Relationship of difficult forceps delivery to dental arches and occlusion

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Abstract

This study examined the relationship between the extensive use of forceps procedures during delivery and later occlusal characteristics. The work uses data collected in National Collaborative Perinatal Research Project (USA), in which more than 60,000 pregnancies and the children's health were followed by regular medical tests and examinations. Of these, a subsample of 2,074 children participated in dental examinations, including the production of dental casts with wax bites to register occlusion. A total of 84 children, 55 boys and 29 girls, were coded as having undergone difficult or very difficult forceps deliveries. A control group was matched by age, sex, race, and site of dental examination. The results show a significant increase in asymmetric molar occlusion ($P < 0.005$) and canine relations ($P < 0.001$) in the study group. The sagittal length of the mandibular arch was increased in the difficult forceps delivery group ($P < 0.01$). In conclusion, difficult forceps procedures are associated with a later asymmetric occlusion. (Pediatr Dent 16:289–93, 1994)

Introduction

The extensive debate in the obstetric literature concerning the general effects of forceps delivery on the health and future development of infants has given rise to research projects yielding diverging results. Special attention has been paid to a possible increase in morbidity among infants who have undergone a difficult instrumental delivery,[1,2] especially to possible neurological defects.[3,4]

Detailed information may be found in the reports of the Collaborative Perinatal Project, which was undertaken to investigate the possible neurologic consequences of obstetric practices.[4–6] Niswander and Gordon[7] found a marked increase in perinatal death rates with increasing difficulty in forceps procedures. Bishop et al.,[6] on the other hand, found that mental, motor, and neurological examinations of infants at 8 months of age showed fewer abnormal scores in cases of midforceps deliveries than in those of spontaneous deliveries. The procedures' degree of difficulty were not taken into account, however.

There have been only a few reports on the possible effects of difficult instrumental deliveries on dental arch formation and occlusal development. Schoenwetter[8] studied a group of crossbite patients and found the incidence of forceps deliveries to be high, whereas Germane and Rubenstein[9] studied a group of children with a history of forceps delivery and noticed a tendency for some abnormal dental arch dimensions but considered the small sample size to diminish the significance of the findings.

This study surveyed the relationship of difficult forceps procedures during birth on occlusal development and arch dimensions of children for whom the degree of difficulty of forceps deliveries had been classified by their attending obstetrician.

Methods and materials

Sample selection

The subjects were 84 children aged 8–13 years who participated in the Collaborative Perinatal Project and had a history of difficult or very difficult forceps delivery. The occlusal variables of the difficult and very difficult forceps delivery subjects were compared with 84 patients with normal birth records.

The comparison group — selected from 2,074 children participating in the dental study of the Collaborative Perinatal Project — was matched for statistical analysis on the basis of their birth records, age, race, and location of investigation. The comparison group had undergone normal, atraumatic delivery with no recorded difficulties. Comparisons were made according to occlusal findings recorded from hard stone dental casts.

The degree of difficulty of traction when delivering the infant with forceps was assessed by the obstetrician. The terms "difficult forceps delivery" and "very difficult forceps delivery" were used for grouping purposes. The grouping is based on the same grading as that used in the work of Niswander and Gordon.[7]

The mean age of the forceps delivery group was 8.1 years, ranging from 6.8 to 10.7 years; the comparison group was 8.0 years, ranging from 6.9 to 12.5 years. One hundred fourteen of the subjects (68%) were white, 54 (32%) were black, 113 (67%) were boys, and 55 (33%) girls. The data were collected from six locations in the US: Buffalo, New York; Baltimore, Maryland; Richmond, Virginia; Portland, Oregon; Philadelphia, Pennsylvania; and Providence, Rhode Island, from 1972 to 1974.

Measurements

The occlusion and sizes of the maxilla and the mandible were recorded by examining and measuring hard

stone casts made from dental alginate impressions by a modified version of that used by Björk et al.[10] and Laine and Alvesalo.[11] The molar occlusions were divided into five subgroups by the Björk et al. method[10] (two mesial, one normal, and two distal) to an accuracy of half a cusp on both sides of the dental arch (the method is explained in detail in Fig 1). The canine occlusions were divided analogously into four subgroups (one mesial, one normal and two distal) on both sides of the dental arch (the method is explained in detail in Fig 2). The occlusal relationships were taken into account in both the permanent and primary dentition.

The widths of the maxilla and mandible were measured between the first molars. The lengths were measured from the incisors to a line perpendicular to a plane between the mesial surfaces of the first molars (Fig 3). The height of the palate was measured at the first molars using sliding calipers (Mauser-Werk, Oberndorf, GMBH) with an accuracy of 0.1 mm and a steel tube (3 mm diameter) with a sliding steel pin inside was used to perform the measurements (Fig 4). Statistical methods used were the Wilcoxon's signed rank test and chi-square analysis.

Intraexaminer error

The intraexaminer error, which is a part of the total methodological error, was tested in linear measurements using the formula:

$$s(i) = \sqrt{\frac{\Sigma d^2}{2N}}$$

where d is the difference between repeated measurements and n is the number of double determinations. Double determinations were performed in 70 dental casts. The intraexaminer error was compared with the total variance of the samples.

The level of intraexaminer error in the analysis of molar and canine occlusions was estimated as the percentage reproducibility of the same occlusal status in double determinations.

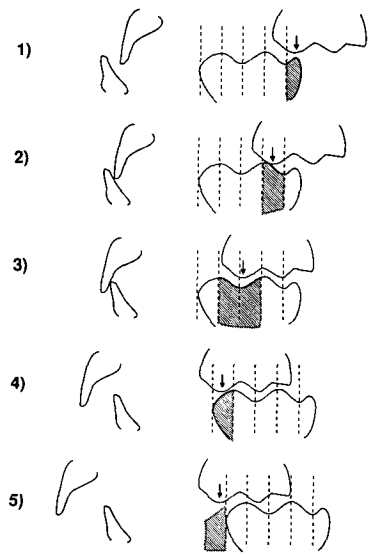

Fig 1. The Molar Sagittal Relationship. The molar occlusion was analyzed on both sides separately and classed into five subgroups according to Björk et al.:[10]
1) Mesial molar occlusion, grade 2: deviation from normal Class I molar occlusion one cusp width and over; 2) Mesial molar occlusion, grade 1: deviation from normal Class I molar occlusion one-half to one cusp width; 3) Normal molar occlusion: deviation from Class I molar occlusion less than one-half cusp width; 4) Distal molar occlusion, grade 1: deviation from normal Class I molar occlusion one-half to one cusp width; 5) Distal molar occlusion, grade 2: deviation from normal Class I molar occlusion one cusp width and more.
The degree of sagittal asymmetry in the bilateral molar occlusions was determined as: no asymmetry = left and right side gradings are equal; mild asymmetry = difference between left and right side is one grade; marked asymmetry = difference between left and right side is two grades; severe asymmetry: difference between left and right side is more than two grades.

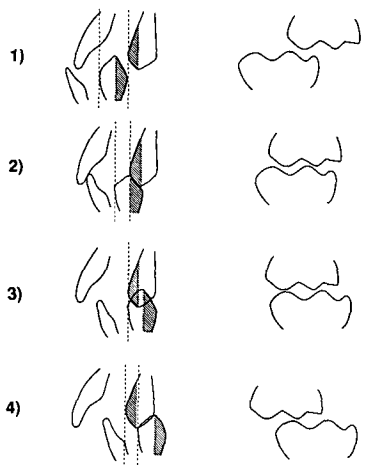

Fig 2. The Canine Relationship in the sagittal plane. The canine occlusion was analyzed on both sides separately and classed into five subgroups as in the method used for the molar occlusion:
1) Mesial canine occlusion, deviation from normal canine occlusion one-half cusp width and over; 2) Normal canine occlusion: deviation from Class I molar occlusion less than one-half cusp width; 3) Distal canine occlusion, grade 1 – deviation from normal canine occlusion one-half to one cusp width; 4) Distal canine occlusion, grade 2 – deviation from normal canine occlusion one cusp width and more.
The degree of sagittal asymmetry in the bilateral molar occlusions was determined as: no asymmetry = left and right side gradings are equal; mild asymmetry = difference between left and right side is one grade; marked asymmetry = difference between left and right side is two grades; severe asymmetry: difference between left and right side is more than two grades.

Results

The height of the maxilla was found to be larger in the difficult forceps delivery group than in the controls, but the groups did not differ significantly in terms of maxillary width or length (Table 1). The length of the mandibular dental arch was found to be greater in the difficult forceps delivery cases than in their controls, but there was no significant difference between the groups in width (Table 1). Fewer bilaterally stable occlusions and correspondingly more asymmetric molar and canine occlusions were found in the difficult forceps delivery group (Tables 2 and 3). There was a tendency for the severely asymmetric occlusions to

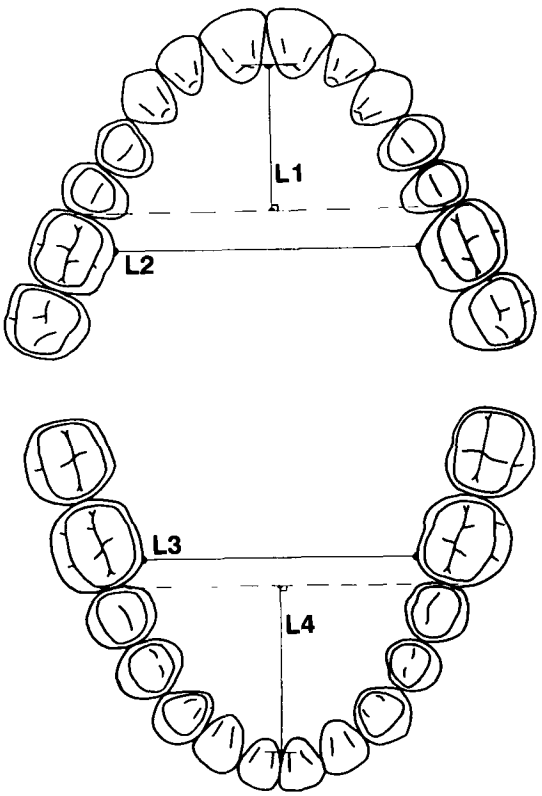

Fig 3. Dental arch dimensions measured on dental casts: L1 = Sagittal length of the maxilla (in mm), measured from from the intersection point of a line connecting the cingular points of maxillary first incisors perpendicular to a line the mesial tangenting the maxillary first molars; L2 = Shortest distance between maxillary first molars (in mm) measured at the gingival margin; L3 = Shortest distance between mandibular first molars (in mm) measured the gingival margin; L4 = Sagittal length of the mandibular arch (in mm), measured from an intersection point of a line connecting the cingular points of lower first incisors perpendicular to a line tangential to the mesial margins of the first mandibular molars.

become more common with increased difficulty in the forceps procedures. The rate of marked or severe asymmetric molar occlusions was 56% in the group that had undergone a very difficult forceps delivery and 15% in those with a difficult forceps delivery. There was no significant difference in the prevalence of lateral crossbites between the difficult forceps delivery group and the controls, the prevalence being 11% in the very difficult forceps delivery group and 9% in both the difficult forceps delivery group and the control group.

The intraexaminer methodological errors of the linear variables are shown in Table 4. Reproducibility in the analysis of molar occlusions was 95% and that of canine occlusions 83%.

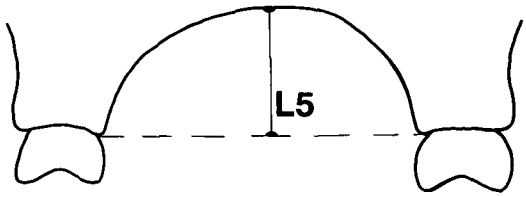

Fig 4. Height of the palate at the first molars. Height of the palate measured in mm perpendicular to the plane between the gingival margins of the first molars.

Table 1. Occlusal dimensions (in mm) in children with a history of difficult or very difficult forceps delivery and in controls with normal delivery (N = 84)

	Forceps Delivery		*Controls*		
	Mean	*SD*	*Mean*	*SD*	*P*
Maxillary arch length	26.2	2.23	26.0	2.34	NS
Maxillary arch width	32.0	2.64	32.0	3.01	NS
Palatal height	10.8	1.80	10.3	1.75	*
Mandibular arch length	23.6	1.85	22.9	2.08	*
Mandibular arch width	31.8	2.04	32.1	2.23	NS

* $P < 0.01$, Wilcoxon's signed rank test.

Table 2. Degree of asymmetry in bilateral molar inclusions in children with a history of difficult or very difficult forceps delivery and in controls with normal delivery (N = 84, DF = 1)

	No. of Patients	
Degree of Asymmetry in Molar Occlusion	*Forceps Delivery*	*Controls*
No asymmetry or mild asymmetry	68	83
Marked or severe asymmetry	16	1
Total	84	84

$\chi^2 = 12.82$, $P < 0.005$.

Table 3. Degree of asymmetry in bilateral canine occlusions in children with a history of difficult or very difficult forceps delivery and in controls with normal delivery (N = 84, DF = 1)

	No. of Patients	
Degree of Asymmetry in Canine Occlusion	*Forceps Delivery*	*Controls*
No asymmetry or mild asymmetry	60	83
Marked or severe asymmetry	24	1
Total	84	84

$\chi^2 = 22.74$, $P < 0.001$.

Table 4. Intraexaminer methodological error s(i) in 70 duplicate recordings, S^2 denotes the variance in the whole sample (N = 168)

	$s(i)$	$s(i)^2$% of S^2
Maxillary arch length	1.05	20.0
Maxillary arch width	0.03	0.3
Palatal height	0.10	3.2
Mandibular arch length	0.21	5.5
Mandibular arch width	0.19	0.8

Discussion

The intraexaminer methodological error in the linear variables was low relative to the total variance of the sample, except for the measure of maxillary length. The latter fact may point to a difficulty in precisely estimating the measurement points for this particular parameter, whereas for the other variables, such as the distance between the maxillary and mandibular first molars, the correct determination of the measurement points is performed more accurately. The level of reproducibility was found to be higher when analyzing molar occlusions than canine occlusions, possibly due to the larger number of subgroups of occlusal gradings. Another factor that may partly explain the difference is the larger size of the molar teeth in the sagittal dimension, which makes it easier to determine cuspal relations.

Apart from intraexaminer error, there are other sources of error in examinations of this type, like dental cast abrasion or tooth restorations, which may have some effect on the measurements. These seldom have a direct biasing effect, however, and tend rather to increase the random error, and thus increase the variance of the records within the groups, a fact that must be taken into account when drawing conclusions from the results.

Our results suggest that a difficult forceps procedure during birth has a significant association with certain dimensions of the dental arch and the occlusion of the child at a later age. Significant differences were found in the length of the mandibular arch, the height of the palate, and the asymmetry of the occlusion between forceps-delivered children and controls. A highly significant difference in symmetry was found in the bilateral molar and canine relations between groups.

The palatal height difference in the children who had undergone a difficult forceps delivery compared with controls may point to a constriction of the child's head during the procedure. In spite of the plasticity of the head at the neonatal stage, some adverse changes will be irreversible. This finding is consistent with the results of longer mandibular arch. Though not tabulated in this study, these children also had a tendency for a narrower shape, suggesting early constrictive forces, the consequences of which are still visible in the teens.

The prevalence of lateral crossbites was not found to be greater in the difficult forceps delivery group in spite of the increase in asymmetric molar occlusion. This may be due to sagittal occlusal asymmetry in the molar regions, leaving the transversal dimensions unaffected. This would not be the case if there was a high prevalence of lateral malocclusions since these are invariably linked to transversal discrepancies.

Much controversy surrounds the general effects of forceps delivery on the later development of the child. Some reports[1, 12] indicate evident pathological processes in the outcome, and even an increase in morbidity,[2] while others are unable to show any adverse effects.[13, 14] Our results are consistent with those of Wylie,[5] who showed a dramatic difference in morbidity between the difficult and very difficult forceps delivery groups, and conform with those of Grosfeld,[15] where an increased asymmetric molar occlusion was reported after traumatic breech delivery. The results suggest that normal symmetric development of the occlusion may be disturbed due to trauma caused by an external factor. Differences may be explained by a unilateral growth disturbance from an early constriction of the orofacial region.

The metric differences found here were in most cases small, although measurable. Considering the linear and lateral occlusal records together, the occlusions develop without any major asymmetric or other severe defect in the vast majority of cases in spite of the difficult forceps procedure. Markedly asymmetric development can be found in a relatively small proportion of cases. Trauma during delivery is only one factor affecting occlusal parameters and it is impossible in most cases to verify which of the potential postnatal cofactors such as sucking habits, early traumas during childhood, or systemic factors such as upper respiratory infections or allergic diseases, have a marked effect on the occlusion.

The need to study the associations between forceps delivery and asymmetric occlusion is great in light of increasing data that show an evident relationship between asymmetric occlusal function and craniomandibular dysfunction. The importance of this issue is emphasized by the fact that in most cases of asymmetric occlusion the etiology remains unresolved or obscure.

Conclusion

We found that difficult forceps procedures have a significant relationship on certain aspects of the occlusion and dimensions of the dental arches. This finding may be important, as more asymmetric occlusions were found among cases of difficult forceps delivery, and thus this procedure may cause masticatory system dysfunction.

This study was supported by contract NO1-NS-2-2302 from the National Institute of Neurological Disorders and Stroke.

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Drug-resistant pneumococcal infections increasing

Administering vaccines may play a crucial part in prevention

Drug-resistant pneumococcal infections and associated complications appear to be on the rise in the United States, according to an article in a recent *Journal of the American Medical Association.*

"Emergence of drug-resistant pneumococcal infections will present critical challenges to clinicians for treating patients with pneumococcal disease. Widened and intensified surveillance is needed," writes Robert F. Breiman, MD, of the Childhood and Respiratory Diseases Branch, Centers for Disease Control and Prevention (CDC), Atlanta, with colleagues.

The researchers compiled data from 544 people with pneumococci isolated from normally sterile sites at 13 hospitals in 12 states between October 1, 1991 and September 30, 1992. Resistance to penicillin was detected in 6.6% of isolates. A total of 16.4% were resistant to a number of drugs, including penicillin, cephalosporins, and macrolide antibodies. These figures are higher than similar research results from 1979 to 1987.

"Comparing our results with data from the CDC pneumococcal surveillance system through 1987 shows that drug-resistant pneumococcal strains are now far more prevalent," the study reports.

"For instance, only one of 5469 isolates collected from 1979 through 1987 had an MIC (minimum inhibitory concentrations) of 2 or more to penicillin, compared with seven of 567 isolates during a 12-month period in 1991 and 1992. Spread of resistant strains to North America has been expected as they have become increasingly prevalent in other regions."

Pneumococcal infections are among the leading causes of illness and death of young children, persons with underlying debilitating medical conditions, and the elderly world-wide. Adults are at greatest risk for severe complications including death from the infections. The case-fatality rate for pneumococcal bacteremia in persons 65 years of age or older is more than 40%.

Infections attributable to drug-resistant pneumococcal likely will be more difficult to treat and empirically thus may be associated with increased costs, sickness, and death among those at risk for pneumococcal disease and its complications.

The researchers believe that currently available pneumococcal vaccine should be aggressively promoted and routinely administered to high-risk patients (people over 65 years, those with chronic health conditions, or with impaired immune systems). The data suggest that a widely and randomly distributed surveillance system for drug resistance is needed to provide useful data to clinicians making empirical therapeutic choices to treat infections commonly caused by pneumococci.

"While the long-term key to controlling drug-resistant pneumococcal infections is prevention via immunization, newer antimicrobial drugs will also be needed to provide clinicians with some alternatives for effective treatment," they write.