STEPS IN THE EVALUATION FROM THE "RADIUS METHOD" TO THE "IMPROVED RADIUS METHOD WITH INTERSECTION POINT"

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INTRODUCTION

Just after the war, the Departement of Physical Education of the University of Southern California had set among its admission tets to the Masters program a posture test drawn from silhouette -types described as good, fair, poor or very poor.

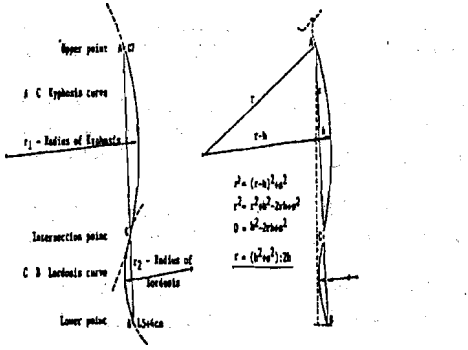
About ten years later, in countries of Eastern Europe, Wolanski used a simple "apparatus" called Kyfolordosometer with which 4 extreme points of the spinal curve helped to establish 3 angles (alpha, beta, gamma) and 9 types of postures constituting 3 groups: equilibrated, lordotic, and kyphotic.

In the seventies, Dr Iwanowski of the AWF Wroclaw created a mechanical apparatus called "Rejestator sferosometryczny" for measurement of the spinal curves with interpretation of 3 angles. A communication was made on this subject by Iwanowski at the "2nd International Symposium on Biomechanics in Swimming (Brussels, August 27-30, 1974).

In 1970, the E C O Laboratory was created, at the Institute of Physical Education of U.C.L., and a study on the use of electronics in the measurement of the rachis curves was started. The Wielki's Electronic Spherosomatograph" was born and basic studies in methodology were started.

METHODOLOGY

In 1975. Iwanowski stayed for a stage of research at Labo JECO in preparation for his agregation. He had developed a mechanical apparatus for measurement of the spine and was researching for a suitable methodology.

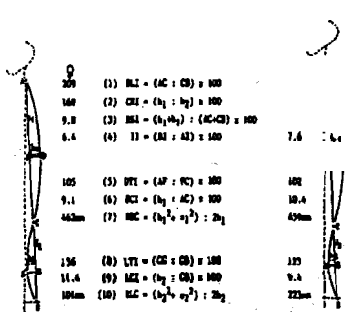


A study of Labo E C O of 20 variables selected from 40 collected by Iwanowski and 3 angles of the spinal curve (the upper angle of kyphosis, the inferior angle of Kyphosis and the angle of lordosis) on 1207 boys and 1174 girls aged between 7 and 14 showed that:

1. the vertebral angles evoluate totally independently;
2. there is no relation between angular and somatic development;
3. the relation between the angles could be probably influenced by the functional activities of the child.

This confirmed our earlier studies about the functional adaptation of the rachis under the influence of sports activities. It was therefore concluded that the mechanical

apparatus is insufficient for the interpretation of the physiological rachis curves as we had advocated when we started with the electronic spherosomatograph and we had begun to apply the "Radius Method" whose principles are presented hereafter.



1. The study of the rachis must be based on a safe and unequivocal system of reference.

2. The system of reference for the dorsal and lumbar curves must be the same in order to allow an interpretation of the whole curve.

3. The point C where the rachis curve bends from its kyphotic form into lordotic form and changes of place is very important.

4. The straight line from the upper point A, at C7, to C is in our study, called the cord of the arc AC.

5. Similarely, the straight line from the lower point B, at L5 + 4 cm. to C is called the cord of the arc BC.

6. Each of the curves, dorsal and lumbar, can be expressed in function of the vertical plane and the horizontal plane.

7. In free-standing active position and due to the human structure, the spine is verticalised but also. leaning slightly forward as, of course. are the curves. Therefore. analysis and interpretation of the curves must be made in function of the inclination of the rachis and not of the vertical as in the angular method.

8. The top of each curve (D for the dorsal. E for the lumbar) is calculated in function of the cord of the curve. It does not coincide with the height of the arc. It is situated higher or lower than the height of the arc.

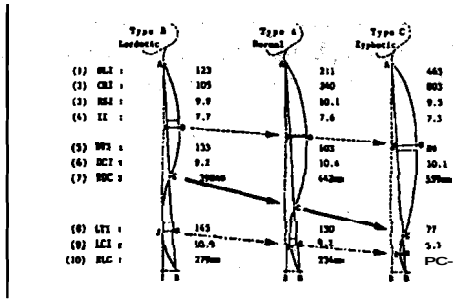
9. Pilot studies have shown that the curves are dependent one of the other. A common system of reference can thus be applied on them. It showed that the straight line from upper point A to lower point B of the rachis crosses the rachis at point C, common to the two curves. Therefora C is the intersection point.

10. A mathematical model for the adults shows that 4 cm. 8% of length must be added to the end of the lumbar curve in order to fix the lower point B. For the children 3 cm have been taken into account.

11. The length of each curve can be expressed in function of the radius which can be calculated by the use of the theorem of Pythagoras where the following variables are used:- h1 = height, s1 = half cord of the dorsal curve and h2 and s2 for the lumbar curve to establish the size of the radius of each curve.

FIRST STEP: The Radius Method and three Groups of rachis curves

Some further points were gradually added to the above principles after fundamental and pilot studies had shown that the dorsal and the lumbar rachis curves of normal subjects in a free standing position could be represented by the size of their radius. This allowed to compare the subjects objectively and free the evaluation of the rachis curves from the subjectivity of the silhouette type of analysis.



Experimentation showed that:

1. Analysis of the physiological curves of the spine in the saggital plane (Kyphosis and Lordosis) must be in relation to their cords, **wich** together **form** a straight line;

2. Analysis in the frontal plane **(Scoliosis)** must be in relation, to the vertical and take into consideration the total inclination of the rachis. Computation of the ratio of the length of the dorsal part of the rachis to the lumbar part of about 500 healthy students (male and female) gave a x of about **200.** This value of the ratio confirmed for a majority of subjects in further investigations conducted on different groups and could thus be regarded as significative.

The subjects with a ratio **dorsal/lumbar** of about **200,** which were the **majorrity** were classified as Group A Normal.

Those with a ratio **dorsal/lumbar** of about 100 belong to Group B **Lordotic** and when the ratio is about 400 they belong to Group C Kyphotic.

SECOND STEP: The "Developed Radius Method with Intersection Point" Three Main Types of rachis curves.

After applying the "Radius Method" to different **Groups** and more particularly 'to sportsmen and sporstswomen, it appeared that the ratio length of dorsal curve to length of lumbar curve had to be completed by other indexes if all the differences and changes of the rachis could be understood. 10 Indexes were gradually worked out. They were applied to subjects **without** distinction of sex. The "Radius Method with Intersection Point", a more elaborate method, showed the importance of the heights of the curves in the understanding of the deviation as well as, particularly, the deformations of the rachis.

The notion of group was replaced by the notion of type. Three main type for men and women together were established with more precision:

Type A Normal with a x of 215.

Type B **Lordotic** with a x of 118 and

Type C Kyphotic with a x of 397.

The ten Indexes were not conceived under the same name or in the present order at the same time. They were arrived at gradually.

Definition of ten Indexes characterizing the anatomical Rachis Curves

Four Indexes characterize the whole profile of the Rachis.

1. **Dorso-Lumbar** Index: Relation between lengths of dorsal and lumbar parts **DLI(1) = (AC :CB) x** 100.

2. Curve Relative Index: Relation between the heights of dorsal and lumbar parts. **DCI(2) =** (h1 : h2) x 100.

3. Relative Summation Index: Ratio of sum of both heights to the total length of the rachis, **RSI(3) = (** h1 + h2) : AB x 100.

4. Inclination Index: Inclination of the rachis to the vertical, relation between length of the horizontal passing through the lower point B to the vertical passing through the upper point A multiplied by hundred. **II(4) = (** BI : AI) x 100.

Three Indexes for the Dorsal part.

5. Dorsal Top Index: Position of the top (D) of the dorsal part of the rachis, it is relation of the distance between the projection of the top of the dorsal curve (D) to the upper point A on one hand to the intersection point C on the other hand multiplied by hunderd: DTI(5) =(AF : FC) x 100.

6. Dorsal Curve Index: Relation between height and length of the dorsal curve multiplied by hundred. DCI(6) = (h1 : AC) x 100.

7. Radius Dorsal Curve: Radius of the circle closest to the dorsal part of the rachis, it is the sum of the square of half the cord (s1) of the dorsal part of the rachis and the square of the height (h1) divided by 2h1 RDC(7) = (s1 + h1) : 2h1.

Three Indexes fot the Lumbar part.

8. Lumbar top Index: Position of the top (E) of the lumbar part of the rachis it is the relation of the distance between the projection of the top of the lumbar curve E to the intersection point C on one hand and the lower point B on the other hand multiplied by hundred. LTI(8) =(CG : GB) x 100

9. Lumbar Curve Index: Relation between height and length of the lumbar curve multiplied by hundred. LCI(9) = (h : CB) x 100.

10. Radius Lumbar Curve: Radius of circle closest to the lumbar part of the rachis, it is the sum of the square of the cord (s2) of the lumbar part of the rachis and square of the height (h2) divided by 2h2. RLC(10) = (s2 + h2) : 2h2.

THIRD STEP: Improved Radius Method with Intersection Point

Normative Typology by sex

In order on the one hand to answer to requests of the sports organisationbeen to know how to improve performance and on the other hand to understand the abnormal changes caused to the spines of high performance athletes with the intention to find how to avoid them, a new study was set up wich a homogeneous selected group of 190 women and 296 men forming a "Normative Group" for each sex.

Analysis showed, once again the importance of the height of the dorsal curve and the height of the lumbar curve. Changes taking place in the height and length of one curve induce changes in the height and length of the other curve and vice-versa.

The " Normative Group " allowed to establish a "Normative Typology" for each sex. Comparing the individual spherosomatogram with the means of his Normative Type, one can see how he is placed in the Normative Type to whom he belongs.

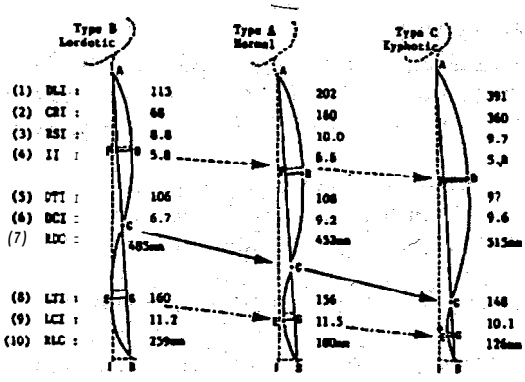
By an analysing. the spherosomatogram one can know if certain particularities are symptomatic or asymptomatic and understand the functional changes of the rachis.

The prototype of the spherosomatograph was used in the described research which is an "Indirect method" for the following reason:

- At first the registration of the spinal curve and the drawing of the shape corresponding exactly to the different variables are made electronically; then. the Indexes are computed with a scientific calculator using the variables measured and establish by the operator.
- No measurement has been taken manually on the subject, the values of the variables and the Indexes are totally exact thanks to the reliability of the electronics and its independence from human error and manipulation.
- The analysis and the repartition in "Typologies"is the last stage, it remains the domain of experience and intellectual scientifical work.

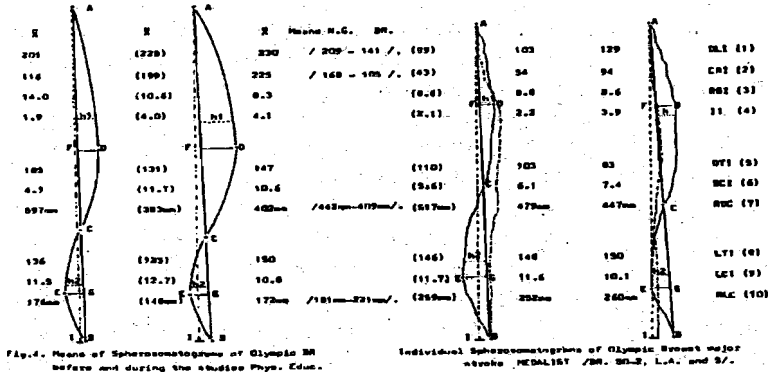
In 1983, the prototype of the "Electronic Spherosomatograph" was connected to a small computer /Apple/. The aim was to obtain by "Direct Method and a suitable software the values of the indexes and the repartition in typologies. Intellectual analysis of "Individual Spherosomatograms" remained indispensable for the discussion of the functionnal adaptation, deviation, or even deformation of the spinal curves (rachi's).

However interesting and fast, the "Direct Method" has the drawback: that the a person under examinations cannot see himself the result; the visibility of graphic-shape when comments have to be about some changes of the rachis or a readaptation is necessary.



CONCLUSION

The "Wielki's Electronic Spherosomatograph" and the different steps of "Improved Radius Method with Intersection Point" were described in several publications since 1979.



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A synthesis was necessary in order that some aspect would not be miscontrued. Accurate knowledge is imperative for the much needed gathering of variables in "Normative Groups" different from the one used in this research.

It is most probable that the first and second indexes /LDI(1), CRI(2)/ differ but next to this possible eventuality, there could also be impossibilities resulting from mistaken interpretation of the method and the technic measurement.

To end this paper, let me express the hope that several Research Centers will establish a Typology by Direct or Indirect Method, so that we can compare and work toward a Universal Typology valid for adults and children of industrial Countries.