9. STUDIES ON THE MUSCLE STRENGTH AROUND THE ELBOW JOINT

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The only Kansetsu-waza (joint technique) allowed in Judo is the joint lock of the elbow joint. This is due to the fact that the muscle strength around the elbow joint is neither too strong (if it is too strong, it is not possible to perform the joint lock, for example the hip joint) nor too weak (if it is too weak, it is dangerous, for example, the finger joints), and also the direction of joint movement is varied, and consequently, there is very little danger involved.

This being the case, it is important from the kinesiologic point of view of measure muscle strength relating to the elbow joint when the joint is in various positions. However, there are certain difficulties encountered in the measurement of muscle strength in this region when the usual measuring instruments are used, and in order to overcome these difficulties a dynamometer suited to the purpose of the experiment was devised.

METHOD OF INVESTIGATION

The muscle strength in the region of the elbow joint depends on the angle of the elbow joint, and also on the direction of the joint movement. The elbow joint is capable of very complex movement: flextion, extension, adduction, abduction, pronation, and supination. Of these movements, pronation and supination which constitute the twisting movements of the wrist were omitted from the study, since they have little significance in the Kansetsu-waza and, also require a different kind of measuring apparatus. The elbow joint was fixed in a supinated position while the experiments were being performed. Consequently, measurements were made of the muscle strength when the elbow joint was in flexion, extension, adduction, or abduction, and for this purpose a special dyanamometer was devised.

Fig. 1 illustrates the part of the apparatus to which pressure of the muscle strength to be studied is applied. As shown in the illustration, one side of the quadrilateral forms the grip and the other three sides are capable of parallel movements, laterally and longitudinally. The pressure applied to the grip is transmitted by this quadrilateral to the circular ring which is distorted by the pressure. This distortion is picked up by a strain gauge and transmitted to a recording meter. By converting the recorded strain to units of weight, the strength applied may be known.

Fig. 2 shows the complete form of the dynamometer. The position of the grip may be regulated according to the length of the arm, and also, in order to make measurements by changing the angle of the elbow, an ergometer is devised to revolve fanwise so that the direction of strength is always parallel to the part upon which the pressure is applied.

Four male healthy adults were selected as experimental subjects.

RESULT AND DISCUSSION

Extension (Fig. 3)

The extension strength was at a maximum when the angle of the elbow was at a right angle, and as the angle increased the strength decreased, and when the angle reached 180°, the strength usually became zero, however, in the case of M., a slight increase was noted. This is thought to be the result of applying strength to the shoulder.

Flexion (Fig. 4)

Measurements of flexion strength disclosed an approximately similar tendency to that of extension strength. The flexion strength, when the elbow joint was at an angle of 90° was approximately 15 kg., and when at an angle of 180°, it was approximately 5 kg. The comparatively small individual differences seen in flexion strength are probably due to the fact that it is possible to measure flexion strength more accurately than extension strength. Flexion strength and extension stength are almost parallel, however, in general, the latter is somewhat weaker.

Adduction and abduction (Fig. 5 and 6).

The adduction and abduction strengths were almost uniform, regardless of the angle of the elbow, and the average values were 5 kg. and 4 kg., respectively, indicating that the adduction strength was somewhat greater than the abduction strength.

CONCLUSION

1) Measurments of muscle strength of extension, flexion, adduction, and abduction were made by varying the angle of the elbow joint (90°, 120°, 150°, and 180°). Results (average values) are summarized in the accompanying table.

	90°	120°	150°	180°
Flexion	14.88	11.06	7.70	4.90
Extension	10.68	8.40	6.82	1.80
Adduction	4.08	3.60	4.88	2.48
Abduction	5.30	4.78	4.92	4.46

2) Extension and flexion strengths are the greatest when the elbow joint is at an angle of 90°, and decrease with increase in the angle of the elbow joint.

3) Adduction and abduction strengths are weaker than extension or flexion strength, and are unrelated to the angle of the elbow joint.

4) It is easier to perform the Kansetsu-waza when the angle of the elbow joint of the Uke (partner on whom the technique is performed) is greater than 90°, and as the angle increases the easier it becomes for the Tori (partner who performs the technique) to perform the technique.

5) In performing the Kansetsu-waza, it is advantageous to the Tori if his elbow joint is also flexed, and it is still better if he uses both arms.

6) When the elbow joint of the Uke is flexed and difficult to perform the Kansetsu-waza, the elbow joint should be first adduced or abduced and then extended, because, there is less resistance

encountered when the elbow is adduced or abduced. However, in this case, it is better to abduce the elbow joint, because by adducing the elbow joint the wrist joint becomes pronated and facilitates the Uke to free himself.

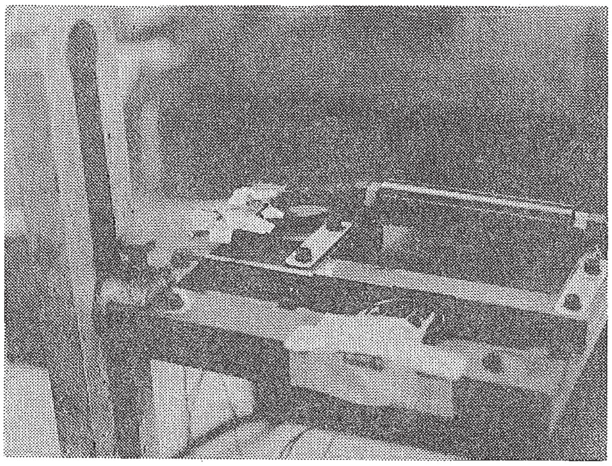

Fig. 1 Part of apparatus to which pressure is applied

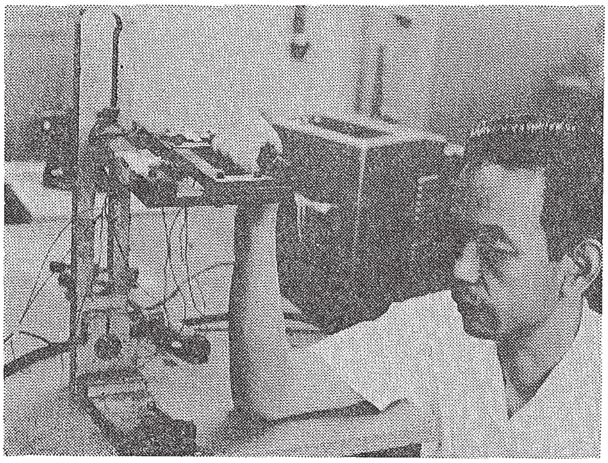

Fig. 2 Posture during measurement

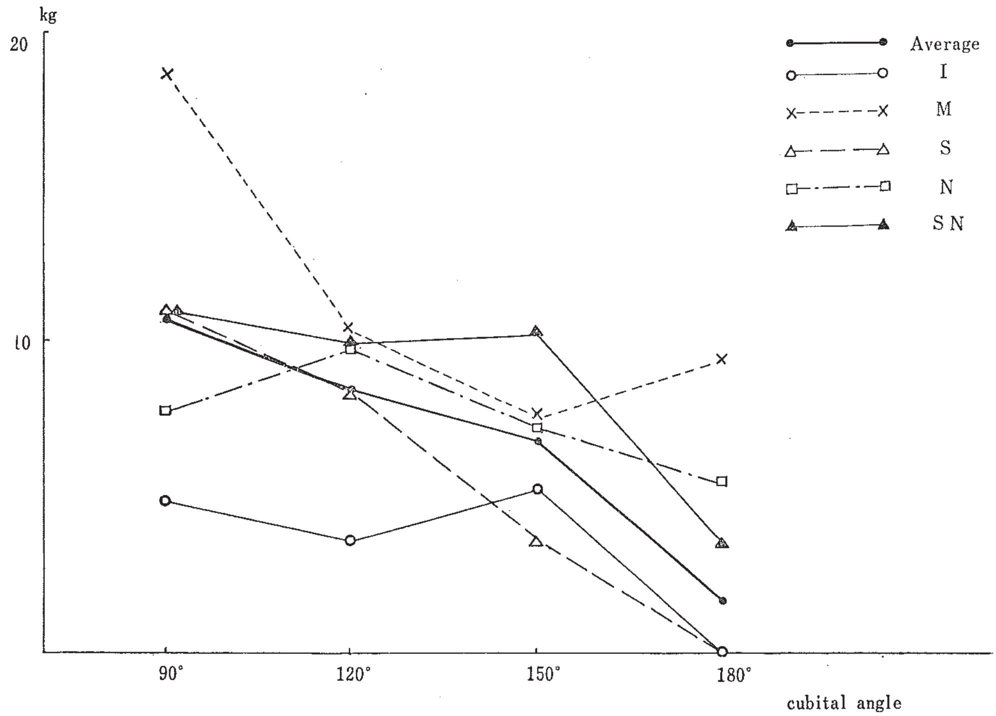

Fig. 3 Extension

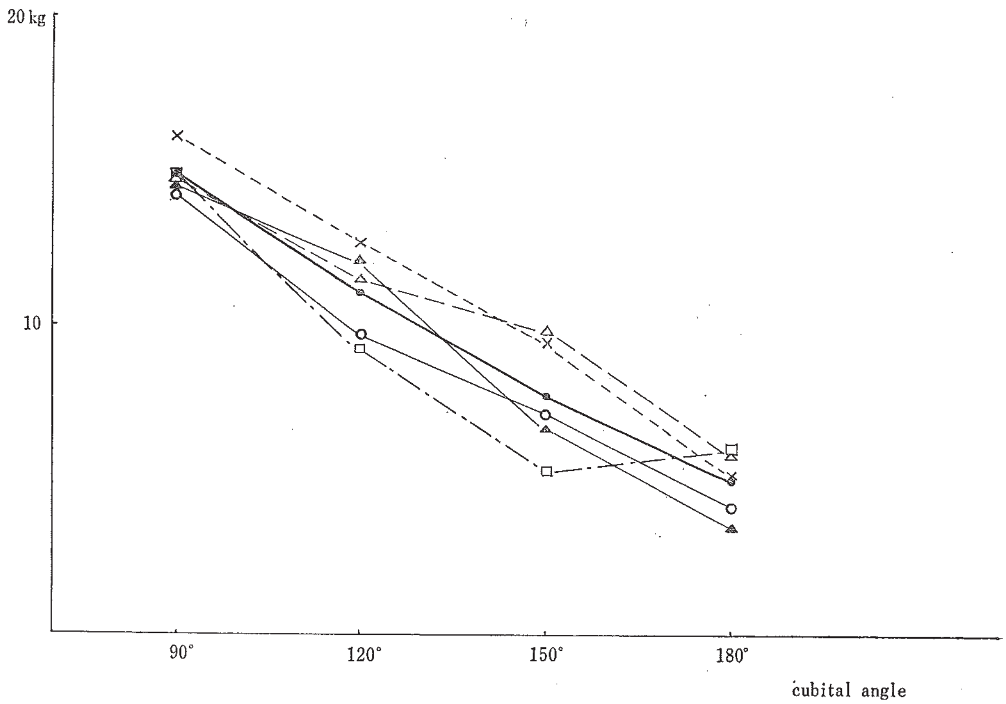

Fig. 4 Flexion

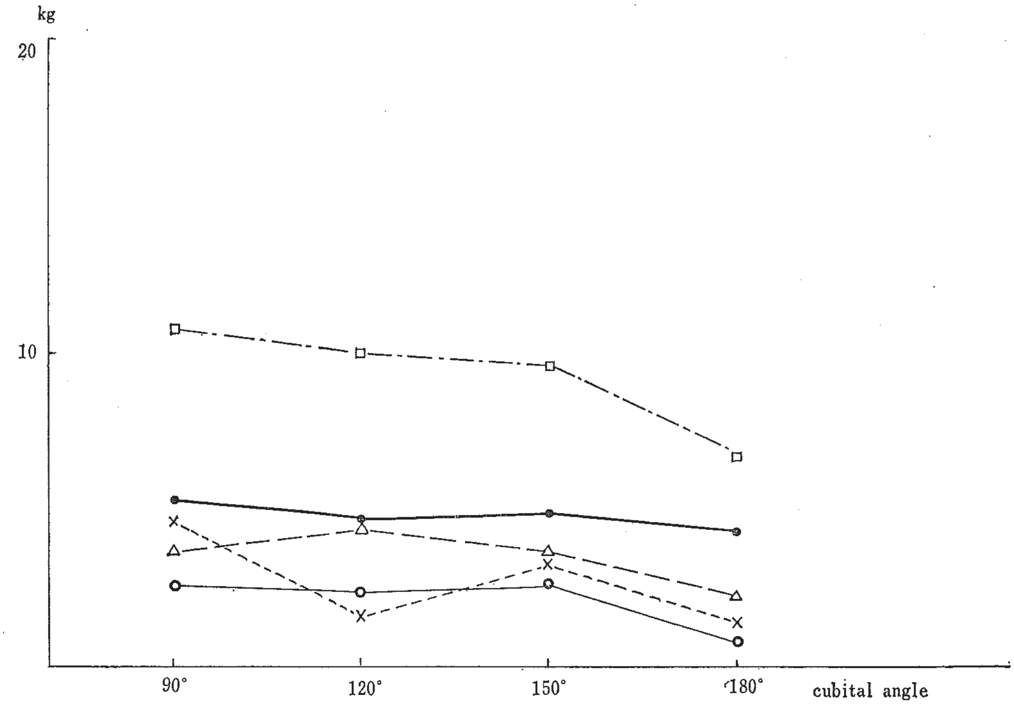

Fig. 5 Abduction

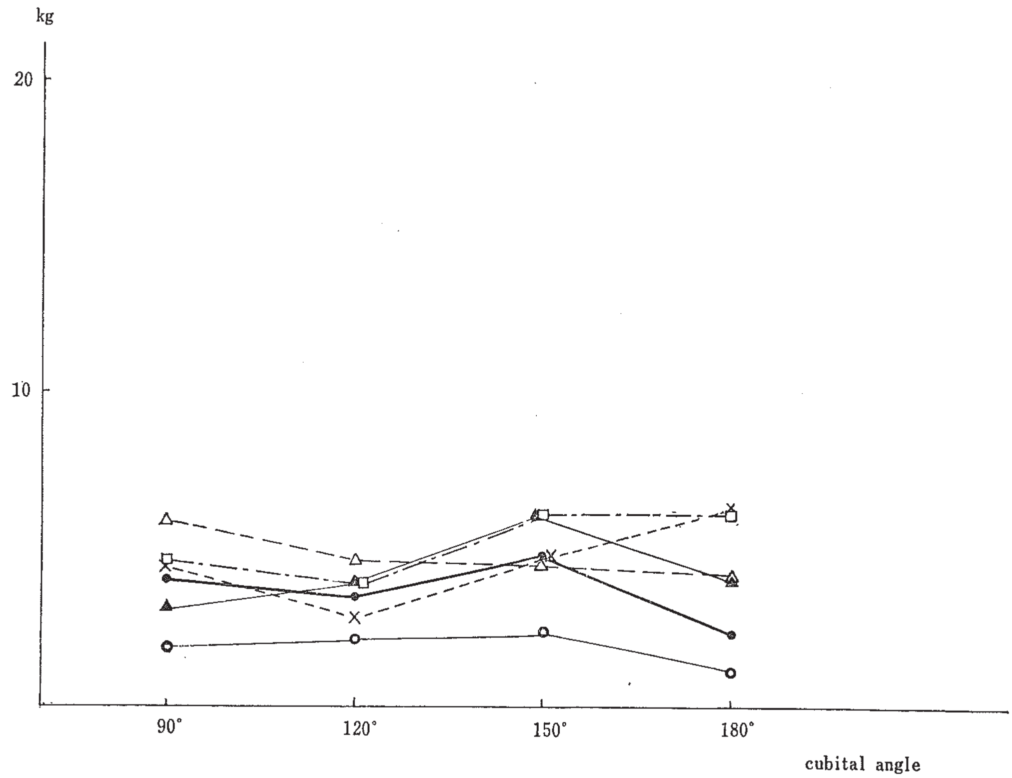

Fig. 6 Abduction