

A SIMPLE APPLICATION OF ORTHOROENTGENOGRAPHY

By

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Every orthopedic surgeon working in the field of skeletal growth very often faces the problem of how to record the length of the bones and especially those of the lower extremities with a method more accurate than those used in clinical practice.

Some years ago only clinical methods were in use and the measurements were in this way more or less crude. Some roentgenological methods have been developed in recent years to obtain more accurate measurements.

Teleroentgenography although permitting more accurate measurements includes several sources of error. White's method (1940) on the other hand is very simple and exact but gives only the existing difference in length between two unequal extremities and not their whole length.

In 1946 Green, Wyatt and Anderson described a new method which they called "orthoroentgenography". This seems to be the most accurate existing method for the above-mentioned purpose. Using the central rays three radiograms are taken. The tube is successively centered over the hips, the knees and the ankles of the leg and all three exposures are taken on the same film, which is a special long film (35 × 90 cm.).

A modification of this method, the "spot orthoroentgenography" was reported by Goldstein and Dreisinger in 1950.

In both these methods a long film (35 × 90 cm.) and a cassette of the same dimensions are necessary and a special brass cylinder in addition in Goldstein and Dreisinger's method. To possess such a cassette and to use such long films is not always possible so that this valuable method has a limited application.

Merrill (1942) described a method which also allows exact measurements. He used three exposures on normal separate films and per-

formed the measurements with the aid of a superimposed numbered metallic scale.

The necessity of having a more practical and less expensive method led the author to develop the following: it is a simple method permitting the use of all the principles of orthoroentgenography with the same degree of accuracy as the original method, applicable even in the simplest X-ray equipment.

The apparatus: A metallic orthogonal frame with its two long sides subdivided in centimeters and millimeters and with six metallic rods parallel to the shorter sides of the frame and moved on its long sides. This is all the apparatus necessary and it is not so expensive¹.

Three ordinary cassettes (40 × 15 cm.) or six cassettes (13 × 18 cm.)—for the cases with severe discrepancies in length or great deformities—can be placed each between two rods, the cassette-holders. From a long splint in the scaled sides of the frame the cassettes can be placed in position or removed without moving the patient at all. The apparatus is placed under a low table of plastic on which the patient is lying. Both apparatus and plastic table are placed on the X-ray table.

Centering: The exact centering in the present method is ensured by a metallic wire encircling each cassette exteriorly in a middle line. As the rods are 5 cm. large, however, only a 5 cm. wide surface of the film is exposed on the X-ray irradiation and in this way also the exact centering is more easily secured.

Technique: The patient lies supine on the plastic table with the frame beneath him, his legs are a little abducted in order to be parallel to the longitudinal axis of the frame. Then they are immobilised in this position with a compressive band. A wooden block under the knees holds both femora parallel and horizontal. Skin marks are drawn on the skin of the patient, as far as possible exactly over his joint spaces. Existing deviations of the pelvis are corrected so that the plane passes from the two anterior superior iliac spines perpendicular to the longitudinal axis of the frame. Then the rods, the cassette-holders, will be moved up or down in order that each cassette is on a level with one joint and so that both the wire and the skin marks may be on the same perpendicular plane. The distance from one cassette to the other can be noticed from the scaled sides of the frame and this will be marked on the film itself by guide numbers.

The X-ray tube will be successively centered on exactly the same perpendicular plane with the skin marks and the metallic wire. Then

¹ The costs for the construction of the apparatus have been estimated up to 1,600 sw. cr. by the Firm "Georg Schönander", Stockholm.

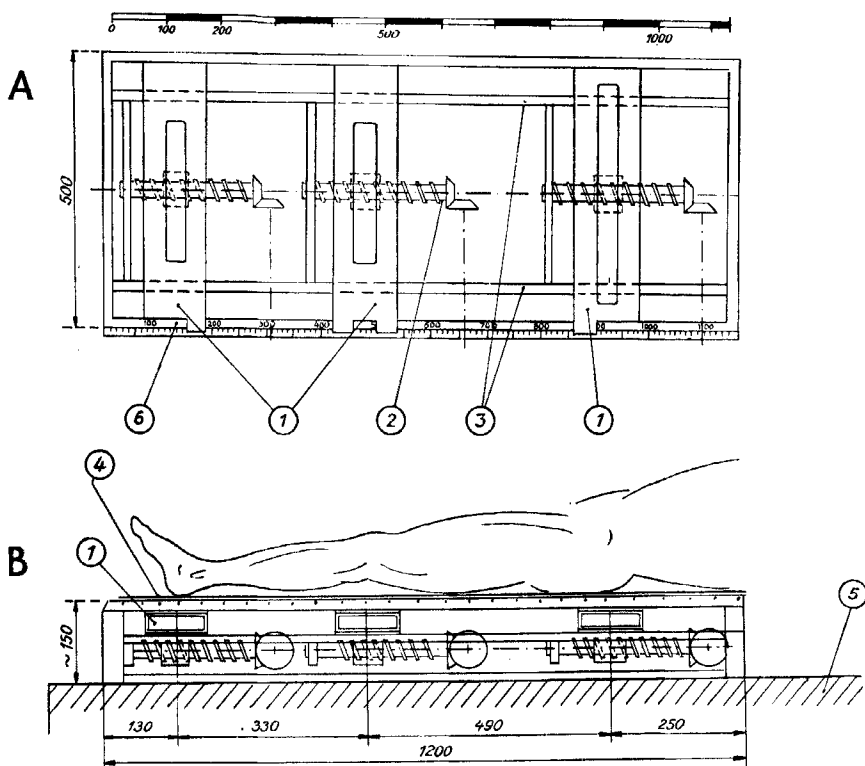


Fig. 1.

A. Sketch of the apparatus

B. Sketch of the apparatus with the patient lying on it.

separate exposures will be taken for both hips, both knees and both ankles. In cases in which the existence of contractures and deformities of the pelvis or a severe longitudinal discrepancy of the extremities does not permit accurate centering for both joints at the same time separate exposures for the three joints of each leg will be taken. In such cases six cassettes (13×18 cm.) must be used.

The target-to-film distance used by Green, Wyatt and Anderson was 183 cm. Goldstein and Dreisinger tried measurements with a target-to-film distance both 183 and 100 cm. and they did not observe any difference in the measurements.

Measurements: Measurements are performed as follows: The part of the femur included in both the hip and the knee roentgenograms is measured with the aid of an ordinary numbered scale and the defined distance between the two cassettes is added and in this way the whole length of each femur is calculated.

Discussion on the present method: The described method represents a combination of Merrill's and Green, Wyatt and Anderson's method. Against the Merrill method there is the advantage that a technique of checking the accuracy of focus is provided. Against the Green, Wyatt and Anderson's method apart from its easier application and diminished cost, the present method has the advantage of overcoming some sources of error arising from the use of long films. As to the clinical application the present method is more simple because it permits all the manoeuvres to be performed without moving the patient.

The sources of error quoted by Goldstein and Dreisinger for their method are the same as in Green, Wyatt and Anderson's method:

A. The exact centering of the tube on each joint space is a very important factor for the accuracy of the measurements. A difference of about 5.5 cm. in centering the exposure of the hip and the same as regards the ankle can give an error of 1.3 per cent, that is 0.91 cm. for a 70 cm. long leg. In many cases the exposure must be repeated in order to secure a good centering and in such cases long films must be wasted in both the orthoroentgenographic methods.

B. Errors from the film itself: a) the average processing of shrinkage of films 90 cm. long is 0.25 per cent. b) humidity expansion per 10 per cent of relative humidity is 0.11 per cent. c) thermal expansion per 10 per cent Fahrenheit is 0.66 per cent.

A disadvantage of the present method is the use of three separate measurements. It is clear that the more measurements there are the more become the sources of error.

S U M M A R Y

A technic for the accurate roentgenologic measurements of the leg-length of the lower extremities is described. The author's apparatus is based on the same principle as Green and Anderson's "Orthoroentgenography" but it has an easier application and in the same time gives in some degree more accurate measurements than the former.

R E S U M E

Une technique pour la mensuration roentgenologique de la longueur des extrémités inférieures est décrite. L'appareil de l'auteur est basé sur les mêmes principes que l'« Orthoroentgénographie » de Green et Anderson, mais il est d'une application plus facile permettant d'effectuer dans une certaine mesure des mensurations plus précises que celui-ci.

ZUSAMMENFASSUNG

Die Technik für die röntgenologische Messung der Länge der unteren Extremitäten ist beschrieben. Der Apparat des Verfassers basiert auf denselben Prinzipien wie die „Orthoröntgenographie“ von Green und Anderson, doch ist die Handhabung vereinfacht und gestattet eine grössere Genauigkeit der durchzuführenden Messungen.

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