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A MORE EXACT MEASUREMENT OF THE SAGITTAL STABILITY OF THE KNEE JOINT

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For a more objective evaluation of injuries to the anterior cruciate ligament the ordinary clinical test for sagittal instability of the knee joint is used. In this technique the examining physician positions himself in front of the knee so that the displacement of the knee joint occurs towards him, but it is then difficult to estimate the extent of the displacement. A better arrangement is to have one person pull on the knee while another stands at the side of the knee and observes the forward displacement. This is done for both knees and a comparison of them is then made. Even with this method it is difficult to measure the true difference in the sagittal mobility, and a number of more objective techniques have been worked out. Volkow (1971) designed a device with which he could measure the sagittal instability in linear units (millimeters), and another method has been reported by Kennedy (1971).

MATERIAL AND METHODS

At the Department of Orthopaedics, Regional Hospital, Linköping, a special apparatus for this purpose has been in use for a number of years; it was designed by O. Lindahl with the collaboration of E. Raeder, an engineer. The apparatus, which is shown in Figure 1, consists of a curved metal plate, of large area, which is placed on the surface of the thigh. Supported on the tibial tuberositas is a freely sliding sphere whose displacement can be measured on a scale. The accuracy of this technique was examined as follows.

On 50 subjects with sound knees 5 measurements of the sagittal instability of the knee joint were performed on each knee, making a total of 500 measurements. The subjects were patients who had sought advice for ailments not involving the legs or knees and who had stated on questioning that they had sound knees, with no history of trauma. The age and sex distributions are shown in Table 1.

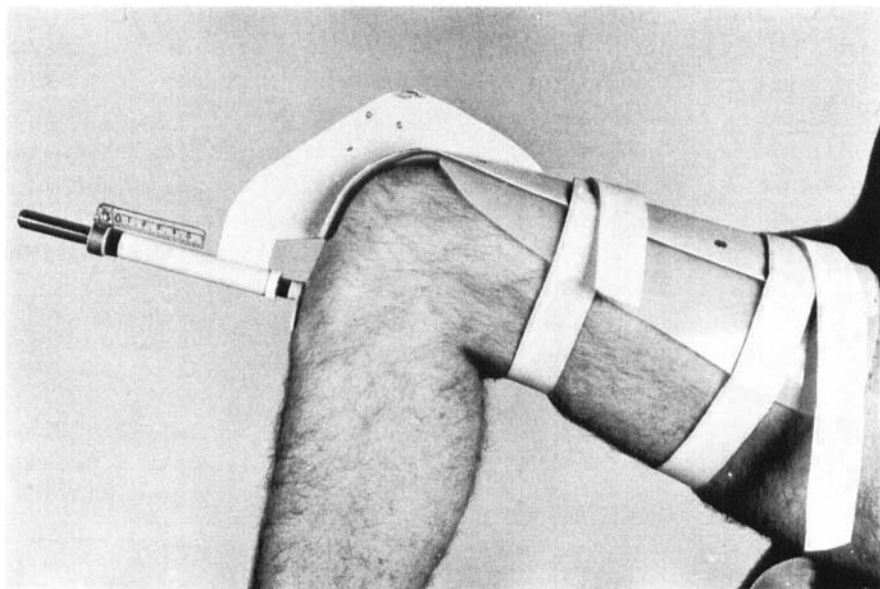


Figure 1. Apparatus in position for measurement.

Table 1. Age and sex distribution of the examined subjects.

Age	10-20	21-30	31-40	41-50	51-60
Males	5	5	5	5	5
Females	5	5	5	5	5

RESULTS

The mean sagittal instability for different age groups and for the two sexes is given in Table 2. The values were slightly greater for males than for females, but the difference is not significant. The sagittal instability increased with age for both sexes, and the difference between the means for the sexes is significant ($P < 0.005$). The mean sagittal instability was somewhat less than 5 mm (range 1-10 mm). The mean difference between the greater and the smaller values for the two knees was about 1 mm (Table 3).

The implications of these figures for a differential diagnosis may be judged on the following basis. A difference exceeding 2.5 mm would be expected in five subjects out of 100 of a normal material, a difference of more than 4.2 in one out of 1000. The calculation is based on five

determinations on each knee. It is also assumed that the values are normally distributed; it would be noted that the limiting values 2.5, 3.3 and 4.2 mm are only estimates obtained from the material presented in this study. The reproducibility of the method was examined by having five investigators each perform three measurements on the same knee. Each investigator reported the same values for all three measurements; two recorded 5 mm and three 4 mm. To obtain an impression of how complete muscular relaxation affects the sagittal instability of the knee joint, measurements were also performed on 10 subjects before and after inducing general anaesthesia. There was no notable difference in the magnitude of the instability.

Table 2. Magnitude of sagittal instability; mean values for the age and sex groups.

Age	10-20	21-30	31-40	41-50	51-60	10-60
Males	4.24	5.00	4.90	4.80	6.78	5.14
Females	3.02	4.44	4.80	3.94	5.12	4.25
Both sexes	3.63	4.72	4.85	4.37	5.95	4.70

Table 3. Difference in sagittal instability of the two knees; mean values for the age and sex groups.

Age	10-20	21-30	31-40	41-50	51-60	10-60
Males	0.96	0.88	1.16	1.52	1.00	1.10
Females	0.60	1.12	0.96	1.08	0.88	0.93
Both sexes	0.78	1.00	1.06	1.30	0.94	1.02

DISCUSSION

Although the usual method for estimating the anterior sagittal instability of the knee joint has obvious shortcomings, great importance is still ascribed to it in the diagnosis and in the evaluation of the results after reconstruction of the cruciate ligaments (Gillquist et al. 1971). Results with fairly exact measurements have been reported. For instance, Volkow found that a sagittal instability of more than 10 mm is indicative of damage to the anterior cruciate ligament. Using a more complex method, Kennedy found that the sagittal instability of the knee joint in a group of 115 athletes ranged from 0 to 5 mm. In the present study in normal subjects values between 1 and 10 mm were found, but

the difference between the two knees was never more than a millimetre or so. This difference is thus considerably more significant than the value for the individual knee. For a group of patients undergoing operations at this department for rupture of the anterior cruciate ligament the sagittal instability ranged from 0 to 12 mm, while the difference between the knees was never less than 5 mm. The advantage of this method, which differs from that used hitherto only in respect of the actual grading of the sagittal instability, is that besides giving a more exact measurement it also gives the difference between the knees, a measurement that is a considerably more reliable measure of the instability than is the value for the relevant knee joint.

In a further study an examination will be made of the correlation between postoperative sagittal instability of the knee joint and a subjective feeling of instability of the knee.

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