

A controlled study of hand function in nodal and erosive osteoarthritis

MARTIN PATTRICK,¹ SHARMAN ALDRIDGE,² EDITH HAMILTON,¹
ADRIAN MANHIRE,³ AND MICHAEL DOHERTY¹

From the ¹Rheumatology Unit, ²Occupational Therapy Unit, and ³Radiology Department, City Hospital, Nottingham

SUMMARY Hand function using a standardised test of activities of daily living was assessed in (a) 57 patients (53 female, four male; mean age 69 years) with established (that is, symptom onset >10 years before) nodal generalised osteoarthritis (NGOA); (b) 10 patients (nine female, one male; mean age 70 years) with established erosive osteoarthritis (EOA); and (c) 52 matched controls (48 female, four male; mean age 71 years) with asymptomatic, clinically normal hands. Although significant differences between controls and patient groups were observed for individual tasks, only minor global impairment was seen, the worst function occurring in patients with EOA. There was no consistent correlation between tested aspects of hand function and extent of radiographic change assessed by summated graded score for separate osteoarthritic features in individual joints. In controls increasing age correlated with longer time to complete all tasks and weaker power grip; a similar, less pronounced correlation occurred in patients. Differences between controls and patients with NGOA were most apparent in younger subjects; in the elderly (>80 years) hand function was essentially the same. This study shows good functional outcome for patients with NGOA, and suggests that the OA process is of little functional importance to the aging hand.

Osteoarthritis (OA) is a heterogeneous condition showing a wide spectrum of clinical manifestations. The hand is commonly involved, and polyarticular interphalangeal OA is taken as the marker for predisposition to OA at multiple sites ('generalised OA')¹; such symptomatic involvement in conjunction with Heberden's or Bouchard's nodes, or both, is recognised as 'nodal generalised OA' (NGOA). Symptoms of NGOA typically accompany the appearance of clinical and radiographic osteoarthritic changes in the fifth to sixth decades but may then subside once the condition is established. There is a strong clinical impression that the eventual prognosis is favourable, but we are unaware of data to substantiate this belief. Discordance between radiographic appearance, symptoms, signs, and functional impairment in OA is well recognised,^{2,3} but symptoms and functional impairment remain the most important outcome measures.⁴ It is known that the normal hand

undergoes functional changes with aging,^{5–10} but the effect of OA on these normal processes is unknown.

Erosive osteoarthritis (EOA)¹¹ is a less common form of generalised OA that differs from NGOA in having a more florid inflammatory component, prominent subchondral erosive change, and tendency to instability and ankylosis. Such changes may delineate a subgroup of patients with NGOA and might be expected to affect hand function adversely.

We therefore compared hand function, pain, and radiographic change between patients with late, established NGOA and a group matched for age and sex with clinically normal hands. A smaller number of patients with EOA were additionally studied.

Patients and methods

The study was approved by the local ethical committee.

PATIENTS AND CONTROLS

Fifty seven Caucasian patients (53 women, four men; mean age 69; range 50–89 years) attending the rheumatology unit in Nottingham with diverse

Accepted for publication 7 March 1989.
Correspondence to Dr M Patrick, Rheumatology Unit, City Hospital, Hucknall Road, Nottingham NG5 1PB.

clinical problems and NGOA were included. All had polyarticular interphalangeal OA affecting more than three rays of each hand with Heberden's node formation, unrelated to obvious trauma, and at least a 10 year history of symptoms. Ten other patients (all Caucasian: nine women, one man; mean age 70, range 53–90 years) having the above characteristics and, in addition, marked radiographic subchondral erosive changes in more than three rays of each hand (classified therefore as EOA) were also studied. Many of the 67 patients had clinical and radiographic OA at other sites, but no attempt was made to subclassify further on the basis of large joint distribution or crystal presence. Apart from OA there was no clinical, radiographic, or serological evidence of additional arthropathy—for example, rheumatoid disease or psoriatic arthropathy.

Fifty two matched controls (48 women, four men; mean age 71, range 47–94 years) were recruited from two general medical clinics. Inclusion criteria were clinically normal hands, absence of hand symptoms, absence of malignancy or other myopathic condition, and no history of steroid treatment. All subjects (patients and controls) were right handed and normal on neurological examination.

HAND FUNCTION

For each subject both hands were assessed by a standardised test including many activities of daily living. Each activity was timed and assessed for presence or absence of pain; difficulty; inability to

Table 1 *Hand function assessment; tasks performed to measure mechanical function*

Mechanical function	Task
Light pinch	Pick up and manipulate solitaire beads Place in holes (33 beads)
Heavy pinch	Pick up and manipulate 10 clothes pegs Attach pegs to side of box
Tripod pinch (right hand only)	Pick up a pencil Write out a sentence
Lateral grip (right hand only)	Pick up and manipulate scissors Cut a square from paper
Dexterity	Pick up 10 tablets Pick up 10 coins Fasten 4 buttons Fasten/unfasten an 8" zip Unscrew a coffee jar Pour from a teapot
Power grip	Grip strength at 30 mmHg

Table 2 *Patient/control characteristics*

	Normal (n=52)	NGOA (n=57)	EOA (n=10)
Mean age (years) (Range)	71 (47–94)	69 (50–89)	70 (53–90)
F:M	12:1	13:1	9:1
Symptom duration (years) (Range)		15 (10–40)	18 (3–38)

*NGOA=nodal generalised osteoarthritis; EOA=erosive osteoarthritis.

complete; and use of trick movement.¹² Several activities were pooled to measure certain mechanical aspects of hand function (Table 1). Grip strength of each hand was assessed at 30 mmHg (mean of three maximal attempts). For light pinch, heavy pinch, and dexterity the timings for right and left hands were added to give a summated time for each function; tripod pinch and lateral grip were measured on the right hand only. A total time to completion was calculated by adding together all the timed functions. All tests were performed by a single trained observer using the same equipment, after 10 am to allow adequate warm up.

RADIOLOGY

Plain anteroposterior radiographs of both hands (to include wrists) were taken on the same day that hand function was assessed. Radiographs were examined by two observers who were unaware of clinical details. For each joint examined individual features of OA (joint space narrowing, osteophyte, sclerosis, and cyst) were scored 0–3; subchondral erosion, attrition, and remodelling were each scored 1 if present. Each interphalangeal, metacarpophalangeal, carpometacarpal, scaphotrapezoidal, and radiocarpal joint in both hands was scored by this method (a modification of that used by Thomas *et al*¹³). A summated score for both hands was produced by adding the scores for individual joints.

STATISTICS

Comparison of prevalences was by χ^2 test with Yates's continuity correction or by Fisher's exact test. Differences in numerically graded data were compared by the Wilcoxon rank sum test. Association of variables was tested by Pearson correlation coefficient and significance of this determined by *t* test.

Results

PATIENT AND CONTROL CHARACTERISTICS

Table 2 shows the characteristics of patients and controls. There were no significant differences

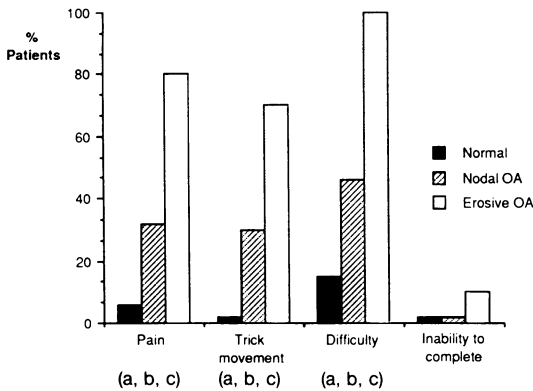


Fig. 1 Pain, trick movement, difficulty, and inability to complete any task in controls and patient groups. Significant differences observed between (a) control and group with nodal generalised osteoarthritis (NGOA), $p < 0.002$; (b) control and group with erosive osteoarthritis (EOA), $p < 0.001$; (c) NGOA and EOA groups, $p < 0.04$.

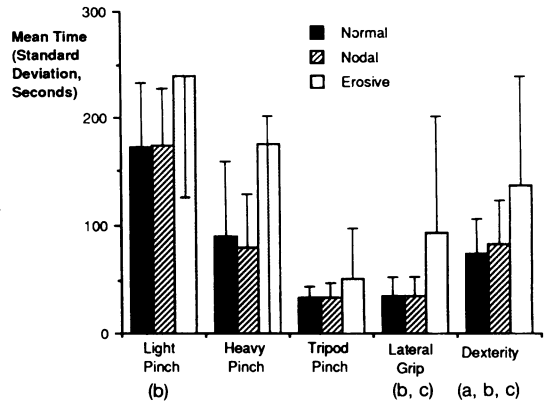


Fig. 2 Time to complete individual timed tasks in control and patient groups. Significant differences observed between (a) control and groups with nodal generalised osteoarthritis (NGOA), $p < 0.05$; (b) control and groups with erosive osteoarthritis (EOA), $p < 0.05$; (c) NGOA and EOA groups, $p < 0.05$.

between the NGOA and EOA groups compared with controls for age ($p = 0.73$ and $p = 0.64$ respectively) and sex ($\chi^2 = 0.05$, $p = 0.18$ and $\chi^2 = 0.51$, $p = 0.52$ respectively). Comparison between the two patient groups, however, showed longer symptom duration in the subjects with EOA ($p < 0.05$).

HAND FUNCTION

Pain, trick movements, difficulty, inability to complete

Pain, use of trick movements, and difficulty performing tasks were most common in the patients with EOA and least common in controls (Fig. 1), with significant differences between the three groups for individual aspects (Fig. 1). The patients with NGOA and EOA, however, did not differ from controls in their ability to complete any aspect of the hand assessment (Fig. 1).

Time to complete

Patients with NGOA did not differ from controls

in any task except dexterity ($p < 0.05$), with no differences in total time to complete the assessment (Fig. 2). Patients with EOA, however, took longer than controls for light pinch, lateral grip, dexterity, and total time, and longer than patients with NGOA for lateral grip and dexterity (all $p < 0.05$).

Power grip

Mean summated grip strengths in patients with NGOA (304 (SD 124) mmHg) and EOA (256 (96) mmHg) were reduced compared with normal subjects (373 (166) mmHg; $p < 0.03$ for both comparisons). There was no significant difference between the NGOA and EOA groups.

Effect of aging

In the control group overall increasing age was strongly correlated with (a) longer time to complete for all tasks and (b) weaker power grip (Table 3). A similar, but less marked association was seen in the NGOA and EOA groups (Table 3); there was no

Table 3 Correlation of age and hand function

	Normal		NGOA*		EOA*	
	r	p	r	p	r	p
Light pinch	0.57	<0.001	0.32	0.008	0.77	0.003
Heavy pinch	0.50	<0.001	0.42	<0.001	0.69	0.014
Tripod pinch	0.27	0.027	0.15	>0.05	0.52	>0.05
Lateral grip	0.38	<0.001	0.45	<0.001	0.65	0.023
Dexterity	0.29	0.019	0.27	0.020	0.76	0.005
Total time	0.65	<0.001	0.48	<0.001	0.75	0.006
Grip strength	-0.59	<0.001	-0.37	0.003	-0.81	0.002

*NGOA=nodal generalised osteoarthritis; EOA=erosive osteoarthritis.

Table 4 Comparison of hand function of elderly subjects*

	Normal (n=10)	NGOA† (n=11)	p Value
Mean age	87	84	0.07
(Range)	(81-94)	(81-89)	
Light pinch (s)	225	188	0.03
(Range)	(155-300)	(107-275)	
Heavy pinch (s)	124	90	0.07
(Range)	(37-207)	(41-147)	
Tripod pinch (s)	35	37	0.33
(Range)	(20-57)	(10-70)	
Lateral grip (s)	44	52	0.19
(Range)	(17-100)	(23-120)	
Dexterity	95	89	0.43
(Range)	(43-181)	(44-200)	
Grip strength at 30 mmHg (mmHg)	219	228	0.43
(Range)	(110-328)	(150-430)	
Pain	1	3	0.33
Trick movement	1	2	0.54
Difficulty	3	4	0.55
Inability	0	1	0.55

*All subjects are female.

†NGOA=nodal generalised osteoarthritis.

association with age for pain, use of trick movement, difficulty, or inability to perform. Interestingly, however, when the oldest controls and patients with NGOA (>80 years) were compared their assessments were identical apart from one variable (light pinch; $p=0.03$, Table 4).

RADIOGRAPHIC FINDINGS (Fig. 3)

As expected, total radiographic scores were greater in both patient groups than in controls ($p<0.001$). Patients with EOA had higher scores than those with NGOA, even after exclusion of scores for erosion ($p<0.001$). Comparison of right first carpometacarpal joint scores showed similar ranking with significant differences ($p<0.001$) between each group (median, range: EOA 4, 1-7; NGOA 2, 0-9; normal subjects 0, 0-3); interestingly, no erosive change was observed in first carpometacarpal joints. No differences in total radiographic scores were apparent between right and left hands in any group.

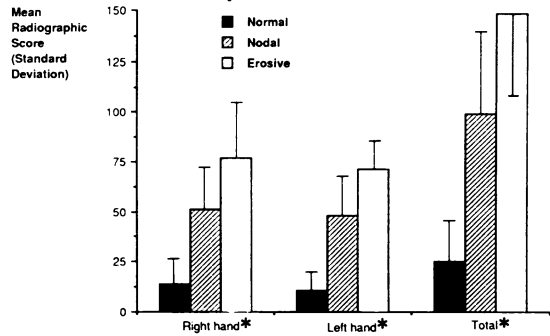


Fig. 3 Radiographic scores for right hand, left hand, and summated total in control and patient groups. *Significant differences between all three groups, $p<0.001$.

CORRELATION BETWEEN HAND FUNCTION AND RADIOGRAPHIC SCORE

In controls the total radiographic score was positively correlated with time to complete for light and heavy pinch ($r=0.29$, 0.27 ; $t=2.14$, 1.98 ; $df=50$; $p<0.02$, <0.03 respectively), and right thumb-base score with dexterity ($r=0.35$, $t=2.6$, $df=50$, $p<0.006$). In the group with NGOA the total radiographic score correlated positively with dexterity ($r=0.28$, $t=2.2$, $df=55$, $p<0.02$), but no other associations were apparent. There were no differences in radiographic scores of those with pain, trick movement, difficulty, or inability to complete compared with those without such disability (Table 5).

Discussion

Pain and functional impairment for daily activities are the two outcome measures of most relevance to the patient.⁴ In this study, therefore, these clinical variables were used in preference to purely biomechanical measurements. Although patients with NGOA had more pain and difficulty, used more trick movements, and had reduced grip strength, they were similar to controls in being able to complete tested daily activities. These findings therefore support the clinical impression of a generally good outcome for hand involvement in NGOA. Patients with EOA, similarly, completed the tested activities, but with more pain, difficulty,

Table 5 Summated radiographic score in those with/without disability

	NGOA* (mean score)				p	EOA* (mean score)				p
	With	(n)	Without	(n)		With	(n)	Without	(n)	
Pain	87	(18)	103	(39)	0.11	149	(8)	126	(2)	0.22
Trick	101	(17)	96	(40)	0.51	152	(7)	126	(3)	0.15
Difficulty	98	(26)	98	(31)	0.37	145	(10)	—	(0)	—
Inability	51	(1)	99	(56)	0.08	101	(1)	149	(9)	—

*NGOA=nodal generalised osteoarthritis; EOA=erosive osteoarthritis.

and use of trick movement than patients with non-erosive NGOA. The presence of subchondral erosions may therefore increase the likelihood of clinical consequence.

The cause of the relatively minor impairment in the two patient groups is unknown. Although pain may inhibit or slow certain movements,¹⁴ not all patients experienced pain, and mechanical factors resulting from cartilage loss, bone remodelling, capsular fibrosis, and associated periarticular changes may be more important. Patients in this study had late, established NGOA and EOA, and the degree of functional impairment during the earlier, more inflammatory development phase remains unknown.

The prevalence of asymptomatic, clinically undetectable radiographic OA in the normal controls accords with previous studies.^{15 16} In OA, discordance between radiographic appearance and clinical significance is well recognised at sites such as the hip and knee,¹⁷ and in this hand study a similar lack of association was found between radiographic OA scores and both pain and functional impairment. The higher radiographic OA scores in patients with EOA than in those with NGOA is of interest, and to our knowledge previously unreported; this excess was not explained by the presence of erosions in themselves. Although longer symptom duration in patients with EOA might have permitted greater osteoarthritic change, lack of correlation between age and radiographic score in patients with EOA and NGOA makes this unlikely. The effect of handedness, usage, or occupation on distribution and severity of OA has previously been investigated¹⁸⁻²⁰ and was not the subject of our study. Interestingly, however, we found similar *total* OA scores in *dominant* and *non-dominant* hands, a finding that accords with one previous report.¹⁹

In the normal population deterioration of hand function with age is well described.⁵⁻⁸ This has been attributed to altered neurological function rather than locomotor impairment.²¹ In our study age related functional impairment was less apparent in patients with NGOA than in controls, but significant correlation remained for the group overall. Differences between controls and patients with NGOA, however, were only really apparent in younger subjects. In elderly subjects hand function was essentially the same; indeed, of the many variables examined, the one difference in those over 80 years favoured the NGOA cohort (Table 4). This supports the concept that the process recognised as 'NGOA' is of little functional importance to the aging hand. A prospective study is required to show whether such interphalangeal changes reflect the inherent repair process of synovial joints that may compensate

for initiating (as yet unidentified) articular insult with good eventual outcome.²²

We thank the Arthritis and Rheumatism Council for financial support, Dr Peter Berman and Dr Dennis Shale for allowing us access to their patients, and Mrs Caroline Bloomfield for secretarial support.

References

- 1 Kellegren J H, Moore R. Generalised osteoarthritis and Heberden's nodes. *Br Med J* 1952; **i**: 181-3.
- 2 Lawrence J S, Bremner J M, Bier F. Osteoarthritis: prevalence in the population and relationship between symptoms and x-ray changes. *Ann Rheum Dis* 1966; **25**: 1-24.
- 3 Cobb S, Merchant W R, Rubion T. The relation of symptoms to osteoarthritis. *J Chronic Dis* 1957; **5**: 197-204.
- 4 Liang M H, Callen K E, Larson M G. Measuring function and health status in rheumatic disease clinical trials. *Clin Rheum Dis* 1983; **9**: 531-9.
- 5 Fisher M B, Birren J E. Age and strength. *J Appl Psychol* 1947; **31**: 490-7.
- 6 Kjerland R N. Age and sex differences in performance in mobility and strength tests. *Proceedings of the Iowa Academy of Science* 1953; **60**: 519-23.
- 7 Agnew P J, Maas F. Hand function related to age and sex. *Arch Phys Med Rehabil* 1983; **63**: 269-71.
- 8 Lundgren-Lindquist B, Sperling L. Functional studies in 79-year olds. II. Upper extremity function. *Scand J Rehabil Med* 1983; **15**: 117-23.
- 9 Williams T F. Assessment of mobility and function in the elderly. *Isr J Med Sci* 1986; **22**: 220-4.
- 10 Baron M, Dutil E, Berkson L, Lander P, Becher R. Hand function in the elderly: relation to osteoarthritis. *J Rheumatol* 1987; **14**: 815-9.
- 11 Peter J B, Pearson C M, Marmon L. Erosive osteoarthritis of the hands. *Arthritis Rheum* 1966; **9**: 365-88.
- 12 Evans D M, Lawton A S. Assessment of hand function. *Clin Rheum Dis* 1984; **10**: 697-725.
- 13 Thomas R H, Resnick D, Alazraki N P, Daniel D, Greenfield R. Compartmental evaluation of osteoarthritis of the knee. A comparative study of available diagnostic modalities. *Diagnostic Radiology* 1975; **16**: 585-94.
- 14 Swanson A B. Pathogenesis of arthritic lesions. In: Hunter J M, Schneider L H, Mackin E J, Bell J A, eds. *Rehabilitation of the hand*. St Louis: Mosby, 1978.
- 15 Gresham G E, Rathey U K. Osteoarthritis of the knees of aged persons. Relationship between roentgenographic and clinical manifestations. *JAMA* 1975; **233**: 168-71.
- 16 Gordon T. Osteoarthritis in US adults. In: Bennett P H, Wood P H N, eds. *Population studies of the rheumatic disease*. Amsterdam, Excerpta Medica, 1968.
- 17 Wood P H N. Radiology in the diagnosis of arthritis and rheumatism. *Transactions of the Society of Occupational Medicine* 1972; **22**: 69-73.
- 18 Chan Y K, Clemett A R. New Haven survey of joint diseases XII. Distribution and symptoms of osteoarthritis in the hands with reference to handedness. *Ann Rheum Dis* 1970; **29**: 275-86.
- 19 Lane N E, Bloch D A, Jones H J, Simpson U, Fries J F. Osteoarthritis in the hand with reference to handedness and hand use. *Arthritis Rheum* 1988; **31** (suppl): 574.
- 20 Acheson R M, Ginsburg G N. New Haven survey of joint diseases. XVI. Impairment, disability and arthritis. *British Journal of Preventive and Social Medicine* 1973; **27**: 168-76.
- 21 Potvin A R, Syndulko K, Tourtellotte W W, Lemmon J A, Potvin J H. Human neurologic function and the ageing process. *J Am Geriatr Soc* 1980; **28**: 1-9.
- 22 Mankin H J. The response of articular cartilage to mechanical injury. *J Bone Joint Surg [Am]* 1982; **3**: 460-6.