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A COMPARISON OF THREE METHODS OF PLANTOGRAPHIC FOOT EXCAVATION ASSESSMENT*

ABSTRACT: Basing on results of cross-sectional medical and anthropometric examinations of 1648 5—19 year-old children (839 boys, 809 girls) from Katowice conurbation, the authors estimated mathematical interdependences between values of Chippaux-Šmiřák, Wejsflog and Schwartz-Clarke plantographic indexes of foot excavation. In the light of statistical analysis it can be stated that foot excavation assessment by means of one of the three analysed methods is sufficient to assess both longitudinal and transverse arch of foot in screening examination.

KEY WORDS: Children — Foot excavation — Plantography — Chippaux-Šmiřák index — Wejsflog index — Schwartz-Clarke index — Interdependences between indexes of foot excavation.

INTRODUCTION

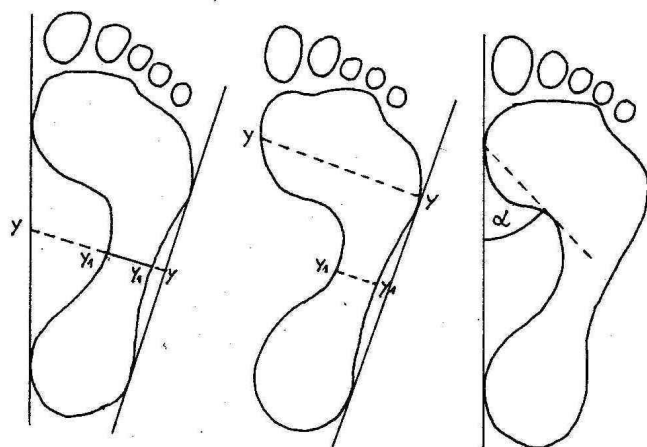
The assessment of foot excavation is part and parcel of its morphology description. The most objective picture of three-dimensional relations of foot bones is given by the radiological method, but both this and the surgico-orthopaedic one, loaded with great subjectivism, cannot be used in screening examinations. Comparability and repeatability can be ensured using methods resting on anthropometric (Matysiak 1980, Szymańska-Parkieta 1977) and podoscopic (Pisani 1983) measurements (often very expensive) as well as cheap, valuable and easy-to-perform methods resting on the assessment of a plantogram (Kurniewicz-Witczakowa 1966; Kurniewicz-Witczakowa, Furman 1959, Šmahel 1977; Ziemlińska 1958). In this paper we have decided to assess mathematical interdependences between index values of three simple and the most widespread methods of plantographic foot excavation assessment, i.e. Chippaux-Šmiřák, Wejsflog and Schwartz-Clarke methods, in order to use them interchangeably for simultaneous, both longitudinal and transverse, foot excavation assessment.

MATERIAL

Cross-sectional studies of 5—19 year-old children and youngsters were carried out in primary, grammar and secondary schools, chosen and random in Katowice conurbation (south of Poland). Examinations were carried on till having about 40 children in each age and sex category. 1648 children (839 boys and 809 girls) in all were examined. They represent all socio-economic groups of the ethnically homogeneous population of the conurbation.

METHODS

Plantograms of both left and right feet of healthy children, i.e. free of recent trauma anamnesis of the lower limbs, inborn or acquired pathology of the locomotor system (except for the static flat foot deformity), were recorded in the usual manner with transmission of the whole body weight to the examined foot with the use of dactyloscopic printing-ink for the footprints. The longitudinal arch was assessed with the methods devised by Chippaux-Šmiřák (1947, 1960) and Wejsflog (1955), the transverse one by measurement of the alpha angle as proposed by Schwartz et al. (1928) and applied by Clarke (1933) (Figure 1 — detailed description of the three methods is to be found in the literature quoted in references).



/a/. $I = \frac{100 \times X}{Y-Y'}$ /b/. $I = \frac{100 \times X}{Y-Y'}$ /c/. $I = \text{alpha angle}$

FIGURE 1. Methods of plantographic assessment of foot excavation according to Wejsflog (a), Chippaux-Šmiřák (b), Schwartz-Clarke (c).

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The data obtained were analysed with statistical procedure of regression and correlation analysis, t-test for "b" coefficient of regression equation, F-test for correlation coefficient using personal computer.

RESULTS

Interdependences between indexes for left and right feet of the children examined are shown in Table 1.

Longitudinal and transverse foot arch index values are mutually correlated positively or negatively, but always the two indexes in regression change in the same direction — they describe worsening or improvement of foot excavation. All the analysed regressions are, in the light of t-test for "b" coefficient, statistically very highly significant ($p < 0.001$). Regression coefficients for dependences of Chippaux-Šmiřák and Wejsflog indexes are so high (profitably equal to 1) that they suggest strict, functional-like dependence between the above mentioned indexes of longitudinal excavation.

TABLE 1. Regression and correlation coefficients for regression equations.

	boys		girls	
	left feet	right feet	left feet	right feet
Ch-Šm vs Wejsf.	a = 1.03 b = 1.23* r = 0.99*	a = 1.18 b = 1.24* r = 0.98*	a = 0.35 b = 1.26* r = 0.99*	a = 0.35 b = 1.27* r = 0.99*
Sc-Cl vs Ch-Šm	a = 67.38 b = -0.85* r = 0.64*	a = 63.84 b = -0.74* r = 0.63*	a = 65.09 b = -0.84* r = 0.59*	a = 65.48 b = -0.84* r = 0.60*
Sc-Cl vs Wejsf.	a = 85.64 b = -1.08* r = 0.65*	a = 82.31 b = -0.97* r = 0.65*	a = 85.53 b = -1.08* r = 0.59*	a = 85.46 b = -1.09* r = 0.62*

* - $p < 0.001$

DISCUSSION

The theoretical assumptions for plantographic methods of foot excavation assessment of Chippaux-Šmiřák and Wejsflog are very similar, what makes the values of indexes based on them so highly correlated that one can recognize the existence of functional-like interdependence. Both above mentioned indexes can be used for the assessment of longitudinal foot arch interchangeably.

In 1928 Schwartz introduced transverse foot arch assessment by means of the alpha angle. The method was spread by Clarke (1933) as "assessment of longitudinal foot arch height" and is generally used.

A considerable dependence between the foot excavation index of Schwartz-Clarke and the longitudinal foot excavation indexes of Chippaux-Šmiřák (Šmahel 1977) and Godunov-Sztritter (Łuba, Twardowski 1978, Prętkiewicz 1979) has been proved, but it does not allow to state that correlated indexes describe the same feature of foot excavation.

In our studies we have admitted Schwartz-Clarke angle as the index of transverse foot excavation and the results of regression and correlation analyses obtained confirm the aptness of this option. They also show limited possibilities (i.e. usefulness for

screening examinations but not for scientific procedure) for conclusions concerning longitudinal excavation based on the values of transverse excavation and vice versa.

CONCLUSIONS

1. One can recognize the existence of functional-like interdependences between Chippaux-Šmiřák and Wejsflog indexes, suggesting the possibility of their interchangeable use.
2. The separate use of each of the three investigated methods allows sufficient assessment of both longitudinal and transverse foot arch in screening examinations, but seems insufficient in scientific procedure.

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