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## COMPARISON OF BONE AND CHRONOLOGICAL AGE IN DIFFERENT TYPES OF PRIMARY AND SECONDARY PALATE CLEFTS

## PORÓWNANIE WIEKU SZKIELETOWEGO I METRYKALNEGO W RÓŻNYCH TYPAH ROZSZCZEPÓW PODNIEBIENIA PIERWOTNEGO I WTÓRNEGO

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### Abstract

**Background:** *The ability to correctly assess the patient's bone age is an important element that allows correct diagnosis and proper planning of the start of orthodontic treatment.*

**Objective:** *The objective of this study was to estimate bone age in children with congenital craniofacial defects – primary and secondary palate cleft.*

**Material and methods:** *The analysis covered lateral head images of 45 patients 8 to 15 years old with different types of cleft (primary and secondary palate cleft, bilateral, right or left unilateral). The patients' bone age was assessed by means of the Cervical Stage method (CS). The correlation between the bone age and chronological age was defined with the division into male and female patients.*

**Results:** *The results showed the relationship between the skeletal age and chronological age by gender and cleft type (the differences between the types of clefts by gender were presented). The correlation rate between the values of variables was defined.*

**Conclusions:** *The chronological age of children with developmental craniofacial defects (primary and secondary palate cleft) in relation to the stages of skeletal development, indicates a difference of about one year in plus and that fact should be taken into account when choosing orthodontic treatment.*

**Key words:** skeletal age (bone age), chronological age, cleft lip and palate, CS method

### Streszczenie

**Wstęp:** *Umiejętność prawidłowej oceny wieku kostnego pacjenta z wadami części twarzowej czaszki jest istotnym elementem, ułatwiającym postawienie prawidłowej diagnozy oraz zaplanowanie właściwego okresu rozpoczęcia leczenia ortodontycznego.*

**Cel pracy:** *Celem pracy było: określenie wieku szkieletowego u dzieci z wrodzonymi wadami części twarzowej czaszki – rozszczep podniebienia pierwotnego i wtórnego.*

**Materiał i metody:** *Analizie zostały poddane zdjęcia boczne głowy 45 pacjentów w wieku 8- 15 lat z różnymi typami rozszczepu (rozszczep podniebienia pierwotnego i wtórnego – obustronny bądź jednostronny lewo lub prawostronny). Oceny wieku szkieletowego pacjentów dokonano wykorzystując metodę Cervical Stage. Określono współczynnik korelacji pomiędzy wiekiem szkieletowym a metrykalnym z podziałem na pacjentów płci męskiej i żeńskiej.*

**Wyniki:** *Wyniki badań wykazały zależności pomiędzy wiekiem szkieletowym a metrykalnym z uwzględnieniem płci oraz typu rozszczepu (zobrazowano różnice występujące pomiędzy typami rozszczepów z uwzględnieniem płci). Wykazano korelację pomiędzy wartościami zmiennych.*

**Wnioski:** Wiek metrykalny dzieci z wadami rozwojowymi części twarzowej czaszki – rozszczep podniebienia pierwotnego i wtórnego w odniesieniu do faz rozwoju szkieletowego wykazuje różnicę około 1 roku in plus, zatem wybór metody leczenia ortodontycznego powinien uwzględniać wiek szkieletowy.

**Słowa kluczowe:** wiek szkieletowy, wiek metrykalny, rozszczep wargi i podniebienia, metoda CS

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## INTRODUCTION

In 1972, *Lamparski*, in the course of his cervical vertebrae development studies, described his own method of defining the skeletal maturity of the cervical vertebrae, i.e. Cervical Vertebrae Maturation (CVM), and identified six stages of skeletal maturity characteristic for subsequent stages of maturation (1). In 1995, *Hassel* and *Farman* discovered that using a thyroid protective collar when taking lateral head radiographs restricted the full view of the cervical spine. Therefore they developed a new CVM index which evaluated only 3 vertebrae: C2, C3 and C4. The authors found that changes in the shape of the vertebrae (concavity of the inferior border and height) may be helpful in defining the bone age and predicting the growth potential (2). *Franchi* et al modified that method and named it CS – Cervical Stage (3, 4, 5).

The ability to correctly predict the peak mandibular growth and, therefore, the growth potential of the mandible, is a vital factor allowing to take effective actions related to a relevant treatment protocol, e.g. concerning patients with craniofacial cleft disorders (6).

## OBJECTIVE OF THE STUDY

The authors attempted to define the skeletal age in children with congenital craniofacial defects, i.e. primary and secondary palate cleft.

## MATERIAL AND METHODS

The analysis covered lateral head images of 45 patients 8 to 15 years old with different types of cleft (primary and secondary palate cleft, bilateral, right or left unilateral). The bone age of the patients was assessed by means of the Cervical Stage method and with the use of the lateral radiographs:

**CS1** – inferior borders of the C2 and C3 bodies are flat, C3 and C4 are trapezoidal; the peak in mandibular growth will occur in 2 years.

**CS2** – concavity appears at the inferior border of the C2 body, C2 and C3 are trapezoid in shape; the peak in mandibular growth will occur in a year.

**CS3** – concavities are present at the inferior borders of C2 and C3 bodies, the C2 and C3 bodies are rectangular horizontal in shape; the peak in mandibular growth will last over the next year.

**CS4** – concavities are present at all the lower borders of C2, C3 and C4 bodies; C3 and C4 are rectangular horizontal; the peak in mandibular growth occurred 1-2 years before that stage.

**CS5** – concavities are present at the C2, C3 and C4 bodies; C3 or C4 is square in shape; the peak in mandibular growth ended a year before that stage.

**CS6** – concavities at the C2, C3 and C4 bodies are evident; C3 or C4 is rectangular horizontal in shape; the peak in mandibular growth ended two years before that stage.

The correlation between the bone age and chronological age was defined with the division into male and female patients.

## RESULTS

Based on the analysis of 45 lateral head radiographs of patients with primary and secondary palate clefts, the bilateral primary and secondary palate cleft (RCO) was identified in 13 patients (10 boys and 3 girls), the right primary and secondary palate cleft (RCP) in 14 patients (5 boys and 9 girls), the left primary and secondary palate cleft (RCL) in 18 patients (11 boys and 7 girls). (tab. I, II.)

Among 45 analysed lateral head radiographs of the patients with primary and secondary palate clefts, 12 patients at the average age of 10 years and 4 months were in stage CS3 as regards the skeletal development and 6 patients at the average age of 14 years and 2 months were in stage CS5. No stage CS6 of the skeletal development was recorded in any of the patients with primary and secondary palate cleft (tab. III).

The correlation rate between the skeletal age and chronological age in patients with complete bilateral cleft was 0.9 ( $p < 0.05$ ), 0.7 ( $p < 0.05$ ) in patients with complete

Table I. The number of male and female patients with a particular type of primary and secondary palate cleft.

Tabela I. Liczba pacjentów płci męskiej i żeńskiej z określonym typem rozszczepu podniebienia pierwotnego i wtórnego.

Cleft type Typ rozszczepu	Male M	Female K	Sum Suma
RCO – Total Bilateral Cleft	10	3	13
RCP – Total Right Hand Cleft	5	9	14
RCL – Total Left Hand Cleft	11	7	18
Total Ogół	26	19	45

Table II. The chronological age and stages of skeletal development in patients with primary and secondary palate clefts.

*Tabela II. Wiek metrykalny oraz stadia rozwoju szkieletowego u pacjentów z rozszczepami podniebienia pierwotnego i wtórnego.*

Age of patients with cleft <i>Wiek pacjentów z rozszczepem</i>		Stages of skeletal development <i>Stadia rozwoju szkieletowego</i>	
average <i>średnia</i>	SD	CS	N
9.4	2.2	CS1	8
10.2	1.6	CS2	10
10.4	1.3	CS3	12
13.6	1.3	CS4	9
<b>14.2</b>	<b>1.2</b>	CS5	<b>6</b>
		CS6	0

Table III. Correlation between skeletal and chronological age in all patients with different types of primary and secondary palate cleft.

*Tabela III. Korelacja pomiędzy wiekiem szkieletowym a metrykalnym u wszystkich pacjentów z różnymi typami rozszczepu podniebienia pierwotnego i wtórnego.*

Cleft type <i>Typ rozszczepu</i>	Bone vs. Chronological age <i>Wiek szkieletowy vs metrykalny</i>	
RCO – Total Bilateral Cleft	0.9	p<0.05
RCP – Total Right Hand Cleft	0.7	p<0.05
RCL – Total Left Hand Cleft	0.6	p<0.05
TRHC or TLHC <i>RCP lub RCL</i>	0.7	p<0.05
All Clefts <i>Wszystkie rozszczepy</i>	0.7	p<0.05

right unilateral cleft, 0.6 (p<0.05) in patients with complete left unilateral cleft, 0.7 (p<0.05) in patients with complete right or left unilateral cleft. The correlation rate for the entire group of patients with clefts was 0.7 (p<0.05) (tab. IV).

The correlation rate between the skeletal age and chronological age in boys with complete bilateral cleft was 0.9 (p<0.05), 0.7 (p<0.05) in boys with complete left unilateral cleft and 0.6 (p<0.05) in boys with complete right or left unilateral cleft. The correlation rate for boys with all types of clefts was 0.7 (p<0.05) (tab. V).

The correlation rate between the skeletal age and chronological age in girls with complete left unilateral cleft was 0.8 (p<0.05) and 0.6 (p<0.05) in girls with complete right or left unilateral cleft. The correlation rate for girls with all types of clefts was 0.7 (p<0.05).

Table IV. Correlation between skeletal and chronological age in male patients with different types of primary and secondary palate cleft.

*Tabela IV. Korelacja pomiędzy wiekiem metrykalnym a szkieletowym u pacjentów płci męskiej z różnymi typami rozszczepów podniebienia pierwotnego i wtórnego.*

Cleft type <i>Typ rozszczepu</i>	Bone vs. Chronological age among boys <i>Wiek szkieletowy vs metrykalny u chłopców</i>	
RCO – Total Bilateral Cleft	0.9	p<0.05
RCP – Total Right Hand Cleft	0.8	ns
RCL – Total Left Hand Cleft	0.7	p<0.05
TRHC or TLHC <i>RCP lub RCL</i>	0.6	p<0.05
All Clefts <i>Wszystkie rozszczepy</i>	0.7	p<0.05

Table V. Correlation between skeletal and chronological age in female patients with different types of primary and secondary palate cleft.

*Tabela V. Korelacja pomiędzy wiekiem metrykalnym a szkieletowym u pacjentów płci żeńskiej z różnymi typami rozszczepów podniebienia pierwotnego i wtórnego.*

Cleft type <i>Typ rozszczepu</i>	Bone vs. Chronological age among girls <i>Wiek szkieletowy vs metrykalny u dziewcząt</i>	
RCO – Total Bilateral Cleft	1.0	small numbers <i>mała liczebność</i>
RCP – Total Right Hand Cleft	0.7	ns
RCL – Total Left Hand Cleft	0.8	p<0.05
TRHC or TLHC <i>RCP lub RCL</i>	0.6	p<0.05
All Clefts <i>Wszystkie rozszczepy</i>	0.7	p<0.05

## DISCUSSION

The conducted study indicates differences between the skeletal age and chronological age in the examined patients. Development appraisal methods comprise: standard tables as biological reference systems, percentile grids, proportion indices, e.g. Quetelet's index, BMI index, morphograms, body composition indices including LBM (Lean Body Mass), BIA (Biological Impedance Analysis) and biological age assessment covering the skeletal age and development of sexual traits (7, 8). The authors found the chronological age to be the least accurate manner to assess the peak growth. On the other hand, appearance of the secondary sexual traits, analysis of the teeth mineralisation degree

and eruption timing, as well as bone age determination can be used as reference points in the assessment of the peak growth. For many years hand and wrist X-rays were used to appraise the changes occurring in specific ossification centres and to determine the skeletal age. The conclusions were developed based on the X-ray images, which allowed for the final determination of a patient's skeletal development (9). However, such images were not a part of the cleft defect diagnosis and exposed a patient to additional radiation. The problem was solved by using lateral head radiographs, which allowed to examine the morphological changes in cervical vertebrae in order to assess the skeletal age. The decision was justified, among others, by the fact that lateral head radiographs are a standard procedure in performing cephalometric analyses which, in turn, were vital for accurate orthodontic diagnostics (10, 11, 12).

The comparison of the skeletal age and chronological age of patients with developmental craniofacial defects has shown that the correlation rate in the group of patients with primary and secondary palate clefts was the highest in patients with complete bilateral primary and secondary palate cleft and the lowest in patients with complete light unilateral primary and secondary palate cleft. The analysis of the outcomes in male patients has brought similar conclusions, whereas in girls the highest value of the correlation rate has been recorded in the cases of complete left unilateral cleft. However, it should be borne in mind that the number of female patients with complete bilateral cleft was too low to consider the correlation rate statistically significant. In the literature concerning dentistry in Poland and abroad there are no reports on the correlation between the skeletal age and chronological age in patients with complete primary and secondary palate clefts, hence it is difficult to refer the obtained results to the studies of other authors (13, 14).

The analysis of the time of the peak growth, covering primarily stages CS3 and CS4, indicated that the slowdown (the beginning of CS5) takes place at an earlier chronological age in patients without developmental craniofacial disorders than in patients with primary and secondary palate clefts.

## CONCLUSIONS

The chronological age of children with developmental craniofacial defects (primary and secondary palate cleft) in relation to the stages of skeletal development, indicates a difference of about one year in plus and that fact should be taken into account when choosing orthodontic treatment.

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