

Medical Anthropometry in Pediatric  
SurgeryŠtefánková Eva<sup>1</sup>, Horn František<sup>1</sup>, Omaník Pavol<sup>1</sup> and Neščáková Eva<sup>2</sup><sup>1</sup>Department of Pediatric Surgery, Children's University Hospital, Comenius University, Slovakia<sup>2</sup>Department of Anthropology, Comenius University, Slovakia

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## \*Corresponding author

Štefánková Eva, Department of Pediatric Surgery, Children's University Hospital, Comenius University, Slovakia, Tel: 02/59317173; Email: evalacho@gmail.com

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## Abstract

**Purpose:** To inform about the excellent non-invasive scientific method in pediatric surgery and to establish a significance of anthropometry as first-line diagnostic method. We focused on the Slovak patients with craniosynostosis and pectusexcavatum in this study.

**Methods:** Anthropometric measurements are performed by standard anthropological technique according to Martin and Saller [1] and its modifications. Special instruments are required: the spreading caliper, the sliding caliper, the measuring tape and anthropometer. Patients are monitored longitudinally.

**Results:** We summarized the most important facts from anthropometrical evaluation in Slovak patients with craniosynostosis and pectusexcavatum deformity in this study.

**Conclusion:** Anthropometric measurements are helpful in accurate documentation of growth, longitudinal observation of the patient and can support decision concerning the type of surgery. We can predict trend of growth by anthropometric measurements in these deformities and we think that anthropometry should be performed prior to CT examination.

## Introduction

Morphometry is introduced as quantitative approach to seek information concerning variation and changes in the forms of organisms that described the relationship between the human body and disease. Scientists of all civilization examined the human body using anthropometric methods. For these reasons, anthropometric data are used in many contexts to screen for or monitor disease. Anthropometry, a branch of Morphometry, is the study of size and shape of the components of biological forms and their variations in populations. Advances in imaging technology have resulted in the protection of a greater amount of morphological information and have permitted the analysis of this information. CT and MRI have started to be used in screening of internal organs. Morphometry measurements are widely used in diagnosis, follow-up and treatment of the diseases [2].

Anthropometric measurements are important for the evaluation of morbidities of individuals in society and thus meet the requirements of that society. For human health, the field of medicine requires constant development and renewal. Throughout history, anthropometric measurements were improved as details of human anatomy were discovered, until the field reached today's standards. In recent years, the utilization of a number of new measurement devices for clinical use and primary studies has inevitably led to improvements in measurement parameters and techniques [2].

Anthropometric methods became very popular non-invasive, inexpensive, time saving, objective measurable methods in the treatment of podiatric patients. The incidence of cranial and thoracic deformities occurs increasingly and we tried to define the most appropriate way to evaluate pathological growth and the methods for objective assessment of surgical treatment.

## Anthropometric Measurement

## Craniosynostosis (CS)

Anthropometric measurement provides the opportunity to document the children's craniofacial parameters and cranium shape at the beginning, during and at the end of the treatment. Important craniofacial dimensions are: the head circumference, the maximum head length, the maximum head width, the minimum width of the forehead, the face width, the morphological height of the face and the width of the skull base (Figure. 1a-b). Measurements are performed by standard anthropological technique according to Martin and Saller [1] and its modifications. Instruments required for anthropometric measurement are the spreading calliper, the sliding calliper, the measuring tape and the anthropometer.

The anthropometric evaluation in patients with CS is carried out as the first clinical examination

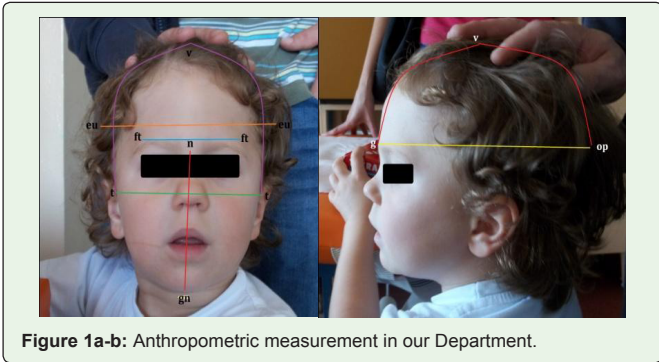


Figure 1a-b: Anthropometric measurement in our Department.

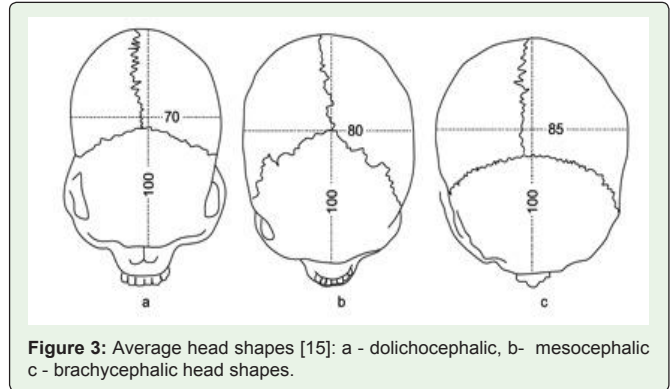


Figure 3: Average head shapes [15]: a - dolichocephalic, b- mesocephalic c - brachycephalic head shapes.

of the child (ideally new-born). Subsequently, further anthropometric evaluations are scheduled (depending on the type and severity of craniosynostosis) until the surgery - once a month, every three months and before surgery. Measurements are carried out also after surgical intervention and during the recovery period (once a month, every three months, every six months, once a year). Surgical treatment is primarily cosmetic for some patients therefore not all the patients with CS are operated on (based on the discourse with parents and extent of fusion of the suture involved). The patients with CS without surgery are long-term monitored by anthropometry at the same intervals as the children who were operated on.

The history of sleeping position in infancy is a very important fact in differential diagnosis, because positional anomalies of the cranium are states that can imitate CS. It could be non-syndromicplagiocephaly, physiological dolichocephalism or physiological brachycephaly [3,4]. Anthropometry can differentiate the primary craniosynostosis and the positional plagiocephaly. Moreover, the anthropometric monitoring of the patient can document the trend of cranial growth (pathological or not) and provides mosaic examinations under which surgeon indicates or does not indicate the intervention [5].

**Pectus excavatum (PE)**

We use also anthropometric measurements also for patients with thoracic deformities. We focused the measurement on the thoracic part but also some other parameters are measured for complex body evaluation. We measured these parameters: body height, body weight, bi-acromial width, transverse diameter of the chest, sagittal diameter

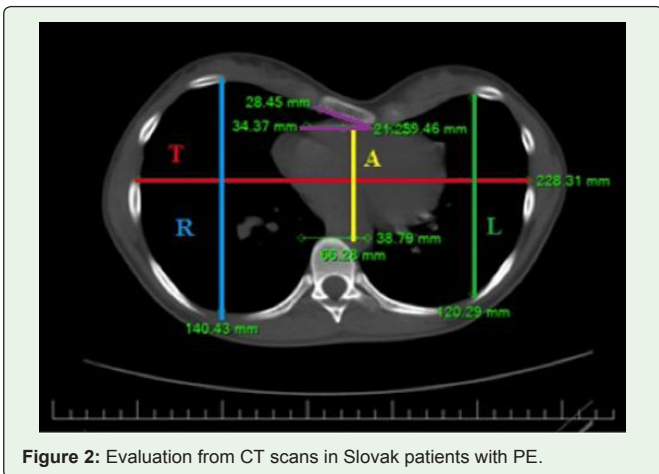


Figure 2: Evaluation from CT scans in Slovak patients with PE.

of the chest and chest circumference. Afterwards the indexes are calculated: Thoracic Index, Brugsche Index, Index of bi-acromial width to the height, Pignet-Vervaeck Index, Rohrer Index and Body Mass Index. We calculated metric parameters from CT scans (Figure. 2). The evaluations of the patient’s CT images are according to the methodology [6]. We analyzed the Haller index, Index of asymmetry, Index of chest shape and the degree of rotation of the sternum.

**Evaluation**

The evaluation of anthropometric dates can be performed in various ways.

The fastest way to determine the head shape is using indexes. The most commonly used index, which shows the relationship between the width and length of the head is called cranial index (index ICE), which is calculated as width of the head x 100 / head length (Table 1). Configuration of neonatal skull is most commonly monocephalic head shape and may vary in the early postnatal period. In the past, brachycephaly was the most prevalent (Fig. 3). Dolichocephaly used to be rare in the past but now is more common [7,8].

Another specific index used in differential diagnostic of skull pathologies is the diagonal index. Diagonal index is mostly applied in the evaluation of positional anomalies – plagiocephaly, as remodelling helmets specifically treat the severe forms of these deformities. The

Table 1: Categories of cranial index [12].

| Categories of cranial index | Boys      | Girls     |
|-----------------------------|-----------|-----------|
| Hyperdolichocephal          | X -70,9   | X -71,9   |
| Dolichocephal               | 71,0-75,9 | 72,0-76,9 |
| Mesocephal                  | 76,0-80,9 | 77,0-81,9 |
| Bachycephal                 | 81,0-85,4 | 82,0-86,4 |
| Hyperbrachycephal           | 85,5-90,9 | 86,5-91,9 |
| ulterabrachycephal          | 91,0- x   | 92,0- x   |

Table 2: Categories of Thoracic index [1].

| Values of Tl index | Distribution of Tl index |
|--------------------|--------------------------|
| X-70               | Flat chest               |
| 71-77              | Bulging chest            |
| 78- X              | Circular chest           |

patient is assessed before the helmet treatment, during recovery and after the treatment is completed [4]. Based on this index we determine the type and severity of plagiocephaly. An index value less than 3.5% is considered to be without deformity, whereas diagonal values of the index greater than 13.5% indicate severe deformity. On the basis of the observed values, cranial and diagonal index can be used to determine the percentage of degree of asymmetry.

In patients with PE we calculated the Thoracic Index (TI) via anthropometric points:  $TI = (\text{The transverse diameter} \times 100) / \text{the sagittal diameter}$ . Thoracic index can be divided into three categories (Table 2).

We used normalized ratio (z-score) to assess deviations between the physiological population and patients. The absolute values of the dimensions and the relative values of calculated parameters were compared to the average values of the physiological population [9-12]. We assembled the morph grams according to the z-score and we determined the mutual disproportionality of physical population. The normalized ratio is used to convey a proportional analysis of the body, allowing the comparison of any number of anthropometric parameters of different gender and age as well as statistical evaluation of the mean difference from the norm [13,14].

We use growth percentile graphs for a detailed analysis of the cranial growth. They demonstrate the pathology of the anthropometrical parameters and also the average growth curve of the norm.

## Conclusion

Anthropometric measurements are helpful in accurate documentation and observation of the patient. Measurements are useful in first contact with patients, in longitudinal observation of growth and can also help surgeon in surgical planning. Otherwise CT scan analysis draws the image on many levels, shows each organ and system in the body which surgeon necessarily need to see before surgical correction and also allows calculate selected indexes very precisely. Monitoring of the anthropometrical parameters can access types of surgical technic, their success and to record a growth accelerations and decelerations during the patient's treatment. Monitoring of the patient's anthropometric dimensions in the short and long – term period provides the optimal opportunity to assess the cranial growth and the suitability of the methodology that was used in a patients with craniosynostosis and positional plagiocephaly. Based on our analysis we can predict trend of growth in each type of cranial deformity and we can also discourse with parents how surgical intervention can help in this type of diagnosis. Craniofacial measurements are helpful in surgeon decision concerning operation and choosing type of intervention most suitable for the patient.

Anthropometry provides feasible and non-invasive method of pectus deformities evaluation. We can evaluate body image and patients' growth trends and surgeon can decide what type of surgical technic is advisable for patients. Anthropometrical parameters can be compared with standards in same age and gender. The deformities tend to progress as the patients grow. It is noticeable during the

pubertal growth spurt when PE can progress from mild to severe. We can assess the growth by anthropometric measurements through evaluating with standards, via indexes or we can predict patient's height, estimated final height and assess the end of growth. All professional examinations help the surgeon in the correct timing of surgical treatment.

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