



## Does restricted wrist motion influence the disability of the upper limb ?

LUC DE SMET

From the University Hospital Pellenberg, Lubbeek (Leuven), Belgium

The purpose of this study was to correlate wrist motion (ROM) and disability of the upper limb. A total number of 205 patients who had undergone various wrist operations were included in this study, in which the range of motion of the wrist was correlated with the DASH (disability of arm, shoulder and hand) score. There was a significant correlation between the DASH score and the ROM of the wrist, but the correlation was rather weak ( $r = 0.24$ ). Inclusion of patients with wrist arthrodesis resulted in a stronger correlation. Preservation of some ROM of the wrist is worthwhile. Evaluation of corporeal damage should be adapted in a more functional way.

**Keywords** : wrist ; range of motion ; DASH score ; upper limb disability.

### INTRODUCTION

Wrist arthrodesis has been considered for a long time as the ultimate salvage procedure for wrist osteoarthritis, but this has been questioned by several authors (8, 9, 14, 36). In the last decade several motion preserving procedures have been developed to treat the painful wrist. These include denervation, partial arthrodesis, (partial) prosthetic implants and proximal row carpectomy. Patient satisfaction seems to be higher, but the risks are progression of the arthritic changes and persisting or progressing pain, failure of fusion and implant failure.

It is not clear to which extent some motion of the wrist is useful or necessary. In most impairment tables, there is a linear relationship between motion of the wrist and impairment. Some authors have measured the range of motion (ROM) during activities of daily living (ADL). Palmer *et al* (41) claimed that 5° of flexion and 30° of extension made for a functional ROM, Brumfield and Champoux (5) claimed 10° of flexion and 15° of extension while the measurements of Ryu *et al* (43) found a much higher ROM, 60° extension and 54° flexion.

Nelson (38) approached the problem from another viewpoint : he measured to motion required to perform the ADL's with or without problems ; 11° of ROM resulted in a slight disability in 13 of the 125 ADL's tested. Adams *et al* (2) reproduced these simulated restrictions of wrist motion in volunteers and concluded that perceived disability was higher than measured functional loss with conventional physical tests.

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■ Luc De Smet, MD, PhD, Orthopaedic Surgeon.  
Hand Unit, Orthopaedic Department, University Hospital Pellenberg, Lubbeek (Leuven), Belgium.

Correspondence : Luc De Smet, M.D., Ph.D., U.Z. Pellenberg, Weligerveld 1, B-3212 Pellenberg, Belgium.  
E-mail : luc.desmet@uz.kuleuven.ac.be.

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In this survey we concentrated on the disability rather than the impairment. In a large group of operated patients who had undergone various procedures on the wrist, the impact of reduced ROM was correlated with the disability.

### MATERIAL AND METHODS

In this survey we wanted to correlate the ROM, a typical impairment measurement, with disability in a group of patients rather than in healthy volunteers. The operated wrist appeared as a reasonable model, as long as the cohort was large enough to have a normal Gaussian distribution. The outcome measurement we chose for the disability evaluation was the DASH score (21).

We could retrieve 205 files of patients with chronic unilateral posttraumatic wrist problems treated surgically. All these patients were recalled and examined. They filled in a validated Dutch translated DASH questionnaire (48), and the range of motion (ROM) of the wrists was measured with a hand held goniometer (1). TAM (total active motion or flexion + extension) of the operated wrist was expressed as a percentage of the motion of the normal contralateral wrist. There were 35 complete wrist fusions; 52 proximal row carpectomies (PRC), 18 four-corner arthrodeses with scaphoidectomy, 12 lunotriquetral ligamentoplasties, 10 scapholunate ligamentoplasties, 21 reconstructions of the scaphoid, 21 osteotomies of the distal radius, 8 revascularisations of the lunate and 25 ulnar shortenings. The mean age was 42 years, ranging from 10 to 79 years; there were 134 males and 71 females (table I). We excluded from this survey all patients unwilling or unable to fill in the DASH score, patients with other pathologies of the upper limbs, bilateral procedures, and inflammatory or neurological pathologies.

### RESULTS

The ROM ranged from zero (arthrodeses) to normal. The mean extension was 44.4° (range 0 to 85°, SD 20.06) the mean flexion was 42.7° (range 5 to 80°, SD 16.53).

The DASH scores ranged from 0 to 90 with a mean of 27.7 and a SD of 23.6.

The differences between the various operative techniques are summarized in table II and figure 1.

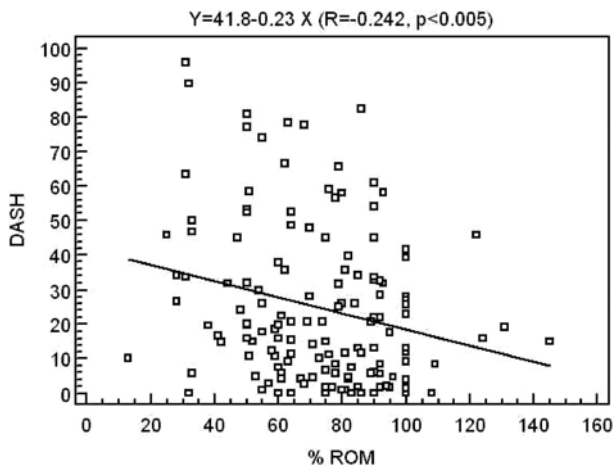
The DASH score was significantly correlated with the ROM (fig 2). This correlation however was weak ( $r = 0.24$ ) when the cohort of wrist arthrodeses was removed. When included, the correlation was somewhat higher ( $r = 0.405$ ). This illustrates the impact of complete loss of motion versus restricted motion.

### DISCUSSION

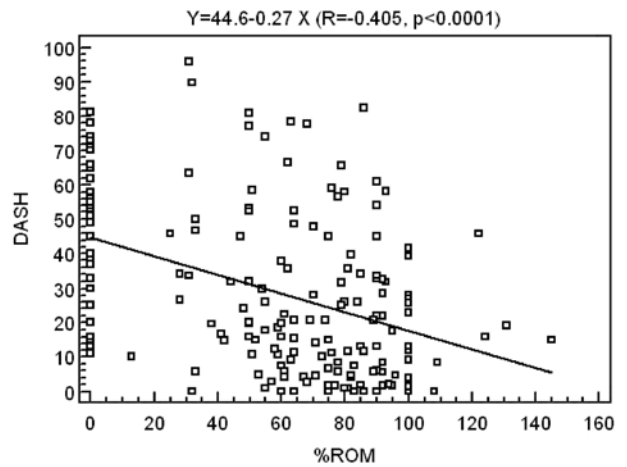
For the wrist, the outcome evaluation has traditionally been based on the measurement of range of motion, sensibility and (sometimes) grip strength. The impairment of wrist function is mainly based on restricted motion. In most scales there is a quasi linear relationship between the flexion/extension arc and the attributed impairment rate. There have been some studies on the so-called functional ROM in daily and sporting activities (41, 43). The reported values however differ markedly between authors and correspond to amplitudes used rather than required in these activities. Nelson (38) has studied the minimal "required" value rather than the ROM that is usually used for ADL's. Only a minimal

Table I. — Demographic features of the cohort

	N	GENDER M/F	AGE (years)	AGE RANGE (years)
Proximal row carpectomy	52	41/11	45	20 – 79
Ulnar shortening	28	6/22	37	17 – 61
Scaphoid grafting	21	19/2	32	18 – 63
Radial osteotomy	21	12/9	38	12 – 60
Vascularized bone graft	8	5/3	25	21 – 35
Lunotriquetral reconstruction	12	7/5	31	10 – 48
Radiocarpometacarpal arthrodesis	35	24/11	47	32 – 72
Scapholunate reconstruction	10	7/3	43	27 – 60
4-Corner arthrodesis	18	14/4	56	29 – 70
TOTAL	205	134/71	42	10 – 79



**Fig. 1.** — Correlation between the DASH and ROM without including patients with complete wrist arthrodesis.



**Fig. 2.** — Correlation between the DASH and ROM with inclusion of patients with complete wrist arthrodesis.

Table II. — Summary of outcomes

	DASH	ROM %
Proximal row carpectomy	18	68
Ulnar shortening	26	89
Scaphoid grafting	18	87
Osteotomy distal radius	26	74
Vascularised bone graft (Kienbock)	30	67
Lunotriquetral ligament reconstruction	35	72
Wrist arthrodesis	46	0
Scapholunate ligament reconstruction	12	70
4-Corner fusion	38	49
TOTAL	27.7 (SD 23.6)	

ROM is essential for the majority of the ADL's with only a few activities hindered by restricted wrist motion.

Numerous wrist scores have been proposed, mostly mixed, combining objective measurements, pain estimation, function and even sometimes radiographs (Mayo wrist score (6), Krimmer score (30), Wrightington wrist score (34), Gartland and Wesley (15)). They can be used in scientific studies, comparing the preoperative with postoperative status, comparing different techniques or different series. There have been however no reports which study whether these scores represent the real status of the wrist or patient.

Since 1996 patient-completed questionnaires, designed to measure the hand and upper limb and related domains have been published. They are now widely used all over the world. We can make a distinction between the more general generic questionnaires, which grossly measure general health, the domain specific ones which measure a limited body part or function (3, 11, 13, 21) and the disease specific which measure the outcome of a more specific disorder (33). All these questionnaires were designed to evaluate the disability rather than the impairment. In 1996 Hudak *et al* (21) published their approach to evaluate disability: the DASH score, a self-administrated questionnaire which includes 30 items related to functional activities and symptoms in ADL's. The patient is asked to give a score from 1 to 5 on all items.

The raw score is converted into a 0 to 100 scale. The questionnaires are designed more critically and analyzed for relevance and validity. The DASH score has been proposed by the AAOS as the standard for hand and upper limb disability evaluation.

Since its publication, the DASH has been investigated extensively for reliability, reproducibility, validity and responsiveness as well as acceptance in clinical practice (7, 11, 13, 17, 19, 26, 28, 47). It has been used in a variety of anatomical regions (shoulder; elbow, wrist and hand) (9, 16, 18, 20, 24, 25, 28, 30, 31). Several validated translations are available (4, 12, 23,

32, 39, 40, 42). In a normal population the mean DASH value is 10.1 (SD 14.88) (22).

When the DASH score is analyzed more in detail there are however also questions concerning the body function ("do you feel weak or stiff") and social activities but the majority are on limitations in daily life. The DASH score was also published several years before the ICF model. Despite this not so perfect questionnaire, it has the major advantage that it is used all over the world. It can be used for different pathologies, is user friendly and completing it is quick and easy. Despite the limitations it is the best alternative up to now. A Medline search revealed more than 300 publications using the DASH score in evaluating upper limb pathology and treatment; it has even been used for disabilities of the lower limb (10).

In 2005, Jester *et al* (27) found no good correlation between ROM and DASH, contrary to our findings. The impact of complete arthrodesis cannot be underestimated. Including patients with arthrodesis into the cohort or not makes an important difference.

In conclusion we can postulate that preservation of motion has a important influence on the disability as it is perceived by the patient, but that the amount of ROM is only of limited relevance. Any effort to avoid a wrist arthrodesis is worthwhile. These observations should also lead to adapted tables of impairment and a more functional approach to evaluate corporeal damage.

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