ACTA MEDICA LITUANICA. 2005. VOLUME 12 No. 1. P. 54–57

Relation between the severity of palatal cleft and maxillary dental arch size

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The disorder of maxilla growth is one of the principal problems in treatment of cleft palate patients. For a long time the main cause for disturbance of maxillary growth has been thought to be surgical intervention – palatoplasty, the closure of palatal cleft. We analysed the influence of palatal cleft width on the development of upper jaw. Evaluation of treatment results requires the records of primary anatomical data on cleft size and maxillary dimensions. **The aim** of the study was to define the primary anatomical data of isolated palatal clefts and to find a correlation between cleft width and maxillary dental arch size. We analysed the influence of palatal cleft width on the development of the upper jaw. **Materials and methods**. We analysed casts of 34 cases of isolated cleft palate patients at the age of 18 months before palatal surgery. The casts were moulded from A type silicone (Panasil, Ketenbach, german) impressions made under general anaesthesia. The measurements were perfomed with a Dentaurum sliding calliper of Munchen design and a three-direction Dentaurum Korkhaus meter. The accuracy of measurements was 0.1 mm. Repeated landmark identification reproducibility test of the measurements was done on 10 randomly selected study casts after at least 1 month by the same investigator. Patiens were treated at Vilnius University Hospital Þalgiris Clinic. **Results**. The results showed that the width of the palatal cleft statistically significantly influenced the size of the maxilla. The largest maxillary dental arch circumference was found in the group of narrow clefts. **Conclusion**. Our results confirm the hypothesis that the width of the cleft influences the dental arch size.

Key words: model analysis, isolated palatal cleft, cast measurements, cleft width, maxillary dental arch width

INTRODUCTION

Every year about 30–40 newborns with some craniofacial malformations are born in Lithuania. Congenital clefts of lip, alveolar process and palate make the major part among them. Maxillofacial surgeons, orthodontists, ENT, speech therapists, paediatricians and restorative dentists provide rehabilitation for patients with maxillofacial clefts (1, 2). The treatment protocol at Vilnius University Institute of Odontology is complex and developed according to the Eurocleft recommendations (2).

In spite of the fact that during the last two decades a significant improvement of treatment techniques and quality has been achieved, there is a lot of discussion left on the treatment time, tactics and methods. This is so because the final results of the treatment can be seen when the patient reaches 18 years of age. There are only a few prospective studies in the literature overviewing the results of 18 years of treatment (2, 3). On the other hand, the primary anatomical data of clefts are of utmost importance, if we start to evaluate the final treatment results and analyse postoperative photos, dental casts, speech fluency. The research projects are limited by a small number of samples, the variety of pathology, different treatment methods, and different case documentation methods (2, 3).

Despite the general opinion that the deficiency of tissue, probably seen as the width of the alveolar cleft, and the position of maxillary segments are essential variables affecting the growth of the maxilla following lip, palate and nose repair, there are only a few studies aimed at examining this possible association. More often the effect of treatment, particularly surgical technique and timing of operation, have been studied and considered to have a great impact on the growth and development of craniofacial complex in children with cleft (4–7).

The aim of our study was to analyse the primary data of maxillary isolated palatal clefts and evaluate the association between cleft severity and maxillary dental arch size.

MATERIALS AND METHODS

The present investigation was performed as a metrical analysis on the dental casts of patients with isolated palatal clefts. Isolated cleft palate is a characteristic pathology where neither the lip nor the alveolar process are involved. The cleft may involve only the soft palate or both the soft and hard palates, but never the hard palate alone. The outline of the cleft may be wide or narrow, pyriform or V-shaped (3).

We analysed 34 models of maxilla of isolated palatal clefts. The models of 15 girls and 19 boys were included in our study.

The models were moulded from white stone and the bases trimmed according to standard angles and heights. This was a prospective study of models. The study was performed at Vilnius University Hospital Þalgiris Clinic. The inclusion criteria were as follows:

- patients were born with cleft palate
- non-syndrome cases
- no orthodontic treatment had been applied
- patients were 18 months of age
- all first deciduous molars present
- the child was healthy except for its single cleft malformation
- all casts in good condition and available.

The casts were moulded from A type silicone (Panasil, Ketenbach, Germany) impressions made under general anaesthesia just before palatal surgery, which is performed when a patient is 18 months old.

The measurements were performed with a Dentaurum sliding calliper of Munchen design and a three-direction Dentaurum Korkhaus meter. The accuracy of measurements was 0.1 mm. Repeated landmark identification reproducibility test of the measurements was done on 10 randomly selected casts after at least 1 month by the same investigator.

The following measurements were made (Figure):

- Max-ICW: maximum intercanine width (distance between central palatal surface of deciduous canine)
- Min-ICW: minimum intercanine width (distance between central palatal surface of deciduous canine)
- Max-IDW: maximum interdeciduous first molar width (distance between central palatal surface of deciduous first molar)
- Min-IDW: minimum interdeciduous first molar width (distance between central palatal surface of deciduous molars). The averages of the maximum and the minimum measurements were calculated to avoid distortions due to tooth size
- Basal ICW: the distance between the deepest points on the alveolar process along the long axis of the deciduous canine
- Basal IDW: the distance between the deepest points on the alveolar process along the long axis of the deciduous first molar
- Cleft size: the distance between the posterior cleft points
- Maxillary arch width: junction of the alveolar ridge with the outline of the tuberosity.

The following dimensions were calculated from the above measurements:

- ICW-interdeciduous canine width (average of Max-ICW and Min-ICW)
- IDW-interdeciduous first molar width (average of Max-IDW and Min-IDW)
- Cleft size
- Posterior maxillary arch width.

The casts were grouped into three groups according to the width of the cleft. The width of the cleft in the maxillary tuberosity region was chosen as a reference point, because in this site we can easily measure the width of the cleft, be it a total or partial, hard or soft palate cleft. Palatal clefts up to 5 mm were defined as narrow ones; clefts from 5 to 9 mm were included in the group of moderate clefts, and if the width of the cleft exceeded 9 mm it was considered to be a wide cleft.

RESULTS

In the group of narrow clefts we analysed 11 models, in moderate clefts 15, and in the group of wide clefts we examined 7 casts. The obtained data are presented in Table 1. We compared every group with each other and used Student's criteria for statistical analysis. We present a comparison among three groups of clefts and their maxillary dental arch

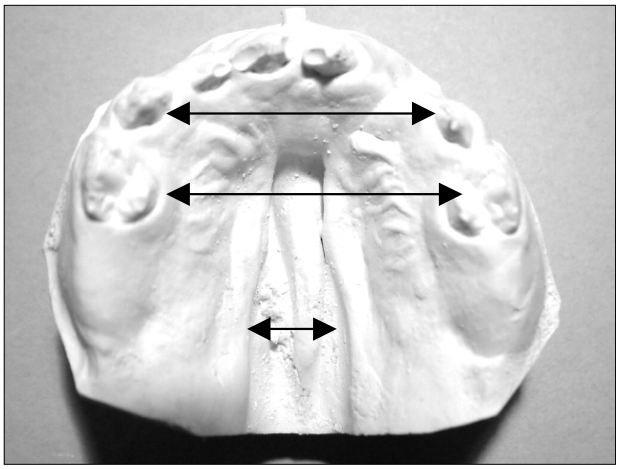

Figure. Schematic presentation of intercanine, interdeciduous molar and cleft width measurements

Table. **Measurements of maxillary dental arch in mm (mean ± SD) in each cleft group**

Cleft size	< 5mm	5–9 mm	Above 9 mm
ICW	29.1 ± 1.48	28.6 ± 1.51	24.4 ± 1.11
IDW	33.4 ± 2.14	33.9 v 1.85	29.5 ± 1.73
Basal ICW	34.9 ± 2.18	34.8 ± 2.16	32.1 ± 1.92
T–T'	37.2 ± 2.54	36.6 ± 2.23	33.2 ± 1.97
Basal IDW	45.6 ± 2.34	45.1 ± 2.11	40.1 ± 1.87
S–S'	51.1 ± 3.11	50.4 ± 2.84	46.1 ± 2.41

dimensions before palatoplasty in this table. The arithmetic means (mean) and standard deviation (SD) are given for each measurement variable.

The results show that the width of the palatal cleft statistically significantly influences the size of the maxilla. The largest maxillary dental arch circumference was found in the group of narrow clefts. In the moderate clefts group we can notice signs of the narrowing of the dental arch between the first deciduous molars. A wide cleft, larger than 9 mm, influences the maxillary dental arch circumferences. In this group we can see a significant narrowing of the dental arch circumference in the maxillary tuberosity region. The dental arch is statistically significantly narrower between deciduous canines as well as between first deciduous molars.

DISCUSSION

We investigated the effect of cleft phenotypic variability, particularly the effect of severity of palatal clefting on the maxillary dental arch before palatoplasty. Our results support the hypothesis that the growth of maxilla is already disturbed since birth and disprove the other opinion that palatal closure surgery violates normal maxillary development (4–7, 11).

Some authors surveyed the influence of palatal cleft size on the growth of maxilla. They studied adult non-operated patients. The conclusions of studies oppose each other. Some state that non-operated patients have a normal maxillary growth, the same as patients in control group without any pathology. Others conclude that palatal cleft disturbs the growth of maxilla in sagittal, transversal and vertical directions (12). The finding that patients with isolated cleft palate may have a very different width of maxilla at the 18th month of age and remain to be characterised by their initial deformity has important clinical implications. Treatment results, and favourable or unfavourable maxillary growth, may be anticipated according to the initial severity of cleft deformity and less related to the given treatment. More important, the treatment protocol could vary according to the severity of the initial deformity (1, 3). Our findings may also have implications for the design of research protocols in cleft lip and palate studies. Patients with cleft traditionally are roughly grouped for clinical and research purposes (7–9). However, as there is a proven variation in the severity of cleft deformity in children with cleft palate, patients could be sorted according to cleft severity before correlating specific treatment variables with outcomes. According to our findings, a child with a small cleft and a large maxillary arch circumference would probably show a different treatment outcome with regard to maxillary growth in comparison to a child with a large cleft and a short arch circumference. In conclusion, our findings confirm the previous opinion that the severity of clefting is an essential variable affecting the maxillary growth of patients with cleft palate.

CONCLUSIONS

1. The severity of clefting statistically significantly influences the maxillary development of patients with cleft palate. When the width of the cleft is larger than 9 mm, the size of the maxillary dental arch is narrower at the site of canines and the first molars.

2. The treatment protocol could vary according to the severity of the initial deformity. The orthodontist should check patients with wide clefts more often. Treatment should start after noting the first signs of crossbite.

3. In clinical research, children with cleft palate could be sorted accordint to the severity of clefting deformity before correlating specific treatment variables with outcomes.

Received 5 November 2004
Accepted 17 December 2004

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VILKO GOMURIO PLOÈIO IR VIRÐUTINIO ÞANDIKAULIO DANTØ LANKO DYDÞIO SÀSAJOS

Santrauka

Virðutinio þandikaulio augimo sutrikimas yra viena svarbiausiø problemø gydant pacientus su gomurio nesuaugimais. Ilgà laikà manyta, kad virðutinio þandikaulio vystymasis sutrinka dël gomurio operacijos. Mûsø tyrimas statistiðkai patikimai árodë, kad net prieð operacijà virðutinio þandikaulio matmenys skiriasi priklausomai nuo nesuaugimo ploèio. Esant plaèiam (didesniam nei 9 mm) vilko gomuriui, virðutinis þandikaulis susiaurëja ilèiø ir pirmøjø krûminiø dantø srityje. Analizuojant pacientø su gomurio nesuaugimais gydymo rezultatus, reikëtø atsiþvelgti á pirminius nesuaugimo duomenis. Iðanalizavome 34 pacientø su izoliuotais gomurio nesuaugimais virðutinio þandikaulio matmenis ir ryðá tarp nesuaugimo ploèio ir dantø lanko ploèio. Mûsø tyrimas patvirtino, kad pirminiai duomenys yra labai svarbûs ne tik ávertinant ilgalaikius gydymo rezultatus, bet gali turëti átakos ir gydymo planavimui bei ilgalaikiø tyrimø organizavimui.