Original Article

Malocclusion Traits and Orthodontic Treatment Needs in Prematurely Born Children

Liselotte Paulsson[a]; Björn Söderfeldt[b]; Lars Bondemark[c]

ABSTRACT

Objective: To evaluate if prematurely born children have higher prevalence of malocclusion traits and greater orthodontic treatment need than matched full-term born controls.

Materials and Methods: Seventy-three preterm children were selected from the Medical Birth Register and divided into two subgroups according to their gestational age. One group consisted of 37 very preterm children (VPT), born in gestational week 29–32, and the other of 36 extremely preterm children (EPT), born before the 29th gestational week. The subjects were compared with a control group of 41 full-term children, who were matched for sex, age, and nationality. Data from clinical examinations, study casts, and panoramic radiographs were used to determine malocclusion traits. The dental health component of the index of orthodontic treatment need (IOTN) was used to rank the treatment need.

Results: Two or more malocclusion traits occurred significantly more often among EPT (83.3%) and VPT children (73.0%), compared with the full-term children (51.2%). Significantly higher prevalence of deep bites and was found in EPT and VPT groups compared with the full-term control group. Deep bite was the most common malocclusion trait in the EPT and VPT group. Higher orthodontic treatment need was found for the preterm children but no differences in prevalence of malocclusion traits and treatment need were found between VPT and EPT children.

Conclusion: The clinician should be aware of the potential for a higher number of malocclusion traits and greater orthodontic treatment need in prematurely born children compared with full-term children.

KEY WORDS: Premature birth; Malocclusion; Orthodontic treatment need

INTRODUCTION

As defined by the World Health Organization, a premature birth occurs prior to 37 weeks of gestation or below 2500 g birth weight. The great improvement in neonatal health and intensive care in the last 20 years has led to increasing survival of very preterm (VPT) infants born between 29 and 32 weeks of gestation and extremely preterm (EPT) infants born before the 29th week of gestation.[1–3] The preterm infants are poorly prepared for the extrauterine life and may require many weeks of intensive neonatal care.[4]

Many studies have indicated that in early childhood, the preterm children show significant delay in many areas of physical and psychological development.[1,5,6] The preterm children, especially EPT children, were shorter, had lower weight and had a smaller head circumference than full-term controls.[1] Also, less muscle mass has been reported.[7] Among behavioral symptoms, the preterm children showed an increased rate of hyperactivity, difficulty concentrating and performed below the average grade level at school.[1]

Oral defects such as palatal grooving, high-arched palate, dental crossbite, and palatal asymmetry have been reported with higher frequencies compared with full-term controls. It has been highlighted that pressure from the orotracheal or nasotracheal tube during neonatal care might account for the defects.[8] Thus, the presence of the tube on the palate can conceivably inhibit a normal growth process, and it has been dis-

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cussed if altered morphology of the alveolar ridge and palate can be eliminated by compensating remodeling and growth.[9]

It has also been pointed out that premature birth and the consequent exceptional adaptation from intra- to extra-uterine life may influence the dental occlusal development. In a systematic review[10] it was concluded that scientific evidence existed for altered palatal morphology in the short term among premature children, and oral intubation was a contributing factor to the alterations. However, because of contradictory results the scientific evidence was too weak to answer the questions whether premature birth in the long term causes permanent alteration of palatal morphology or alteration of dental occlusion.[10] Thus, it is clear that the literature gives no clear answers whether children born prematurely are at higher risk for malocclusion traits. Therefore, the aim of this study was to evaluate the prevalence of malocclusion traits as well as the orthodontic treatment need in 8- to 10-year-old children born very preterm or extremely preterm and to compare these findings with matched full-term born controls. The null hypothesis was that neither the prevalence of malocclusion traits or treatment need would differ between the preterm and full-term children.

MATERIALS AND METHODS

Subjects

This study was approved by the Ethics Committee of the University of Lund, Sweden. After permission from the National Epidemiologic Center of the Swedish National Board of Health and Welfare, access to the Medical Birth Register was obtained. An epidemiologist at the Department of Epidemiology, University of Lund performed the selection from the register and created a data file of all children born in gestation week 23–32 during 1992–1996 in the County of Skane, Sweden. The data file contained information about gestational age and birth weight for 340 VPT children and 150 EPT children. After a sample size calculation, it was considered sufficient to enroll at least 35 children in each group, which would yield a power of 80% to discover a difference of 25% regarding treatment need or prevalence of malocclusion traits.

The inclusion criteria to participate in the study were white children of 8–10 years, born at the University Hospitals of Lund and Malmö, and now living in the southwest part of the County of Skane. Children with syndromes or with neuromuscular disorders, ie, cerebral palsy were excluded (two VPT and seven EPT children). Written information about the study was sent to the parents, and after 1–2 weeks the parents were called by telephone and given information about the study and an opportunity to ask questions. Those who had not responded within three weeks were sent a mail reminder. After that, no further attempt was made to contact the families. Informed consent was obtained for each participant and confirmed in writing by at least one parent. In the group of EPT children, 56 fulfilled the inclusion criteria and were invited to participate. Among the 184 VPT children who fulfilled the inclusion criteria, 52 children were randomly selected and asked to participate in the study. The study population consisted finally of 36 EPT children and 37 VPT children. Nonparticipants are described in the flowchart (Figure 1).

The control group was also recruited from the Medical Birth Register. A full-term normal birth weight child who was born at the same hospital, of the same gender, nationality, living area, and nearest in birth month ($\pm$1 month) to the preterm child was selected. Furthermore, to be included the control children should have no history of oral or nasal intubation. Children with syndromes or with neuromuscular disorders were also excluded (one child). Three control participants were identified for every preterm child. If the family of the identified control patient did not respond or refused to participate, a second family and, if necessary, a third family was contacted. Our aim was to have at least one control for two preterm children. Ninety control children were consecutively asked to participate, but 5 were unreachable and 44 denied. The control group finally consisted of 41 children who fulfilled the investigation.

METHODS

Clinical Examination

The examination was performed by one experienced clinician (Dr Paulsson) at the Orthodontic Department, Faculty of Odontology, Malmö University, Malmö, Sweden during 2002–2005. The examination followed a specific protocol including registration of functional disorders such as swallowing with tongue thrust or lip pressure, and forced bite in the lateral or anterior direction. Any kind of sucking habit was registered. The height, weight, and head circumference of each child were also registered. Height was measured with a stadiometer attached to the wall to the nearest 0.5 cm. Weight was measured on a digital scale with an accuracy of 0.1 kg. Head circumference was measured in the maximum fronto-occipital plane using a nonextensible plastic-coated tape measure.

Panoramic Radiographs

The radiographs were taken using an X-ray unit, Cranex 3+ Ceph (Soredex Co, Helsinki, Finland), and

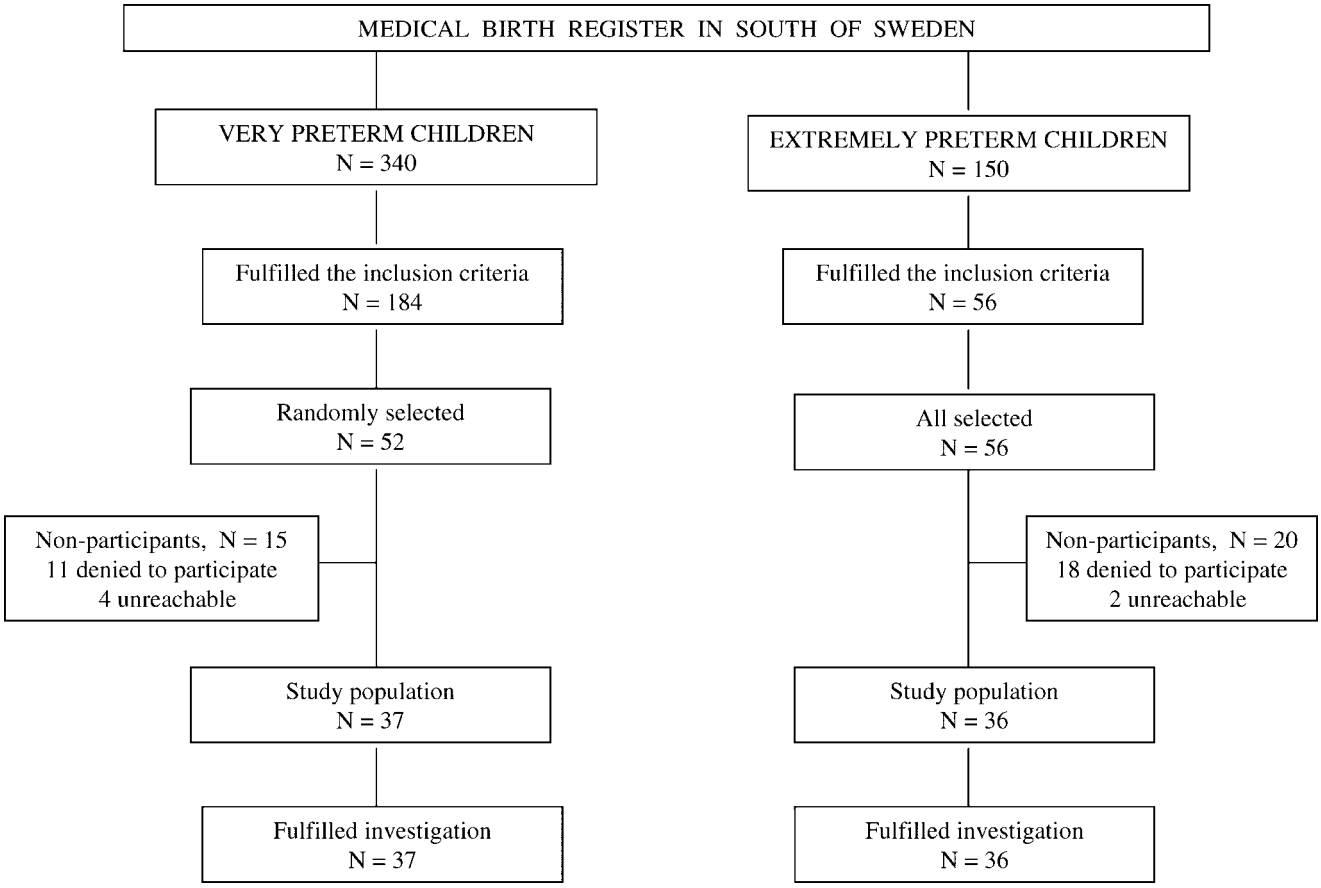

Figure 1. Flow chart showing the recruitment of preterm participants.

an intensifying screen (Kodak Lanex, Eastman Kodak Co, Rochester, NY) was used. The radiographs were table mounted, suitably masked and studied under standardized conditions using Mattsson's binoculars[11] with a 2× magnification. Radiographs from no more than 30 patients at a time were evaluated in order to minimize the risk of doubtful assessments caused by fatigue. The radiographs were screened for supernumerary teeth, agenesis, transpositions, and ectopic eruptions.

Study Casts

Alginate impressions were taken and study casts were made and trimmed after index in central occlusion. The method of Björk et al[12] was used as a guide for registration of malocclusion traits.

The sagittal occlusion was determined by the relation between the first molars:

— Angle Class I: normal, up to or equal to ½ cusp postnormal or prenormal relation
— Angle Class II: more than ½ cusp postnormal relation on at least one side
— Angle Class II subdivision 1: with proclined upper incisors
— Angle Class II subdivision 2: with retroclined central incisors
— Angle Class III: more than ½ cusp prenormal relation on at least one side

When a Class II or III molar relation was observed, the maxillary and mandibular canine relation was checked to verify the result. Attention was also given to the distal surfaces of the maxillary and mandibular second deciduous molars. If they were in the same vertical plane (flush terminal plane) a Class I relation was registered.

— Overjet was measured at the most protruding maxillary incisor.
— Anterior crossbite was registered if one or more maxillary incisors occluded lingually to the mandibular incisors.
— A deep bite was registered when more than ⅔ of the mandibular incisors were covered by the maxillary incisors.
— A negative overlap in the vertical plane was recorded as an anterior open bite. Incisors in edge-to-edge relationship were not considered to be in open bite or if there were lack of overlap due to incomplete eruption of the incisors.

Table 1. General Characteristic Data[a] of the Extremely Preterm (EPT group A), Very Preterm (VPT Group B), and Full-Term Control Children (FT Group C)

	EPT Group (A)		VPT Group (B)		FT Group (C)		
	N = 36		N = 37		N = 41		
	Girls/Boys 11/25		Girls/Boys 17/20		Girls/Boys 19/22		
	Mean	SD	Mean	SD	Mean	SD	Group Differences[b]
At birth							
Gestational age, weeks	26.8	1.0	30.8	1.1	39.8	1.0	A,B/C***; A/B***
Birth weight, g	939.5	241	1639.6	341	3581.2	470	A,B/C***; A/B***
At investigation							
Age, y	9.2	0.6	9.4	0.4	9.5	0.5	A/C*; A/B and B/C NS
Height, cm	133.6	8.1	137.1	6.1	139.4	7.0	A/C**; A/B and B/C NS
Weight, kg	29.5	6.8	32.7	7.4	36.5	7.3	A/C***; A/B and B/C NS
Head circumference, cm	52.2	1.5	52.8	1.6	53.6	1.5	A/C***; B/C*; A/B NS

[a] SD indicates statistical significance.
[b] NS indicates not significant.
* $P < .05$, ** $P < .01$, *** $P < .001$.

— Posterior crossbite or scissors bite was recorded if one or more teeth were involved.
— Crowding of ≥5 mm in each jaw was registered.
— Spacing of ≥2 mm in each jaw was registered.
— Rotation of a permanent tooth was registered when it exceeded 30°.
— Finally, the dental stages were registered.

Measurements of overjet and overbite were made with a stainless steel ruler and the spacing and crowding with a sliding caliper. All measurements were made to the nearest 0.5 mm.

Orthodontic Treatment Need

The dental health component of the index of orthodontic treatment need (IOTN) was used to rank the treatment need.[13]

Data Registration

The registrations on panoramic radiographs and study casts including treatment need were performed by two independent investigators (Drs Bondemark and Paulsson). All radiographs and study casts were coded by an independent person, and the two examiners conducting the analysis were unaware of the group to which the subject belonged.

Method Error Analysis

A total of 1792 decisions were made and concordance between the two independent observers was reached in 92.1% of the decisions. The interexaminer disagreements of 7.9% were resolved by discussions to reach consensus. Most of the disagreements dealt with determinations of dental stages and crowding.

Statistical Analysis

All data were analyzed using the SPSS 13.0 software program. For numerical data, mean and standard deviations were calculated and one-way analysis of variance (ANOVA) with Tukey's post-hoc test was used to test differences between groups. Chi-square analysis and Fishers's exact test were used to determine differences between groups regarding categorical data. Differences with probabilities of less than 5% ($P < .05$) were considered to be statistically significant.

RESULTS

General Data

No significant difference in any of the variables used in the study was found within the groups between boys and girls, and consequently, the data for girls and boys within groups were pooled and analyzed together. The mean gestational age for EPT and VPT children was 26.8 and 30.8 weeks, whereas the value of birth weight was 939.5 and 1639.6 g, respectively. The corresponding average values for the full-term control children were 39.8 weeks and 3581.2 g (Table 1). At the examination the mean age of EPT and VPT children was 9.2 and 9.4 years, and 9.5 years of the full-term controls. However, a small and significant difference in age was found between EPT and full-term control children. The EPT children were significantly shorter, had lower weight, and both the EPT children and VPT children had smaller head circumference compared with the full-term control children (Table 1). None of the children in the three groups reported any history of orthodontic treatment.

Table 2. Individual Data and Distribution of Malocclusion Traits for the Extremely Preterm (EPT Group A), Very Preterm (VPT Group B), and Full-Term Control Children (FT Group C)

	EPT Group (A)		VPT Group (B)		EPT + VPT (A+B)		FT Group (C)		
	N = 36		N = 37		N = 73		N = 41		
	n	%	n	%	n	%	n	%	Group Differences[a]
Class I	25	69.4	26	70.3	51	69.9	27	65.9	NS
Class II:1	7	19.4	6	16.2	13	17.8	11	26.8	NS
Class II:2	0	0	3	8.1	3	4.1	1	2.4	NS
Class III	4	11.1	2	5.4	6	8.2	2	4.9	NS
Deep bite	14	38.9	15	40.5	29	39.7	5	12.2	A,B/C $P = .009$
Open bite	3	8.3	1	2.7	4	5.4	1	2.4	NS
Posterior crossbite	4	11.1	5	13.5	9	12.3	5	12.2	NS
Anterior crossbite	2	5.6	4	10.8	6	8.2	1	2.4	NS
Scissors bite	0	0	1	2.7	1	1.4	0	0	NS
Crowding ≥ 5 mm	4	11.1	3	8.1	7	9.6	2	4.9	NS
Spacing ≥ 2 mm	19	52.8	16	43.2	35	47.9	12	29.3	A+B/C $P = .039$
Ectopic eruption									
Canines	3	8.3	4	10.8	7	9.6	3	7.3	NS
Molars	3	8.3	0	0	3	4.1	0	0	NS
Infraocclusion	1	2.8	4	10.8	5	6.8	2	4.9	NS
Agenesis	1	2.8	1	2.7	2	2.7	2	4.9	NS
Supernumerary teeth	1	2.8	2	5.4	3	4.1	0	0	NS
Midline discrepancy	8	22.2	6	16.2	14	19.2	9	22.0	NS
Rotated teeth ≥ 30°	8	22.2	11	29.7	19	26.0	6	14.6	NS
No malocclusion trait	1	2.8	3	8.1	4	5.5	6	14.6	NS
One malocclusion trait	5	13.9	7	18.9	12	16.4	14	34.1	NS
Malocclusion traits ≥ 2	30	83.3	27	73.0	57	78.1	21	51.2	A,B/C $P = .041$ A+B/C $P = .012$
Overjet ≥ 6 mm	10	27.8	9	24.3	19	26.0	9	22.0	NS
Overbite ≥ 5mm	14	38.9	10	27.0	24	32.9	6	14.6	A+B/C $P = .034$
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
Overjet	4.5	2.3	4.3	2.3	4.4	2.3	4.6	2.3	NS
Overbite	3.7	2.2	3.6	1.8	3.7	2.0	2.9	1.7	A+B/C $P = .04$

[a] NS indicates not significant.

Malocclusions and Clinical Findings

Two or more malocclusion traits occurred significantly more often in EPT (83.3%) and VPT children (73.0%), compared with the full-term children (51.2%; Table 2). It can be mentioned, that six preterm children had between six and eight malocclusion traits compared to none in the full-term group. Deep bite was the most common malocclusion trait in the EPT and VPT group and occurred significantly more in those groups compared with the full-term control group. In addition, the mean overbite value was significantly higher for the preterm children (Table 2). No significant difference was found for overjet (Table 2). In addition, significantly more preterm children had spacing (Table 2). Few subjects with ectopic eruption of molars were found, ie, three EPT children compared with none in the full-term control group, and this difference was not significant (Table 2).

The number of participants with ongoing sucking habit or swallowing with tongue thrust were few, and with no significant differences among the groups. Considering dental stages, no significant differences were found among the three groups.

Orthodontic Treatment Need

Table 3 shows the distribution of the treatment need according to the dental health component grades of IOTN. A higher, albeit not significant, total treatment need (grade 4 plus 5) was found in the EPT (52.8%) and VPT group (51.4%) compared with the full-term control group (36.6%). However, if the borderline need was also included a significant higher need was found for the preterm children (Table 3). For little or no need, no significant differences were found among the groups.

DISCUSSION

This study suggests a higher prevalence and severity of malocclusions in preterm compared with full-term children. In addition, the professionally assessed need of orthodontic treatment was higher among the preterm children.

Table 3. Treatment Need for Extremely Preterm (EPT Group A), Very Preterm (VPT Group B), and Full-Term Control Children (FT Group C). The Dental Health Component Grades of the Index of Orthodontic Treatment Need (IOTN) Were Used to Rank the Treatment Need

		EPT Group (A)		VPT Group (B)		EPT + VPT (A+B)		FT Group (C)		
		N = 36		N = 37		N = 73		N = 41		
IOTN	Grade	n	%	n	%	n	%	n	%	Group Differences[a]
Treatment need	5	3	8.3	5	13.5	8	11.0	3	7.3	NS
Treatment need	4	16	44.4	14	37.8	30	41.4	12	29.3	NS
Total need	4 and 5	19	52.8	19	51.4	38	52.1	15	36.6	NS
Borderline need	3	2	5.6	2	5.4	4	5.5	0	0	NS
Total need	3, 4, and 5	21	58.3	21	56.8	42	57.5	15	36.6	A+B/C $P = .032$
Little need	2	12	33.3	13	35.1	25	34.2	18	43.9	NS
None	1	3	8.3	3	8.1	6	8.2	8	19.5	NS

[a] NS indicates not significant.

Increased prevalence of deep bite, spacing, or greater orthodontic treatment need has not been reported in previous investigations of prematurely born children. Instead, other studies have reported higher frequencies of oral defects such as palatal grooving, high-arched palate, dental crossbite, prenormal occlusion, and palatal asymmetry in preterm children compared with full-term controls.[10,14] Thus, several independent studies have shown that different malocclusion traits occur more often among prematurely born children compared with full-term children, but the underlying causes or in detail which specific factors that are involved are still unclear. It has been highlighted that pressure during oral intubation might account for the defects.[8,10] Nevertheless, in this study the preterm children were not orally intubated, since nasal intubation and continuous positive airway pressure (CPAP) were routinely used during the neonatal care at the University Hospitals of Lund and Malmö.

However, it is not surprising that preterm children have higher prevalence of malocclusion traits as well as orthodontic treatment need, since it is well known that preterm children show significant alterations in many areas of physical and psychological development.[1,5,7] With regard to dental status, it is also known that malocclusion is a manifestation of morphologic variations that are related or attributed to environmental factors. Thus, the clinician should be aware of the potential to detect higher number of malocclusion traits and expect greater orthodontic treatment need in prematurely born children.

The main strengths of the present study include that all registrations were based on standardized and repeatable methodology, all measurements on study casts and radiographs were performed blinded, and reliability was controlled with high interexaminer agreement. Moreover, two strictly divided groups of preterm children, according to their gestational age and birthweight, have been compared with a well-defined and matched control group of full-term children. In order to reduce potential confounding factors like ethnic differences, only whites were included in the study, and thereby, a homogeneous sample was made.

The IOTN was selected to rank the professionally defined treatment need because this index has been used in several investigations, thereby making comparisons with other materials possible.

The age group 8–10 years was selected deliberately, since most often this age group represents subjects that are in mixed dentition, and thereby, in an appropriate time to be assessed for orthodontic treatment need and then to be selected to receive orthodontic treatment. In addition, from the birth to this age a reasonable time has passed for possible catch-up growth of the preterm child to occur. In this perspective, it can be mentioned that none of the children examined had any history of previous orthodontic treatment.

The ambition was to have one control per each preterm child, but this was not possible since many control families denied to participate because of lack of time. In addition, recruiting the control children was a slow process, which resulted in a control group that was a few months older than the EPT group. Nevertheless, the control children did not differ from the final control group considering age, gender, ethnic origin or living area. Even if the number of nonparticipants was high, the control as well as the preterm groups had enough participants according to the original performed sample size calculation. It can also be noted that other studies have reported similar problems of recruiting full-term controls.[15,16]

Based on the dental health component of IOTN the need of orthodontic treatment (grade 4 and 5) was 36.6% in the full-term control group. This is somewhat higher compared with other studies, where orthodontic need between 26% and 31% has been reported in the early or mixed dentition.[17,18] It can be speculated that one reason for the higher total treatment need in the present study might be that those full-term controls

who wanted to participate in this study also calculated that participating would imply an increased chance for orthodontic treatment, while those who denied probably had lower self-perceived treatment need. These circumstances might have yielded an overestimation (positive bias) of the prevalence of the malocclusion trait and orthodontic treatment need in the control group.

Controlling for malocclusion traits and other variables, with for example multiple regression analysis, has not been performed in this study. Such information will be presented in further studies as well as whether prematurely born children are at risk of altered crown size dimensions, altered craniofacial morphology, or temporomandibular disorders.

CONCLUSIONS

- This study suggests a higher prevalence of malocclusion traits in preterm compared with full-term children and that the professionally assessed need of orthodontic treatment was higher among the preterm children.
- No differences in prevalence of malocclusion and treatment need were found between very preterm and extremely preterm children.
- The clinician should be aware of the potential for a higher number of malocclusion traits and a greater orthodontic treatment need in prematurely born children compared with full-term children.

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