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### Application of 3D scanning to morphological evaluation of cleft palate in infants

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**ABSTRACT:** This paper presents the procedure of 3D scanning of dental plasters of infants' cleft palates, in order to obtain 3D models for quantitative objective morphological analysis. The aim of the research was to check the effects of preparation of patients for lip and palate correction surgery. 13 patients with bilateral cleft and 40 patients with unilateral cleft were examined. The percentage changes in the dimensions of the palate gap during the treatment with personalized acrylic plates were analyzed. Based on the research, it was found that the resulting gap narrowing of several dozen percent is a good preparation for the final treatment of the palate correction.

**KEYWORDS:** cleft palate, cleft lip, presurgical preparation, linear dimensions, statistical analysis

#### 1. Introduction

Cleft of the lip, palate, or both is one of the most common congenital abnormalities and has a birth prevalence rate ranging from 1/1000 to 2,69/1000 amongst different parts of the world [2]. One of the treatment procedures involves several months of preparation of the patient by using personalized acrylic plates to initially reduce the cleft gap [1, 3]. The main aim of this work was to evaluate the level of correction that can be achieved with the use of presurgical orthopedics.

#### 2. Material & Methods

In this study 33 patients (20 with unilateral and 13 with bilateral cleft palate) aged 0-6 months were analyzed. All patients were made minimum three dental impressions:

- first day – diagnosis (stage 0),
- before lip surgery (stage 1),
- before palate surgery (stage 2).

Subsequently the impressions were scanned with the use of metrological 3D scanner Kscan Magic (Scantech), to obtain digital geometrical models of all palates.

On the models, respectively, 13 or 12 characteristic points [4-6] for unilateral and bilateral clefts were marked (Fig. 1). Then it was possible to calculate the dimensions and proceed the objective evaluation of applied treatment.

To compare the selected dimensions in the group of patients, percentage differences were calculated. Additionally, for bilateral clefts, two indices of symmetry (upper IoS and middle IoS) have been formulated (equations 1 and 2), that can be used to determine the severity of the disease and the symmetry of the cleft gap.

$$\text{upper IoS} = \frac{|1 - 10|}{|5 - 10|} \quad (1)$$

$$\text{middle IoS} = \frac{|6 - 10|}{|7 - 10|} \quad (2)$$

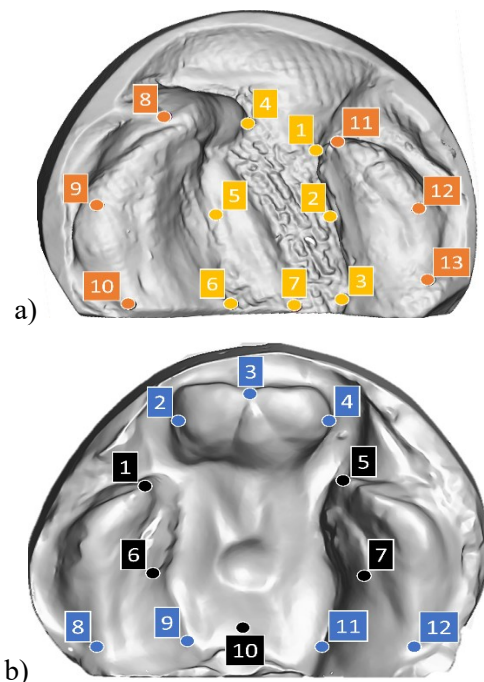


Fig. 1. Characteristic points marked on 3-dimensional models of unilateral (a) and bilateral (b) cleft palate

### 3. Results

Application of personalized acrylic palate for 9 months resulted in approximation of cleft segments and reposition of larger segments in patients with unilateral cleft lip and palate (Fig. 2-4).

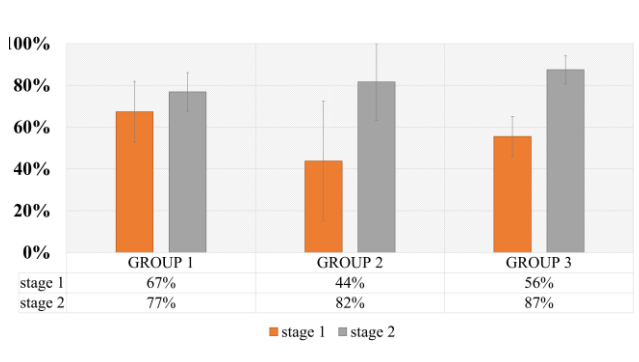


Fig. 2. Percentage differences in the width of a cleft gap (*unilateral points 1-4*) in the subsequent stages of treatment

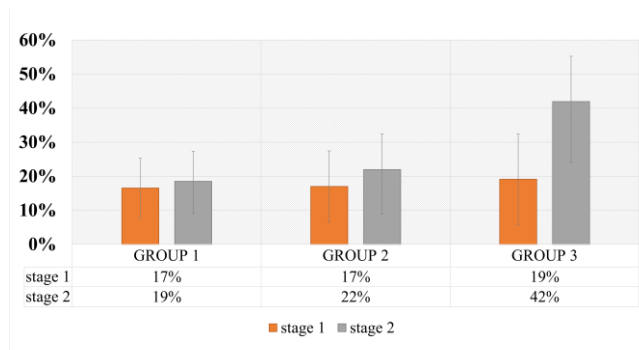


Fig. 3. Percentage differences in the distance between midpoints of a cleft palate (*unilateral points 2-5*) in the subsequent stages of treatment

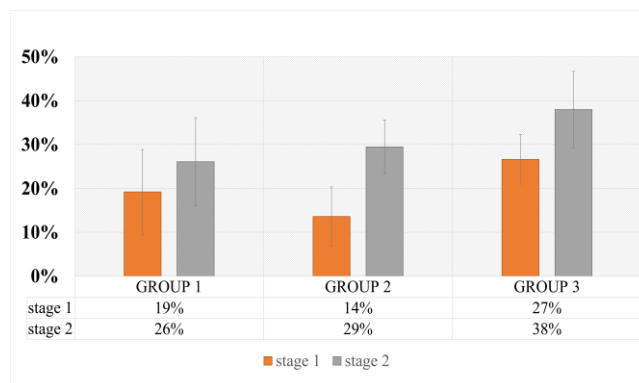


Fig. 4. Percentage differences in the distance between midpoints of a cleft palate (*unilateral points 3-6*) in the subsequent stages of treatment

In cases of bilateral cleft, 60-66% reduction of the gap between segments and premaxilla was achieved (Fig. 5). The values of both indices increased and approached the value of 1,0, which means that the symmetry has been balanced (Fig. 6).

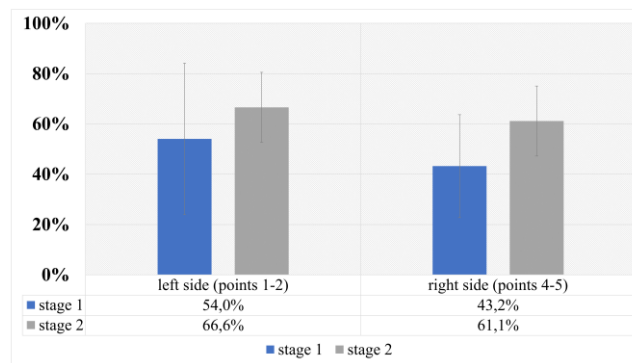


Fig. 5. Average percentage differences in the width of a bilateral cleft gaps in the subsequent stages of treatment

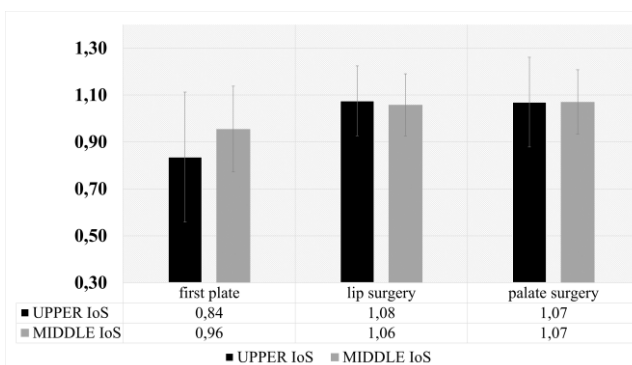


Fig. 6. Mean values of symmetry indices in the subsequent treatment stages

### 4. Conclusion

Presurgical orthopedics preparation with acrylic plates of patient with cleft lip and palate led to superior intraoperative conditions. As a consequence, less extensive and invasive techniques can be used, resulting in reduced number of complications.

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