Handedness and deformities, radiographic changes, and function of the hand in rheumatoid arthritis

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SUMMARY The correlation of handedness with deformities, radiographic changes, and function of the hand was studied in a large group of patients with rheumatoid arthritis and a dominant right hand. There was no significant difference in the proportion of patients who had swan neck deformity, boutonnière deformity, uncorrectable ulnar deviation, and flexor tenosynovitis in the dominant and non-dominant hands. There were significantly greater radiological changes in the dominant hand, however, and the middle and index fingers were most severely affected. The severe involvement of these fingers may be related to their greater use in daily activities. There was also more severe functional impairment in the dominant hand.

When patients with hemiplegia or poliomyelitis develop rheumatoid arthritis (RA) the paralysed muscles are either spared or less severely involved.^{1,2} The most likely explanation for the asymmetrical involvement is the relative lack of use of the paralysed limb.¹ Physical rest or immobilisation is a beneficial form of treatment and has been shown to have a potent anti-inflammatory effect.^{3,4} Bone cysts or geodes have been reported more frequently in patients with RA who do heavy manual work because the inflamed synovium may be forced into the porous cancellous bone.⁵⁻⁷

The factors which contribute to the development of deformities of the hands are the structural changes of RA together with the forces involved in the use of the hands.⁸⁻¹⁰ Hakstian and Tubiana emphasised the importance of tissue destruction in the production of deformity and stated that external forces of hand use only have a secondary effect.¹¹ Hasselkus *et al* studied the relation between handedness and clinical involvement of the hand in RA and did not find any evidence of significantly greater joint destruction in the dominant hand.¹² Increased severity of radiographic changes has been reported in the dominant hand, however.^{13,14}

The aim of this survey was to determine whether there was a relation between handedness and (a) the

prevalence of swan neck deformity, flexor tenosynovitis, boutonnière deformity, and ulnar deviation; (b) the severity of radiographic changes in the hands; (c) the function of the hand based on the assessment of the finger tip to palmar crease distance for all the fingers.

Patients and methods

A group of 256 patients with classical or definite RA who were attending the rheumatic diseases unit in Cape Town were studied. All the patients were interviewed and the handedness of the patient was recorded. The hands were examined to detect the presence of swan neck deformity, boutonnière deformity, uncorrectable ulnar deviation, and flexor tenosynovitis. Flexor tenosynovitis was considered to be present if the patient had two or more of the following criteria: pain, tenderness or swelling localised to the flexor tendon or tendon sheath, crepitations, snapping, locking, and limitation of digital flexion or extension.¹⁵ Uncorrectable ulnar deviation was considered to be present if the deformity could not be actively corrected by the patient. The function of the index, middle, ring, and little fingers was assessed by asking the patient to make a fist and the distance from the tip of the finger to the proximal palmar crease was measured for each finger. All the patients had standard posteroanterior radiographs of the hands. These radiographs were graded according to the Larsen

standard radiographs¹⁶ by two observers. There was very good agreement in the grading by the two observers (96% for the metacarpophalangeal joints and 95% for the proximal interphalangeal joints).

Two hundred and thirty three patients had a dominant right hand, and their data were analysed. Information about the prevalence of swan neck deformity, boutonnière deformity, ulnar deviation, and flexor tenosynovitis was recorded for the 233 patients. The measurement of the finger tip to palmar crease distance was available in 224 patients. Some of the 233 patients with a dominant right hand had had an operation to the hands or severe deformities where radiographic grading was not possible. Two hundred and ten patients had radiographs that could be analysed for most of the joints

(the proximal interphalangeal joint of the index finger could not be graded in the right hand in one patient and in the left hand in another patient). Thus comparison of the radiographic scores of the dominant and non-dominant hand was based on 210 patients unless the index finger was included when the analysis was based on 208 patients.

STATISTICAL METHODS

McNemar's test and the paired *t* test were used for statistical analysis of the data. The level of significance for these tests should be adapted for multiple comparisons according to Bonferroni.¹⁷ As this was a probing survey this adaptation was not taken into consideration and *p* values of <0.05 are reported as significant. The exact probabilities to four decimal places are reported so that corrections for multiple comparisons can be made.

Results

DEFORMITIES OF THE FINGERS

Table 1 shows the prevalence of flexor tenosynovitis, swan neck deformity, boutonnière deformity, and ulnar deviation in the different fingers of the right and left hand. There was no significant difference in the proportion of patients with swan neck deformity, boutonnière deformity, flexor tenosynovitis, and uncorrectable ulnar deviation in the right hand compared with the left hand.

RADIOGRAPHIC FINDINGS

Table 2 shows the mean Larsen scores for all the

Table 1 Prevalence of swan neck deformity, boutonnière deformity, flexor tenosynovitis, and ulnar deviation in the different fingers (n=233)

Deformity	Digit					
		Thumb	Index	Middle	Ring	Little
Swan neck deformity	(R)*	25	33	31	31	31
	(L)	30	41	32	25	25
Boutonnière deformity	(R)	3	24	25	10	
	(L)	4	19	20	18	
Flexor tenosynovitis	(R) 11	74	63	30	21	
	(L) 23	54	46	30	25	
Ulnar deviation	(R)	20	23	24	26	
	(L)	24	25	22	21	

*R=right; L=left.

Table 2 Comparison of the Larsen score for the proximal interphalangeal and metacarpophalangeal joints of the right and left hands. Values are mean (SD)

Joint	Larsen score		Number	<i>p</i> Value*
	Right hand	Left hand		
IP+ thumb	1.443 (1.102)	1.405 (1.027)	210	0.4940
PIP+ index	1.699 (1.173)	1.512 (1.097)	209	0.0019
PIP middle	1.967 (1.321)	1.719 (1.254)	210	0.0030
PIP ring	1.900 (1.422)	1.771 (1.270)	210	0.1112
PIP little	1.838 (1.370)	1.686 (1.216)	210	0.0478
Mean of all PIP + IP thumb	8.838 (5.238)	8.086 (4.721)	208	0.0004
MCP+ thumb	1.867 (1.276)	1.695 (1.121)	210	0.0336
MCP index	2.462 (1.593)	2.409 (1.575)	210	0.5301
MCP middle	2.252 (1.502)	2.176 (1.513)	210	0.3882
MCP ring	1.924 (1.432)	1.790 (1.395)	210	0.0848
MCP little	2.114 (1.517)	1.833 (1.385)	210	0.0005
Mean of all MCP	10.619 (6.125)	9.905 (5.819)	210	0.0024
Mean of all PIP + MCP	19.470 (10.403)	17.990 (9.486)	208	<0.0001

*Paired *t* test.

†IP=interphalangeal joint; PIP=proximal interphalangeal joint; MCP=metacarpophalangeal joint.

individual joints and groups of joints. The mean Larsen score for all the metacarpophalangeal (MCP) and the proximal interphalangeal (PIP) joints (including the interphalangeal joints of the thumb) was significantly higher for the right hand than for the left hand ($p < 0.0001$). When the MCP and PIP joints were compared separately the mean values for the right hand were also significantly higher than for the left hand. The combined score for each finger (MCP and PIP) was compared with the corresponding finger in the opposite hand, and the values for all the fingers were significantly greater in the right hand (Table 3). The mean radiographic scores for the index and middle fingers in the right and left hands were significantly higher than all the other fingers except the right index and little finger where the difference was not statistically significant. There was no significant difference between the index and middle fingers.

ASSESSMENT OF HAND FUNCTION

Table 4 shows the mean distance from the tip of the finger to the proximal palmar crease for each finger. The overall mean distance for the right hand was greater than for the left hand ($p = 0.0174$). The mean values were highest for the index fingers followed by

Table 3 Comparison of the Larsen score for each finger (MCP + PIP)* with the corresponding finger in the opposite hand. Values are mean (SD)

Digit	Larsen score		Number	p Value†
	Right hand	Left hand		
Thumb	3.309 (1.991)	3.100 (1.729)	210	0.0311
Index	4.167 (2.361)	3.933 (2.203)	209	0.0049
Middle	4.219 (2.339)	3.895 (2.277)	210	0.0030
Ring	3.824 (2.409)	3.562 (2.294)	210	0.0164
Little	3.952 (2.480)	3.519 (2.141)	210	0.0002

*MCP=metacarpophalangeal joint; PIP=proximal interphalangeal joint.

†Paired *t* test.

Table 4 Pairwise comparison of the mean values of the finger tip to palmar crease distance for the right and left hands ($n = 224$). Values are mean (SD)

Finger	Right hand	Left hand	p Value*
Index	26.013 (16.782)	24.017 (18.385)	0.0329
Middle	22.629 (20.830)	21.106 (21.442)	0.1220
Ring	19.865 (21.594)	17.914 (21.122)	0.0377
Little	12.960 (18.708)	11.978 (17.229)	0.2442
Mean value per finger	20.366 (17.996)	18.754 (17.763)	0.0174

*Paired *t* test.

the middle, ring, and little fingers. The mean distance for each finger was compared with the distance for the other fingers of the same hand; the values for all the fingers in the left hand were significantly different from each other, whereas in the right hand all the fingers were significantly different from each other except the middle and ring fingers.

Discussion

The presence of significantly greater damage in the dominant hand on radiological assessment has been reported by Mattingly *et al* in a study of 30 patients¹³ and by Owsianik *et al*, who studied 20 patients with RA.¹⁴ In the present study of 208 patients these findings were confirmed, and there was significantly greater involvement of the dominant hand ($p < 0.0001$).

Dickson *et al* measured the flexion and pinch force of the fingers and found that the index and middle fingers were significantly stronger than the ring and little fingers.¹⁸ The earliest erosions in the MCP joints were found to occur in the index and middle fingers.¹⁹ Mattingly *et al* also found that the MCP joints of the index and middle fingers were more severely damaged than the MCP joints of the other fingers,¹³ and those findings were confirmed in this survey. The combined MCP and PIP joint score for each finger was highest for the index and middle fingers. It is likely that the severe changes in the index and middle fingers occur because of the greater use of these fingers. The combined score for the thumb (MCP and interphalangeal joints) was significantly less than the combined score (MCP and PIP joints) for each of the other fingers in the right and left hands. Mattingly *et al* also found that the joint damage was least severe in the thumb.¹³

The prevalence of ulnar deviation and handedness has been studied previously and conflicting results have been noted.^{8 20-22} There were no significant differences in the prevalence of ulnar deviation, swan neck deformity, boutonnière deformity, and flexor tenosynovitis in the dominant and non-dominant hand in this study.

In conclusion, there was significantly greater radiographic involvement of the dominant hand, and the index and middle fingers were most severely involved. The function of the hand was also more severely impaired in the dominant hand. There was no significant difference between the prevalence of flexor tenosynovitis, swan neck deformity, boutonnière deformity, and ulnar deviation in the dominant and non-dominant hand.

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