Orthodontics in 12-year-olds

Evaluation of treatment in the primary and mixed dentition in general dental practice

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Ortodontisk behandling i primära bettet och växelbettet bör inriktas mot funktionella avvikelser som kan störa en optimal bettutveckling, såsom tvångsbett, och mot avvikande eruption av tänder. Tidig planering av aplasifall kan minska behov av senare komplicerade insatser. Tidig reduktion av stora överbett som traumaprevention tycks också vara välmotiverad. Behandling med övervägande estetisk motivation bör inte utföras förrän patienten är mogen att själv ta beslut om åtgärd, i de flesta fall efter växelbettsperioden.

Samtliga 12-åringar som tillhörde en folktandvårdskliniks upptagningsområde kallades för klinisk undersökning och intervju. I flertalet fall överensstämde klinikens behandlingsprioriteringar med de ovan nämnda. Dock hade endast omkring 1/3 av stora överbett reducerats genom behandling. Nästan lika många hade inte noterats eller åtgärdats. Traumafrekvensen var nästan 3 gånger större redan vid överbett omkring 4,5 mm jämfört med mindre överbett. Resultaten understryker behovet av effektiv reduktion av överbett redan i tidigt växelbett.

Orthodontic treatment in young children is usually interceptive or prophylactic. The phrase "interceptive orthodontic treatment" is open to interpretation, and the borderline between prophylactic and definitive treatment is not sharply drawn. In this study the phrase "interceptive orthodontic treatment" implies treatment provided when an individual demonstrates a clear deviation from optimal occlusal development – whether due to environmental or other causes – to encourage a patient to resume optimal occlusal development. The treatment has limited aims and is of short duration. Interceptive treatment usually involves early diagnosis. The treatment is usually, but not always, uncomplicated.

There are occasions when early definitive treatment is appropriate to avoid damage to the dentition or to avoid more complicated and expensive treatment when the patient is older. Relevant examples are the early correction of increased overjets to avoid traumatic injuries to anterior teeth [1] and the occlusal management of patients with hypodontia.

Definitive treatment for dental crowding on aesthetic grounds should almost always be postponed until the individuals are mature enough to make their own decisions concerning treatment [2, 3]. The results of classical serial extractions have not lived up to expectations when compared with the results of treatment carried out in older patients [4].

According to the orthodontic literature, functional anterior and lateral crossbites, large overjets, and abnormal dental eruption patterns may all benefit from early treatment.

Functional lateral crossbites, also known as lateral forced bites, have been associated with the risk of asymmetric craniofacial development with

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Key words

Malocclusion; orthodontics; interceptive; methods.

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Figure 1a,b. A 12-year-old boy with an 8-mm overjet and incompetent lip posture. He was treated with a removable appliance in the maxilla to retract the maxillary incisors 2–3 years ago. Composite restorations on 11 and 21 are due to crown fractures.

various degrees of severity. Increased electrical activity in the temporal muscle on the crossbite side and a displacement towards that side have been recorded [5–7]. Lateral crossbites may also present an obstacle to the increasing intercanine width, which would be expected as the maxillary canines complete eruption. Consequently, space conditions within the occlusion become unfavourable. At present, it is not easy to predict how important the effects of functional crossbites are, but on the other hand, limited treatment to correct functional crossbites usually seems to be justifiable.

Functional anterior crossbites, also known as functional anterior displacements, may prevent proclination of maxillary incisors taking place during eruption. This may lead to a reduction in the forwards development of the anterior segment of the maxilla. Proclination of the mandibular incisor segments may follow as a consequence, but this has yet to be clearly documented. Early orthodontic treatment using reversed headgear may have an orthopaedic effect on the maxilla in addition to encouraging the correction of the functional displacement [8, 9]. Creation of a normal intermaxillary compensation may encourage a better occlusal development. It may be difficult to predict the results of treatment for the individual patient, but treatment of functional anterior crossbite is easy to perform and may reduce the need for more complex treatment in a considerable number of patients [10]. In addition, there may be less risk of the development of temporomandibular disorders, TMD, in later years [11].

Patients with large overjets have an increased risk of traumatic injuries to the maxillary incisor teeth [1]. Most of these accidents occur before 10–11 years of age and the prevalence of injuries to permanent teeth has been reported to be about 20% [1, 12]. Almost half of the injured permanent teeth required treatment according to Forsberg and Tedestam [12]. The teeth most often damaged are 11 and 21 [1]. Thus, early orthodontic correction of large overjets is a valuable preventive initiative. Two other benefits of the early reduction of large overjet are known. The establishment of normal lip posture may influence occlusal development in a positive way and improve the vertical tooth support. Increased overjet has been associated with increased plaque accumulation and gingival inflammation [13]. Although a poor periodontal condition is not, on its own, a major indication for treatment, the improvement in gingival conditions remains an important additional benefit of overjet reduction. Orthodontic treatment in the early mixed dentition can usually be achieved using simple appliances such as an activator or headgear.

The normal tooth eruption pattern may be significantly affected by supernumerary and congenitally missing teeth and, in addition, by the ectopic eruption of permanent teeth such as the maxillary canines. Early diagnosis and treatment planning for certain patients with congenitally missing maxillary lateral incisors to encourage space closure may reduce the need for complicated rehabilitation. This simple approach to treatment is usually well accepted by patients. The ectopic eruption of maxillary canines should be detected at about 10 years of age. Canines can be encouraged to move towards a more normal path of eruption by providing space and removing the primary canines. Hence, early intervention may save resources and reduce the need for advanced orthodontic treatment [14].

A few studies have evaluated the quality of mixed dentition treatment in general dental practice. Bäckström [15] and Follin et al. [16] reported on prevalent failures with activator treatment in general practice. In addition, Follin and Milleding [17] reported many complications during arch expansion with the quadhelix appliance.

The *aim* of this study was to evaluate the effectiveness of diagnosis and treatment during the primary and mixed dentition period in a general practice. In a later report, the functional status, the future treatment needs, and the desire for treatment in 12-year-old children will be evaluated. The present study analysed the following questions:

- Had important malocclusions been diagnosed and treated? For the purposes of this study, these were:
  - Large overjet
  - Functional lateral crossbite
  - Functional anterior crossbite
  - Ectopic eruption of maxillary canines
  - Congenitally missing teeth
  - Hypodontia and abnormalities of normal eruption
- Was the technical quality of treatment acceptable?
- To what extent had the aims of treatment been realised?
- To what extent had other malocclusions received treatment?

Material and methods

Subjects

All 12-year-old children listed at the Åby Public Dental Service Clinic, Mölndal, Sweden, were invited for dental examination; 283 children were asked to participate. Six had moved from the area or were on the lists of other clinics. Fourteen did not wish to participate or repeatedly failed to attend. The study group thus consisted of 263 individuals, which is 93% of the 12-year-old children listed in the clinic at the time of examination. The sex distribution was even, with 130 boys and 133 girls.

All individuals were subjected to the following examinations: clinical examination of occlusal function and morphology, intra-oral clinical photos from the frontal and lateral aspects, and extra-oral three-quarter profile views with the lips at rest. The children were interviewed and asked about previous experience of treatment, previous orthodontic treatment, and their feelings about whether orthodontic treatment would be of benefit to them. Patient records were analysed.

Figure 2. Tooth 23 was diagnosed as erupting ectopically in a mesially inclined position. Tooth 63 was recently extracted to encourage normal canine eruption.

Figure 3. One of the (few) patients already referred for specialist treatment on psychosocial indications.

Clinical examinations

Angle´s classification of the sagittal occlusion was recorded with the lip posture at rest; overjet, overbite, and any gingival contact by the mandibular incisors were also recorded. Lateral crossbites involving at least two teeth and anterior crossbites involving at least three teeth, ectopically erupting teeth, congenitally missing teeth, and supernumerary teeth were recorded. The presence of ectopic eruption or hypodontia was confirmed by available X-rays. The presence of frontal irregularities and an overall evaluation of the aesthetic impression will be presented and discussed in a separate paper.

Lateral and anterior functional displacement was recorded from the retruded contact position, RP. The result of the complete functional exa-

mination will also be presented and discussed in a later paper.

Interviews

A structured interview was performed by one of the examiners (BM). The interview included questions on the children´s worries about visits to the dentist, their previous dental experience, their thoughts about the appearance of their teeth, their wishes for improvements in their dental status (stated in ranking order, including shape, colour, oral function, and finally, general dental health), their wishes for changes in the position of their teeth, their previous experience of orthodontic treatment, and whether they suffered from headache or experienced temporomandibular joint (TMJ) sounds, and/or locking/luxation of the TMJ.

Dental records

The following items were recorded: time and reason for consulting a specialist; orthodontic treatment including the reason for treatment, the type of appliance used, the number of check-ups, appliance activation and complications during treatment, co-operation, and the treatment result according to the clinic records; and traumatic dental injuries including the nature of the injury, when it occurred, and what was done afterwards. Some details of general dental treatment were also noted: poor oral hygiene, high caries experience, extractions, and endodontic treatment. Information on the duration of individual courses of dental treatment was extracted from the clinic´s computer records.

Associations

The possible increase in the risk of traumatic dental injuries was calculated as relative risk (*ad modum* Tayler) with a 95% confidence interval. Figures above 1 imply an increased risk. The chi-squared test was used to establish significant differences in the influence of an overjet on the prevalence of traumatic dental injuries.

Table 1. Prevalence (n; %) of diagnosed and treated overjet in 263 12-year-old children. Figures are presented in overjets ≥6.0 or ≥4.5 mm

Present overjet (mm)	Diagnosed subjects (n)	(%)	Treated subjects (n)	(%)
≥6.0	34	12.9	10	3.8
<6.0	229	87.1	9	3.4
≥4.5	50	19.0	16	6.1
<4.5	213	81.0	3	1.1
Total	263	100.0	19	7.2

Table 2. Prevalence (n; %) of traumatic injuries to permanent incisor teeth in 263 12-year-old children with and without large overjets ≥6.0 or ≥4.5 mm.

Overjet (mm)	Injuries (n)	(%)	No injuries (n)	(%)	Total (n)	(%)
≥6.0*	10	29.0	24	71.0	34	100
<6.0*	32	14.0	197	86.0	229	100
≥4.5**	16	32.0	34	68.0	50	100
<4.5**	26	12.0	187	88.0	213	100

*p=0.021; RR=2.1 (risk for injuries 110%); 95% confidence interval: (1.14–3.88)
**p=0.0006; RR=2.62 (risk for injuries 162%); 95% confidence interval: (1.53–4.50).

Results

Sagittal occlusion

Of the 263 children, 202 (77%) had an Angle´s class I, 60 (23%) an Angle´s class II, and only one child an Angle´s class III occlusion.

Thirty-four children (13%) had an overjet of ≥6 mm, 25 of these children also had incompetent lips. Ten (29%) of these 34 children with recorded large overjets ≥6.0 mm, had received treatment to reduce their overjets (according to the clinic records) (Table 1). Another nine children had received treatment and achieved an overjet reduction to <6 mm; six of these children still had an overjet of ≥4.5 mm.

Another 12 of the 34 overjet children (35%) had seen an orthodontist, but no treatment had yet begun. The remaining 12 subjects with increased overjet (35%) had not received treatment or consultation according to the clinic records and the results of the interview with the children.

The prevalence of traumatic injuries affecting both deciduous and permanent maxillary incisors was analysed with respect to overjet. Forty-three children were initially and/or currently defined as having large overjets. Twenty-two (51%) of these children compared to 67 (31%) of the 220 who had no previous or present significant overjet had suffered incisor trauma. Ten (29%) of the 34 children with an overjet ≥6.0 mm at the time of examination had a history of trauma affecting permanent incisors compared to 32 (14%) of the 229 who had no significant overjet.

When large overjet was defined as an overjet ≥4.5 mm, 50 children were defined as having large overjets; 16 (32%) of these had suffered trauma affecting permanent incisors. Of the 213 children excluded from the definition of increased overjet (≥4.5 mm), 26 (12%) still had a history of trauma affecting permanent incisors. Associations between traumatic injuries and overjet are presented in Table 2.

Functional lateral crossbite

Only one patient had a forced lateral crossbite. Nine subjects had a lateral crossbite without any functional deviation. Twenty-nine children had received treatment for lateral crossbites; 14 of these had received treatment to eliminate the functional shift, but there was no information about possible functional deviation for the other 15 children.

Functional anterior crossbite

No children had functional anterior crossbite. According to the clinic records, two children received treatment. Minor functional displacement from RP to IP was found in seven patients.

Ectopic eruption of canines

Eighteen children had had a diagnosis of, and sometimes treatment for, ectopic canine eruption. Three children had had deciduous canines extracted. Nine children had one or two undiagnosed maxillary canines at the time of the survey. No reference had been made to their unerupted canines nor had any X-rays been taken during the previous 2 years.

Congenitally missing teeth

Two children had multiple congenitally missing teeth; both had been referred to a specialist clinic. Two children with missing maxillary lateral incisors had been identified. One with a congenitally missing mandibular incisor appeared not to have been diagnosed. Eleven children were found to have missing second premolars, all in all 9 in the maxilla and 15 in the mandible. Three children had only one second premolar missing; five had two second premolars missing. Three other children had at least three second premolars missing. The congenitally missing teeth had been identified in the clinic records of 9 of the 11 children. The remaining two children had received orthodontic treatment (with either an activator or a quadhelix appliance), but hypodontia had not been diagnosed and the treatment had not been planned to address this problem.

Extractions

Fourteen children had undergone extraction of permanent teeth. In one child this was due to endodontic reasons; in two children it was due to impaction or ectopic eruption. In five children supernumerary teeth had been removed (two being a mesiodens). In two children the extractions were compensatory due to congenitally missing teeth. In six children teeth had been extracted to relieve crowding.

A few patients had combinations of reasons for extraction, and these usually involved crowding and supernumerary or congenitally missing teeth. Extractions of primary teeth had been carried out in four children who had congenitally missing or supernumerary teeth.

Early appliance treatment

Activators, extra-oral traction with headgear, removable appliances, and quadhelices had been prescribed for 13 children each. Three children had been treated with dental cribs, four with lingual arches, and two with sectional arches. Twelve children had been treated with more than one appliance. The indications for treatment included crowding (six children, four with extractions and appliances), spacing (four children), deep bite (two children), and sucking habits (four children). Combinations such as increased overjet and deep bite had often been encountered.

Of the 49 children who had answered questions about difficulties with orthodontic appliances, 25 (51%) reported no significant problems when wearing the appliances, 14 (29%) had experienced moderately severe problems, and 10 (20%) were in no doubt that they had met difficulties in managing the appliance. A clear evaluation of the results of treatment was often absent in the patient´s records.

Discussion

Most orthodontic treatment carried out in the 12-year-old children in this study was provided to correct forced occlusion, to reduce large overjet (associated with an increased risk of traumatic injuries), and to deal with various problems of tooth eruption; all these therapies are well motivated for early treatment as outlined in the introduction. The proportion of subjects who had been diagnosed and treated successfully varied considerably between these different malocclusions.

In this study, large overjets accounted for almost 13% of the children. This is very similar to the prevalence of increased overjet found in 10-year-old children in Göteborg 25 years earlier

when the resources were more modest [18], and it also agrees with early data from a number of other Scandinavian studies [19]. Almost one third of the children with increased overjet did not have the diagnosis in their dental records. Another third had seen an orthodontist but had not received treatment promptly. The final third had received treatment and their overjets had been reduced to less than 6.0 mm but the overjet remained greater than 4.5 mm in several children.

Orthodontic intervention and successful treatment for this vulnerable group of patients has been modest, which is in agreement with conclusions drawn by Bäckström [15] and Follin et al. [16]. Our study did not identify a single principal cause but some possible reasons are failure in clinical observation and diagnosis, e.g. failure to identify mouth breathing, or failure in clinical technique. The patients themselves may not have been well motivated. Indeed, most of the treatment regimens employed were demanding and required good co-operation if they were to succeed. Almost one-half of the vulnerable children had not received diagnosis or treatment, which implies that many dentists do not feel that early reduction of overjet is a priority.

In 1979 Järvinen [1] reported the association of large overjet and traumatic injuries to the maxillary incisors and our figures confirm his observation. The prevalence of injury to permanent maxillary incisors in children with large overjet was twice that of their peers; even an overjet of 4.5 mm carries an increased risk of dental injury. Our figures are extracted from the clinic records, and it is reasonable to assume that most severe injuries had been reported. Nevertheless, there may be some underreporting of the true situation. Even with this proviso our figures underline once again the benefit of early diagnosis and treatment.

Diagnosis and treatment of lateral and anterior functional crossbite had been carried out more effectively than when the issue was reviewed by Follin and Milleding [17]. Almost all of these malocclusions had been successfully identified and treated. The majority of patients were treated with appliances which did not require much co-operation, but even here, some difficulties in management had to be overcome. The distinction between functional and non-functional lateral crossbites was not always clear in the patient´s records.

The majority of congenitally missing and supernumerary teeth had been identified and dealt with promptly. Only one patient with a missing mandibular incisor had been overlooked. Two children with absent second premolars might have been overlooked: clinic records were not clear. All patients with ectopically erupting molars had been treated. Identification of ectopic canine eruption ought to have been made by 12 years [14], but there had been a failure of diagnosis for several patients.

Most of the extractions of permanent teeth had been undertaken to deal with the problems of eruption or of supernumerary or congenitally missing teeth. Only six patients had had permanent teeth extracted to relieve crowding. This agrees with a circumspect attitude to the early treatment of malocclusions where the indication for treatment was primarily aesthetic and psychosocial rather than functional [2, 3].

The appliances used most frequently were the same as those previously reported by Swedish orthodontists [20]. Specifically, they were activators, headgear and removable appliances, quadhelices followed by other types of lingual arches, and finally, a small number of sectional arches. Mohlin and Persson [20] also found that dental students and young general practitioners had not been well trained in the techniques of orthodontic treatment. Over one-third of the orthodontists approached for their comments agreed that the orthodontic skills of general practitioners were inadequate. The modest results of treatment for increased overjet identified in our study underline again the need for improvements in undergraduate training and continuing professional education for general practitioners.

The demand for treatment in the 12-year-olds and estimates of the future need for orthodontic treatment on functional and psychosocial grounds will be analysed in a separate paper.

Summary

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Based on the results of the present and previous studies we suggest that the orthodontic treatment priorities during the primary and mixed dentition periods should be:

- The elimination of anterior and lateral forced bites which interfere with normal occlusal and craniofacial development.
- The problems associated with the eruption of teeth.
- The early management of patients who have congenitally missing teeth.

- The reduction of large overjets to reduce the risk of traumatic injuries to the permanent incisors.

All 12-year-old children registered at a general dental practice were called for clinical examination and interview. Only one patient was found to have an untreated functional crossbite. Most patients with problems of eruption and congenitally missing teeth had been identified. Only about one third of the patients with a large overjet had received successful interceptive treatment and as many had not been identified. For patients with an overjet of 4.5 mm and above, the prevalence of traumatic injuries was increased almost 3 times.

This underlines the need for effective reduction of large overjets in the early mixed dentition.

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