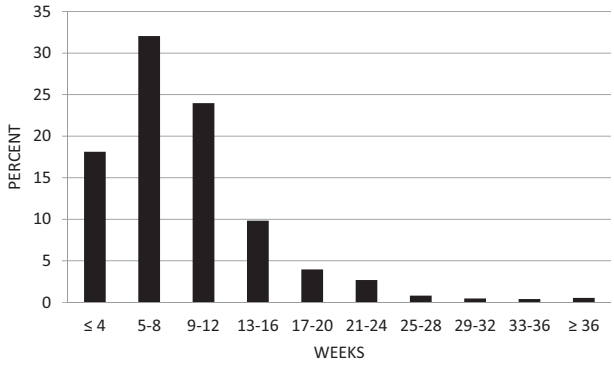

Figure 1. Distribution of 1341 children and adolescent referred internally according to waiting time.

Preparation for subsequent orthodontic treatment, in terms of application of orthodontic chains or composite built-up of the permanent canine to secure the eruption path, were made in 81.2% of the denudations of upper canines and in 37.8% and 30.3% of the denudations of upper and lower permanent molars, respectively.

More than 80% of almost all the types of dentoalveolar surgical interventions were referred internally (Figure 3). Exceptions were (in decreasing order) hemisection of primary teeth, management of oral mucosal lesions, frenulectomia and extraction of primary teeth.

Finally, due to the relatively small number of dentoalveolar surgical intervention needed in the children treated under GA (62 interventions), possible differences in treatment patterns between children treated under GA and children treated without GA is difficult to determine. However, removal of third permanent molars was performed more frequently in children treated without GA than in children treated under GA (18.3% vs. 11.3% of the interventions). The opposite pattern was found for extraction of permanent teeth, removal of supernumerary permanent teeth or odontomas which were performed more frequently in children

Table 3. Distribution of 1149 denudations according to jaw and tooth type.

Upper jaw	Incisors	63 (5.5%)
	Canines	706 (61.4%)
	Premolars	23 (2.0%)
	Molars	127 (11.1%)
Lower jaw	Incisors	2 (0.2%)
	Canines	54 (4.7%)
	Premolars	52 (4.5%)
	Molars	122 (10.6%)

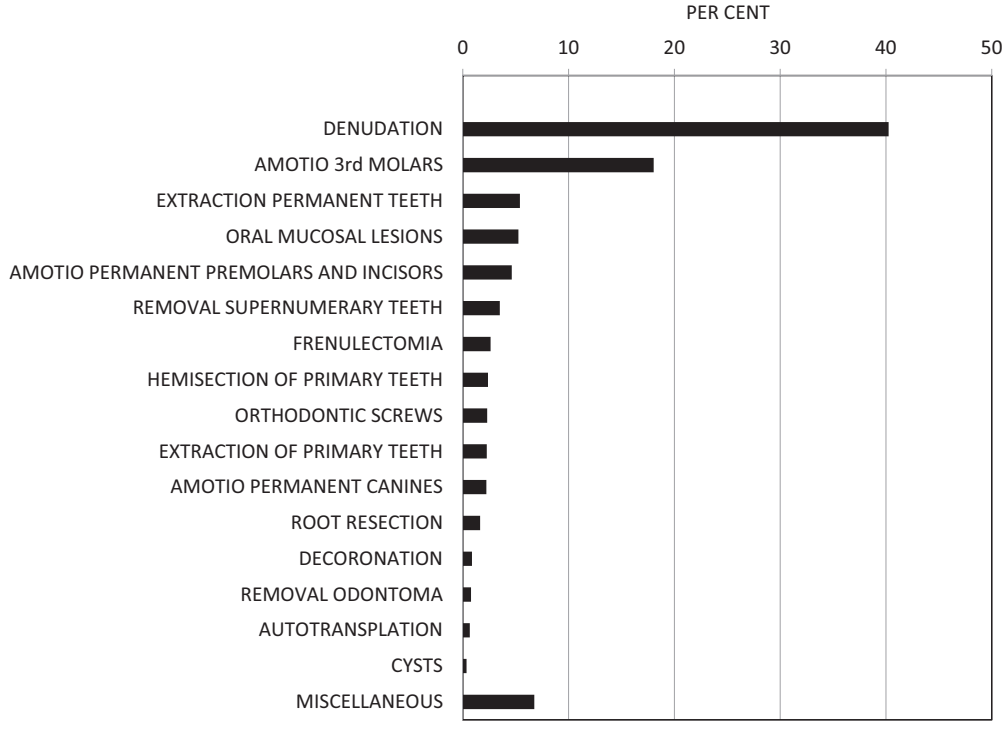

Figure 2. Percentage distribution of 2670 dentoalveolar surgical interventions according to type of intervention.

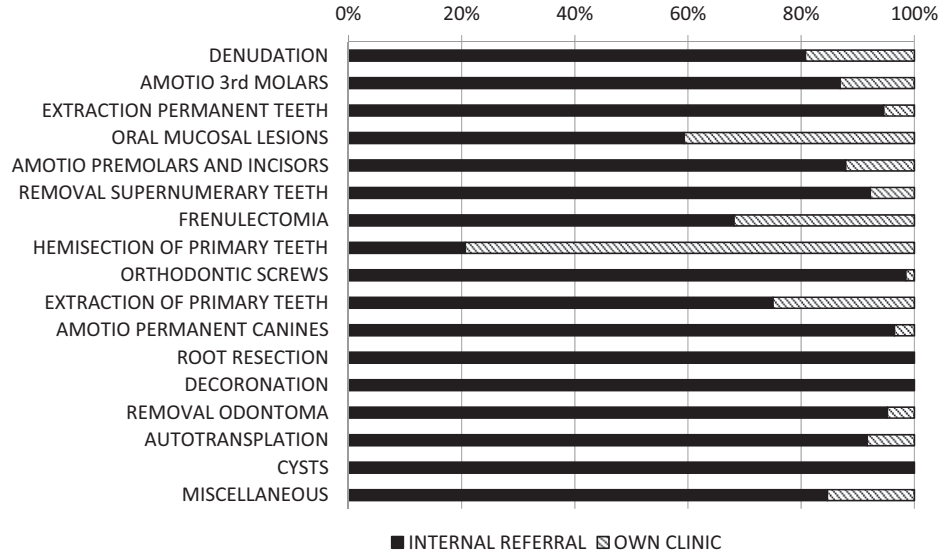

Figure 3. Distribution of 2464 dentoalveolar surgical interventions according to whether they were performed in the child's own clinic or after internal referral.

treated under GA than in children treated without GA (17.4% vs. 9.5% of the interventions).

Discussion

Whereas many reports in the literature within the field of paediatric oral and maxillofacial surgery are clinical in their approach and focus on the assessment of the patients, the individual treatment procedures, and outcomes of the interventions, our study has its main focuses on the need of dentoalveolar surgery and the organization of dentoalveolar surgery in paediatric dentistry.

The present study is population-based and based on routinely collected treatment data from a typical, large municipal dental service in Denmark. As the attendance rate is high, the data can be considered representative for the Danish population.

The need for dentoalveolar surgery is relatively low in children and adolescents and considering the relative complexity of some of the interventions, the individual dentist will not be able to attain a volume of these interventions which allows for the development of competency in this field. The finding that the interventions carried out covers a large range of procedures emphasizes this problem. The solution to this, chosen in The Municipality of Aarhus has resulted in an efficient system, where the majority of dentoalveolar surgical cases are referred internally to a few colleagues who have developed competency in this area. The study also shows that most patients could be treated in this organization, and only relatively few patients were referred externally. Furthermore, the waiting time for patients treated after internal referral was two months or less for half of the patients, which must be considered acceptable considering the non-acute nature of most of the conditions. We have no data on the need for emergency care, but it is generally perceived as being very low in this population. Trauma cases are usually treated in the child's own clinic – extensive and complex cases are referred to Aarhus University Hospital, Denmark.

The age of the children varied considerably, but the majority was between 12 and 16 years, which is the age when orthodontic treatment as an integrated part of the municipal dental service is usually performed. This explains why denudations were the most common dentoalveolar surgical procedure. The earlier eruption of the permanent teeth in girls is reflected in the somewhat earlier peak in dentoalveolar surgical interventions in girls. Upper permanent canines were the most frequently denudated, and of these more than 80% had an orthodontic chain for traction applied, or built-up of the crown to secure the correct eruption path. This reflects the common eruption problems of these teeth, often combined with loss of space of the dental arch. Denudation of permanent molars was less frequently combined with attachment of orthodontic chains or built-up of the crown. A full assessment of the efficacy of denudations is not possible based on this study, but would require a properly conducted randomized clinical trial.

Removal of third molars is the second most frequently performed procedure. Removal of third molars has been a subject of heated debates, and the prophylactic removal of asymptomatic third molars has been abandoned [9]. In the present case, removal of third molars was done only on indications or after orthodontic referral as part of an orthodontic treatment plan.

While amotio of third molars, premolars, incisors, supernumerary teeth and odontomas are complicated procedures, which may require higher competencies, it could be argued that all dentists should be able to handle extraction of primary and permanent teeth. However, as tooth extraction has become a rare procedure due to the improved dental health of Danish children and adolescents, these procedures have become more challenging to the dentists. Ankylosis of primary teeth may further influence the dentists to refer. Another explanation could be, at some extractions were performed in conjunction with other surgical procedures

(e.g. denudation of unerupted permanent teeth). Further research is needed in order to explain this finding which may also need to be addressed organizationally.

This population-based study has shown that the need for dentoalveolar surgery in children and adolescents is relatively low, and the organization developed in the municipality of Aarhus makes it possible to centralize this type of service to secure at larger volume of interventions on a few operators. This study also shows that dentoalveolar surgery in children and adolescents covers a large range of different interventions, including both hard and soft tissues. In addition, it is shown that in a population as large as the one studied in the present study, the absolute number of relatively rare conditions (e.g. odontomas and supernumerary teeth) is large enough to allow for systematic studies of location, type and prognosis of these conditions. The effect of denudations also seems to demand systematic studies, as clinical, but unsystematic, observations seem to indicate that this intervention promotes eruption of canines, but not of molars.

In the present study, 40 children had to be treated in GA corresponding to eight patients per year. The need for GA has been estimated to be 0.7–2.2 per 1000 children per year for a general population comparable to the population in this study [10]. With an average population of children and adolescents of 66.360, the number of children and adolescents per year with need for GA in this municipality would be expected to be between 46 and 146. Of these only eight were children and adolescents with need for dentoalveolar surgery. This may reflect the strategy pursued in this study of making extensive use of behaviour management techniques, sedation and local pain control.

Note

1. The search was performed on 2nd June 2017. A complete account for the search strategy and the 47 studies identified can be obtained from the corresponding author.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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