STUDIES ON "KANSETSU-WAZA"

(2) Roentgenographic Studies on "Kansetsu-waza"

K. SUZUKI (Nihon University)

In order to make Roentgenographic studies on "Kansetsu-waza", the following method of experiment was used: The positions of the arm are shown in Figs. 1 and 2, i. e., when the arm was extended forward at right angles to the body, the palm of the hand faced up (Fig. 1), and when the arm was abducted at right angles to the body, the palm of the hand faced forward (thumb pointing up). (Fig. 2). With the arm in these positions, the X-ray film was placed under the elbow, i.e., when the arm was put in forward extension, the film was placed directly under the extensor aspect of the elbow, and when the arm was abducted, the film was placed directly under the ulnar aspect of the elbow.

Then, with the upper arm fixed, the forearm was pulled, first, in the ulnar direction until the experimental subject could no more bear the pain which he notified by a prearranged signal. At this moment, the X-ray film was exposed. A similar procedure was repeated by pulling the forearm in the radial direction, and then in the direction of extension. When the forearm was pulled in the ulnar, and radial directions the palm of the hand was facing up (Fig. 1), and when the forearm was pulled in the direction of extension, the palm of the hand was facing forward with the thumb pointing up (Fig. 2).

Fig. 1

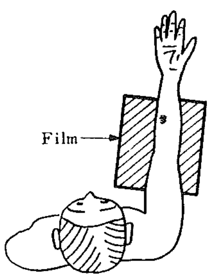


Fig. 2

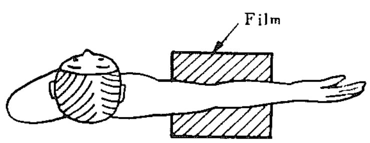


Fig. 3

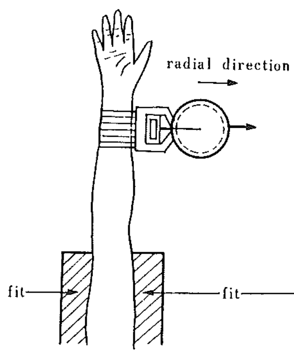


Fig. 4

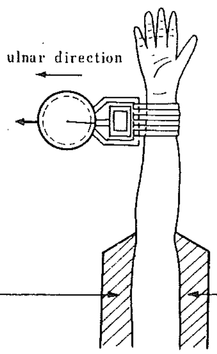
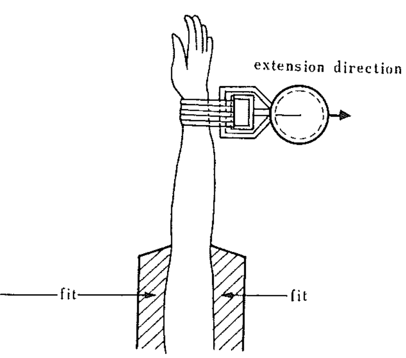


Fig. 5



This procedure of pulling the forearm was done by wrapping a band around the wrist of the experimental subject, and to this band was connected a squeeze dynamometer, so that the pulling force could be measured (Figs. 3, 4, and 5.).

Three male university students majoring in physical education were selected as experimental subjects.

Results of Experiment

1) The force pulling the forearm.

Table 1

direction of pull / exp. subject	extension	radial	ulnar
U	18.0 kg.	18.5 kg.	3.5 kg.
Y	22.0 kg.	20.0 kg.	6.0 kg.
I	18.5 kg.	15.0 kg.	14.0 kg.

Table 1 shows that in experimental subjects Y and U, very little strength was required before they gave the signal indicating "I cannot bear any longer", when the forearm was pulled in the ulnar direction. Experimental subject I also gave up more readily when the forearm was pulled in the ulnar direction than in the other two directions.

2) Locality of pain.

The locality where pain was felt was somewhat indistinct, however, Table 2 shows the approximate site of pain.

Table 2

direction of pull / exp. subject	extension	radial	ulnar
Y	pain in middle part of flexor aspect of elbow	pain & friction sound in region of head of radius	pain & friction sound in region of olecranon
U	pain in region of olecranon	pain & friction sound in region of head of radius	pain in region of olecranon
I	locality, indistinct	pain in region of head of radius	pain in entire elbow joint

From Table 2, it may be inferred that pain and friction sound were felt in the region which acted as the fulcrum when the forearm was pulled. In the experiment, the forearm was pulled gradually, so that the condition differed somewhat from that prevailing during actual performance of the "Kansetsu-waza" in which case the forearm is pulled rapidly. This being the case, in this experiment stretch pain was felt, at first, in the soft tissue of the region opposite the point acting as the fulcrum, for example, when the forearm was pulled in the radial direction, pain was felt in the ulnar region opposite the head of the radius. During actual performance of the "Kansetsu-waza" both the stretch pain and the pressure pain are felt simultaneously, so that pain is felt in the entire region of the elbow joint.

3) Roentgenographic measurements.

Roentgenography was performed by two projections with the arm in extension, viz., flexor-extensor projection (Fig. 1), and radial-ulnar projection (Fig. 2).

In the flexor-extensor projection, three exposures were taken, viz., 1) when the arm was outstretched and without any force applied to the forearm, 2) when the forearm was pulled in the radial direction (Fig. 3), and 3) when the forearm was pulled in the ulnar direction (Fig. 4).

In the radial-ulnar projection, two exposures were taken, viz., 1) when the arm was outstretched and without any force applied to the forearm, and 2) when the forearm was pulled in the direction of extension (Fig. 5.).

Fig. 6

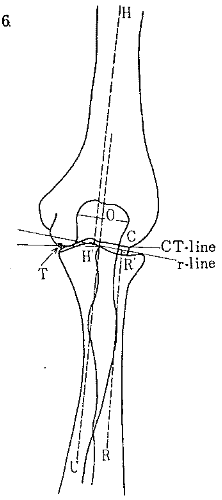
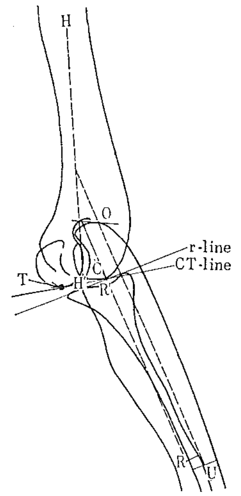


Fig. 7



Interpretation of the film was done by measuring angles formed after drawing lines in fixed directions on the film, as shown in Figs. 6 and 7.

Description of Fig. 6. A line was drawn tangent to the articular surface of the capitulum and trochlea of the humerus with C and T as the respective points of contact. H' is the center of the line CT. H is a point 12 cm. from H', and the middle point of the width of the humerus. Line HH' was designated as the long axis of the humerus.

The center of the greatest width of the olercanon of the ulna was designated as point O. U is a point 12 cm. from O, and the middle point of the width of the ulna. Line UO was designated as the long axis of the ulna.

A line r was drawn tangentially to the two edges of the concavity of the articular surface of the head of the radius. R' is the center of the line connecting the two points of contact of the line just described. R is a point 10 cm. from R', and the middle point of the width of the radius. Line RR' was designated as the long axis of the radius.

Description of Fig. 7. Points and lines in relation to the humerus and radius were fixed in the same manner as in Fig. 6.

A line was drawn tangentially to the two edges of the incisura semilunaris, i.e., a line tangential to the proc. conronoides and the olecranon. Another line perpendicular to this line and tangent to the convex surface of the flexor aspect of the olecranon was drawn. Point O is the contact point of this second line and the olecranon. U is a point 13 cm. from O, and the middle point of the width of the ulna. Line UO was designated as the long axis of the ulna.

The long axis of the humerus, ulna, and radius just described do not necessarily correspond to the anatomical axes of the respective bones. This is because points H, U, and R are not at the other extremity of the respective bones, and also they were fixed for the sake of convenience for the respective bones, after examining 15 films, at the farthest points and having equal distances from the elbow joint.

Measurements made from the film are shown in Table 3.

Table 3

		Rad.-uln. proj. (Fig. 7)		Flex.-exten. proj. (Fig. 6)		
		normal	during experim.	normal	during experiment	
					rad. dir.	uln. dir.
Y	Hum.-uln. angle (HH'-UO angle)	184.5	199.5 (15.0)	189.0	215.0 (26.0)	180.0 (9.0)
	Hum.-rad. angle (HH'-RR' angle)	180.5	201.0 (20.5)	192.5	217.0 (24.5)	181.5 (11.0)
	CT-r angle	nearly parallel	ext. aspect open, 10.5	uln. aspect open < 1.0	uln. aspect open 18.0	rad. asp. open 11.5
U	Hum.-Uln. angle (HH'-UO angle)	179.5	190.0 (10.5)	188.5	199.5 (11.0)	183.5 (5.0)
	Hum.-rad. angle (HH'-RR' angle)	180.0	191.0 (11.0)	188.5	199.5 (11.0)	181.0 (7.5)
	CT-r angle	ext. asp. open 2.0	ext. open 12.0	nearly parallel	uln. asp. open 7–8	rad. asp. open 8.5
I	Hum.-uln. angle (HH'-UO angle)	192.0	199.5 (7.5)	192.5	200'0 (7.5)	184.0 (8.5)
	Hum.-rad. angle (HH'-RR' angle)	185.5	198.0 (2.5)	195.0	203.0 (8.0)	186.0 (9.0)
	CT-r angle	nearly parallel	ext. asp. open 9–10	rad. asp. open < 1.0	uln. asp opne 7.0	rad. asp. open 10.0

(Notes on Table 3)

1) Figures indicate angles.

2) Figures in ( ) indicate difference in angle between normal condition and experimental condition.

3) In the radial-ulnar projection, when the elbow was extended so that the upper arm was in line with the forearm, the angle was designated as being 180°; values smaller than this meant that the elbow was flexed, and values larger than this meant that the elbow was hyperextended.

In the flexor-extensor projection, when the elbow was extended so that the upper arm was in line with the forearm, the angle was designated as being 180°; values smaller than this meant ulnar flexion; and values larger than this meant radial flexion.

4) Measurement of the angle formed by the lines CT and r lacked precision.

COMMENTS

The elbow of experimental subject I in comparison to the other two was in hyperextension even under normal conditions—a condition very often seen among women—consequently, the findings differed somewhat from the other two, When the forearm was pulled in the direction of extension (Fig. 5), the angle of shift of the radius was greater than that of the ulna (the difference in the degree of the angles formed by the axis of the humerus and that of the ulna or the radius during normal condition and during experiment was arbitrarily called the "angle of shift").

When the forearm was pulled in the radial direction (Fig. 3), although pressure was mainly borne by the ulna, no uniform relation was found between the angle of shift of the ulna and that of the radius.

When the forearm was pulled in the ulnar direction (Fig. 4) the pressure was mostly borne by the radius, and as expected the angle of shift of the radius was somewhat larger than that of the ulna. Experimental subject Y showed a difference of 2° (anlge of shift of radius, 11°; angle of shift of ulna, $9^\circ \therefore 11^\circ - 9^\circ = 2^\circ$), U showed a difference of 2.5°, and I showed a difference of 0.5°.

Small angles of shift were observed in Y and U, when the forearm was pulled in the ulnar direction, and in I, when the foream was pulled in the radial direction.

In experimental subjects Y and U, the differences in the respective angles of shift when the forearm was pulled in the radial direction and when the forearm was pulled in the ulnar direction were considerably large. In experimental subject I, the anatomical structure under normal conditions was somewhat different to that of the other two experimental subjects, and consequently the difference in the angles of shift was reversed, although the difference was only 1°. Pulling in the ulnar direction was more effective than pulling in the radial direction. How many degrees in the angle of shift an individual can bear depends on the anatomical structure of the individual elbow joint, and also on the mentality of the individual.

As regards the articular gap, because of its fineness, it was difficult to determine fixed points for measurement, and consequently, although it somewhat lacks accuracy, the change in the angle formed by the lines TC and r was taken as the index as it roughly corresponds to the change in the angle of shift.

A few points whose shifts were clearly visible on the film will be now discussed. A film exposed (experimental subject Y) during experiment was placed over a film exposed during normal extension condition, so that the trochlea and the capitulum of the humerus overlapped each other. In this way the shifts were measured with the following results. When the forearm was pulled in the direction of extension (i. e., during experiment), the tip of the proc. coronoides

Fig. 8

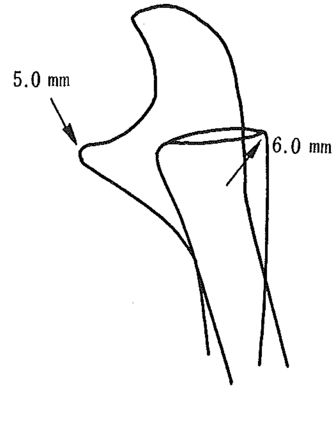


Fig. 9

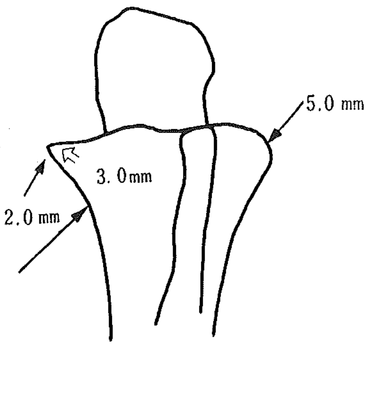
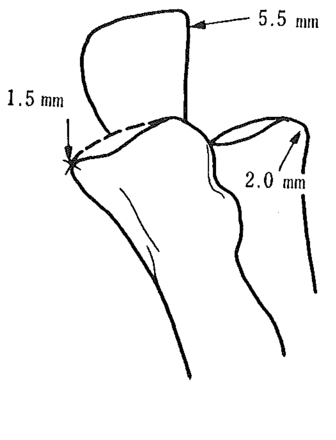


Fig. 10



shifted 5.0 mm. in the direction of the arrow (Fig. 8), and one point of the capitulum radii shifted 6.0 mm. in the direction of the arrow.

When the forearm was pulled in the ulnar direction, the medial edge of the proc. coronoides shifted 2.0 mm. in the direction of the arrow (Fig. 9), and one point of the capitulum radii shifted 5.0 mm. in the direction of the arrow. In experimental subject I, shifts of 1.5 mm. and 5.0 mm., respectively, in the same direction were observed. In experimental subject U, the medial edge of the proc. coronoides shifted 3.0 mm. in the direction of the arrow (↑) (Fig. 9), and one point of the capitulum radii shifted 6.5 mm. in the same direction as that of experimental subject Y.

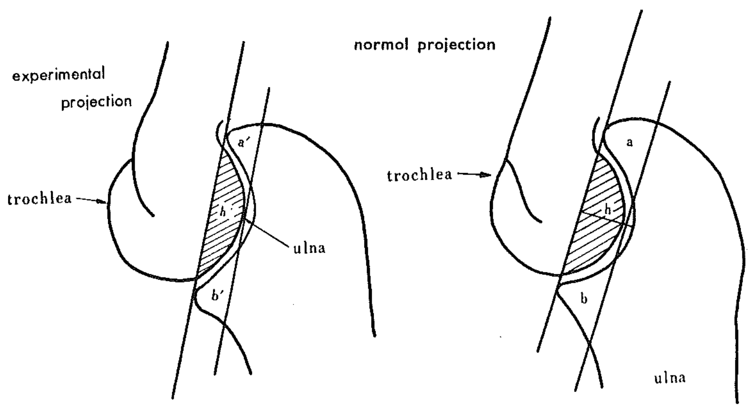
In experimental subject U, when the forearm was pulled in the radial direction, one point of the olecranon shifted 5.5 mm., one point of the proc. coronoides shifted 1.5 mm., and one point of the capitulum radii shifted 2.0 mm. as indicated by arrows in Fig 10.

Comparison of the arc formed by a line drawn across the circular shadow of the trochlea and connecting the tips of the proc. coronoides and the olecranon (Fig. 11) were made, of films exposed by radial-ulnar projecton during experiment and during normal extension. The elbow was placed in a position so that the shadow of the trochlea appeared circular and that of the incissura semilunaris of the olecranon crescent shaped.

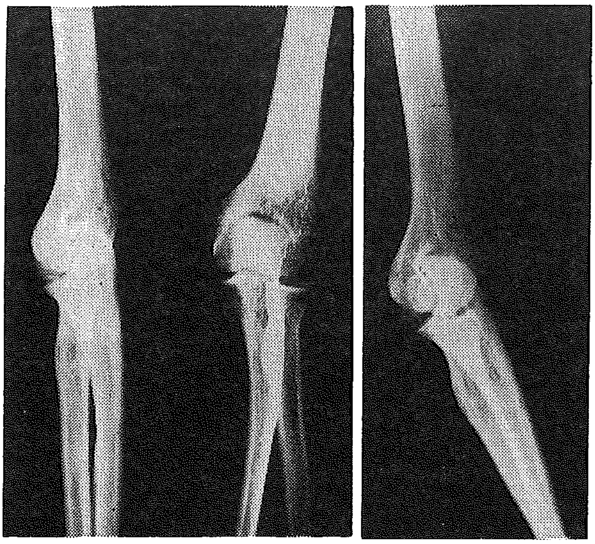
During normal extension: the base (ab) (Fig. 11) of the arc was 24.5 mm., and the height (h) 10 mm..

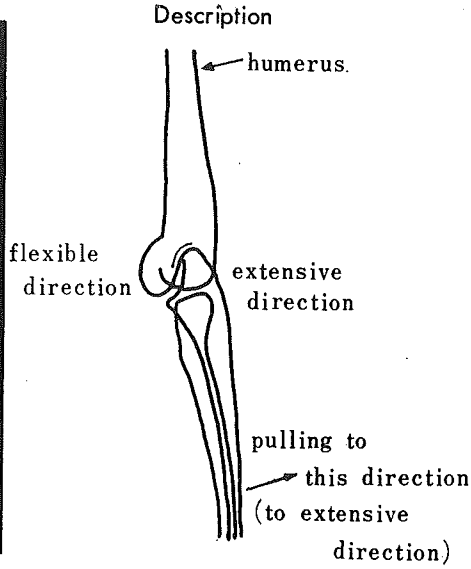
During normal extension: the base (a'b') (Fig. 11) of the arc was 23.0 mm., and the height (h') 7.5 mm.

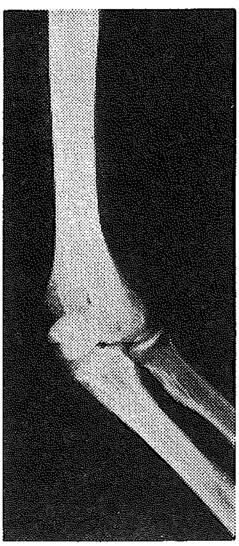
Fig. 11

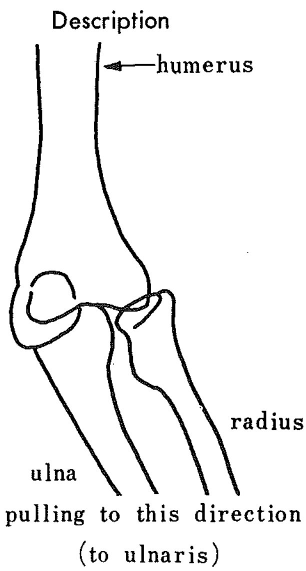


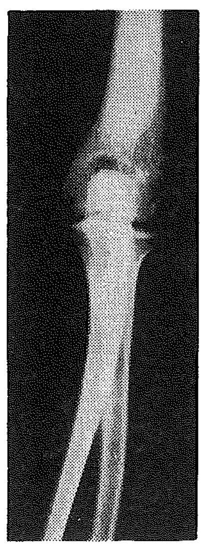
The foregoing observations disclose that when the forearm is pulled in the direction of extension (Fig. 5), the tip of the olecranon acts as the fulcrum; when the forearm is pulled in the radial direction (Fi. 3), the base of the incisura semilunaris of the ulna acts as the fulcrum; and when the forearm is pulled in the ulnar direction (Fig. 4) in some individuals (for example, Y and I), the radial part of the incisura semilunaris acts as the fulcrum, whilst in others (for example, U), the medial aspect of the tip of the olecranon acts as the fulcrum. The capitulum radii is not rigid but movable, and consequently, when the forearm is pulled in the radial direction, the aricular surface of the capitulum radii shifts while under pressure, and as a result a friction sound is produced.

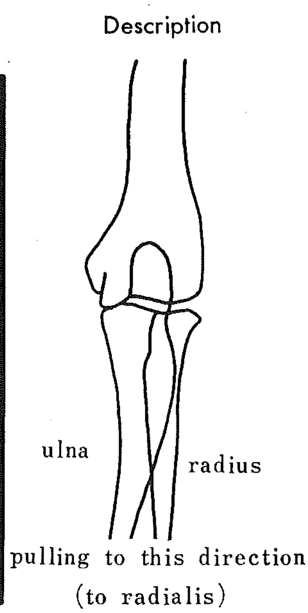












CONCLUSION

From the aforementioned observations it is concluded that in the "Kansetsu-waza" in which the forearm is fixed, the most effective direction of pull is the ulnar direction, in other words, a pull in the ulnar direction requires the least amount of force for the "Kansetsu-waza" to take effect.

REFERENCES

1. Von Lanz, T., Wachsmuth, W.: Praktische Anatomie.—Arm Berlin. Verlag von Julius springer.
2. Yokokura, S.: Principles of Roentgenographic Diagnosis of the Bone.—Nanzando
3. Jinnaka, M.: Orthopedic Surgery.—Nanzando
4. Saito, K.: "Sport" and Orthopedia.
   Jap. Journ. Orthopedic Surgery. 9. (6)
5. Sakurai, L.: Medical Research of Tennis.
   Jap. Journ. Orthopedic Surgery. 9. (5, 6)