

# “MACRO-VIEWS” IN THE EARLY DIAGNOSIS OF SCAPHOID FRACTURES : EARLY RESULTS OF A PROSPECTIVE SERIES

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**A prospective series of 40 patients with suspected scaphoid fractures was assessed using the technique of early ‘macro-radiography’ and followed up for at least a year. Using this technique, confident diagnoses are possible, abolishing the need for unnecessary immobilisation of wrists where scaphoid fracture is suspected but not proven radiologically. The technique is simple and provides a useful tool for the surgeon faced with cases that are otherwise difficult to diagnose.**

**Keywords :** scaphoid fracture ; macro-radiography ; prospective study.

**Mots-clés :** fracture du scaphoïde, macro-radiographie, étude prospective.

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## INTRODUCTION

Scaphoid fracture and specifically its diagnosis has tested established authorities for many years (3, 4, 10, 13). The diagnosis is often difficult both clinically and radiologically and several techniques have been developed to overcome this (1-4, 9, 10, 17, 21, 23, 24).

Magnification radiology is known to demonstrate clearly changes in trabecular organisation within the scaphoid (19). The use of early “macro-views” of the scaphoid i.e. high-resolution macro-radiography, provides a quick, readily available method of overcoming diagnostic difficulties. It is sensitive to cases missed on standard radiographs and, in particular, gives added confidence to treat conservatively if no fracture is seen.

We are aware of published series using macro-views (15, 19, 22), but rarely in the *early* diagnosis and treatment of suspected scaphoid fractures. We

present the early results of a prospective series using this technique to determine the management of patients with suspected scaphoid fractures.

## METHOD

All patients with a suspected scaphoid fracture at our unit are referred from the Accident and Emergency department to the next available fracture clinic (usually the following day). A prospective trial using early macro-views in the management of such patients presenting to one consultant’s fracture clinic (RKS) was undertaken. Patients were examined out of plaster and the plain radiographs were reviewed at their initial presentation to the fracture clinic by the senior author (RKS) and an experienced trainee (LRI) and excluded from the study if :

1. they were found to be asymptomatic with normal plain radiographs of the scaphoid ;
2. a definite scaphoid fracture was present (both clinically and radiologically) ;
3. a definite other diagnosis could be made.

The remaining patients were sent for anteroposterior and lateral scaphoid macro-views of the injured wrist out of plaster.

Macro-views can be obtained by one of two methods. The first requires magnification radiology with machines capable of producing ultra small focal spots less than

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0.1 mm. The second method, while less acceptable to the purists, is still a recognised method of producing such radiographs, and uses magnification radiology with high resolution radiographic film (as used for mammography). It was this second method that was employed in this study, as it required no special equipment to be purchased and only needed minimal training to enable these images to be obtained reliably. The magnification obtained was in the order of five times using plain AP and lateral views, without ulnar/radial deviation or 'clenched fist' views.

Negative macro-views were interpreted as meaning that there was no fracture of the scaphoid present. Such patients were treated with an elastic support bandage and entered into a programme of rehabilitation exercises. Positive macro-views were considered diagnostic of a scaphoid fracture and such patients were treated in a below elbow cast with the thumb immobilised until fracture healing had occurred (although not offering complete immobilisation *vis à vis* prono-supination, this is standard UK practice).

All patients in the trial were clinically assessed at six weeks and three months from injury jointly by RKS and LRI. A final review at approximately two years from injury was performed blind of the initial diagnosis and treatment. This review was by clinical assessment, further macro-views of the injured wrist, and functional testing of both wrists using a JAMAR grip strength meter by an experienced trainee (AJF).

## RESULTS

Forty patients with a possible scaphoid fracture were included in the study of whom 18 were males and 22 females. The mean age was 32.6 years (range 6 to 75 years), and the mean follow-up was 2.4 years (range 18 to 38 months).

Initial macro-views were positive for a scaphoid fracture in six patients (two distal pole and four undisplaced waist fractures) and these patients were immobilised in plaster (figs. 1-4). The remaining 34 patients had negative macro-views for a scaphoid fracture. However, two of these patients with negative macro-views of the scaphoid did have subtle fractures of the radial styloid that had not been diagnosed on the initial plain radiographs (figs. 5-6).

At the three-month review, two of the patients with negative macro-views were sufficiently symptomatic to warrant further macro-views. These remained negative for a scaphoid fracture. One patient had persisting pain that settled within two weeks of this review and in the other patient, settled by the time of a five-month follow-up.

The final follow-up attracted 30 of the 40 patients (14 males and 16 females). Nine patients failed to attend despite three recall letters,

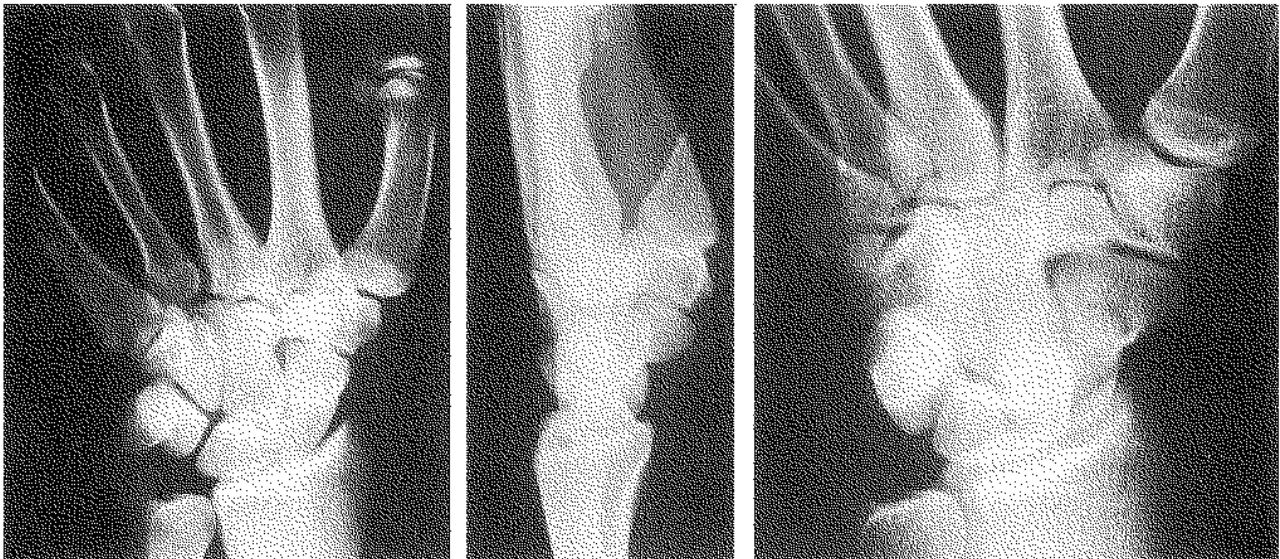
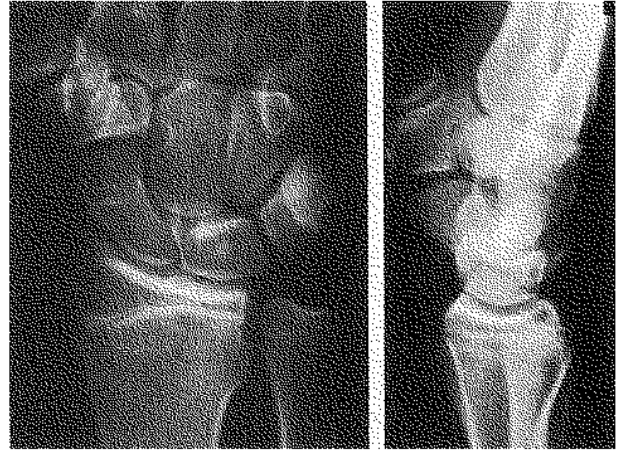


Fig. 1. — Negative plain radiographs of the carpus.



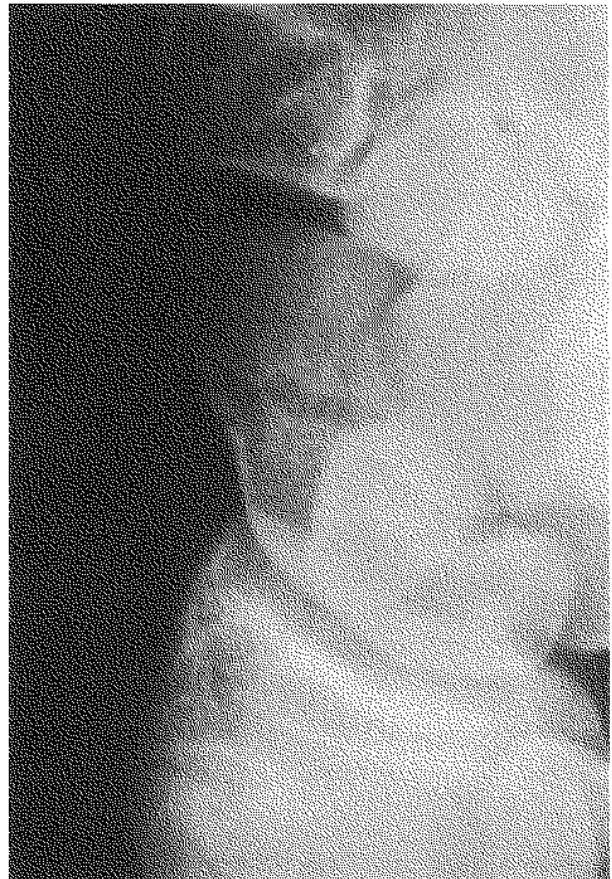
*Fig. 2.* — Macro-views of patient in figure 1 showing clear evidence of a scaphoid fracture.



*Fig. 3.* — Negative plain radiographs of the scaphoid.

and one patient had left the region but wrote to report an asymptomatic wrist. This level of follow-up is not unusual in patients with this pattern of injury. At clinical review, three patients complained of occasional mild aches around their wrists on heavy stress, but the other 27 were asymptomatic at all times. The asymptomatic group included one patient with a persisting non-union of the distal pole of the scaphoid.

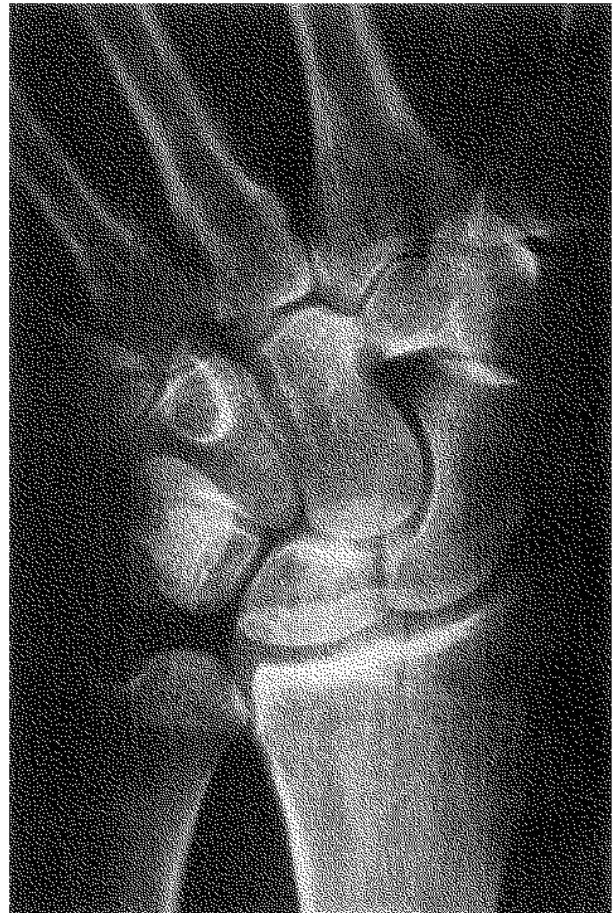
Functional assessment using the JAMAR grip strength meter did not reveal any significant differences in values between injured and uninjured wrists ( $p = 0.4$  ; Student's one-tailed, paired t-test), dominant and non-dominant hands or between the fractured and not fractured patients ( $p = 0.06$  ; Student's one-tailed, two sample, unequal variance t-test) (table I). Radiographic assessment with further macro-views showed that no diagnosis made on the early macro-views required revision. No late scaphoid fractures came to light after two years of follow-up.



*Fig. 4.* — Clear evidence of a scaphoid fracture on macro-view from the same patient as figure 3.



*Fig. 5.* — Plain views of a patient with 'snuffbox' tenderness. The distal radial fracture was missed on these initial films. In retrospect, with the benefit of the macro-views, a fracture can be seen easily.



*Fig. 6.* — Same patient as in figure 5, macro-views clearly showing the intra-articular fracture of the distal radius.

## DISCUSSION

There is a great deal of literature on the subject of scaphoid fractures. Despite this, the size and importance of the problem is not clear (13, 16, 25). It has traditionally been taught that scaphoid fractures are not always seen on the initial plain radiographs, and that all clinically suspected fractures of the scaphoid, with apparently normal initial radiographs, should be immobilised in plaster and then reviewed with further radiographs out of plaster at two weeks (1, 3, 4, 10, 17). However, work has shown that, depending on experience, only 2-5% of scaphoid fractures are missed on initial radiographs (16), and that only 5-12% of all scaphoid fractures go on to nonunion if untreated (6, 16).

Table I. — Mean grip strength readings at two-year review using mean of three attempts with JAMAR grip strength meter (Kg)

	Injured side (range)	Uninjured side (range)
Male	41.4 (32 - 64)	42.2 (31 - 60)
Female	27.1 (18 - 36)	27.5 (24 - 32)

Traditionally, nonunion of the scaphoid has been hailed as a sentence of impending disaster, but the actual evidence for this is tenuous (13). It is worth emphasising that despite pressure from professional indemnity advisors, the immobilisation of 'x-ray negative scaphoid fractures' because of clinical suspicion is questionable. Such practice may well be clinically and scientifically unsound (8, 16, 25) and potentially costly to the community with some patients enduring several weeks of unnecessary casting (8).

In an attempt to demonstrate 'missed' scaphoid fractures, radiographs are usually repeated at 10-14 days from the initial injury. The yield of newly diagnosed fractures when examined critically is however, very limited (7, 8, 16) and this finding appears to be independent both of experience and of seniority of the observer (7). Other techniques have been proposed to try and improve the diagnostic yield. These include radiographic assessment of the uninjured side for comparison if the symptoms persist (1, 3), and the taking of multiple (usually 6) angled views of the scaphoid (10, 17). High success rates are claimed with such assessments, but in these studies the additional radiographs are reserved for a patient who has already been immobilised in plaster for two weeks.

Perhaps a more exacting approach is to insist on good quality films initially, where the trabecular pattern can easily be distinguished (3). The combination of magnification, high quality film, and the extra attention to detail required of the radiology department to produce scaphoid macro-views, could be regarded as an extension of this principle.

Ultrasonography has been proposed as a diagnostic tool in cases of doubt at the later stages of management (3). It has the value of being safe, cheap and non-invasive but it is rarely available at short notice. One review has been very scathing about the value of this technique, demonstrating 37% sensitivity and 61% specificity (7), as compared with clinical assessment at 100% sensitivity and 12% specificity. Christiansen *et al.* (5) concluded that ultrasound has no place in the early diagnosis of scaphoid fracture.

Early promise (5) with the use of intrasound vibration (i.e. vibratory examination using frequencies within the human auditory range) has not been sustained and the technique is no longer recommended (14, 20).

Isotope bone scanning is considered the gold standard for diagnosis of scaphoid fractures. It is usually quoted as being 100% sensitive, but all authors admit to a lower specificity of around 87%, because of the identification of other injuries around the wrist (9, 21, 24). There is debate as to the optimum timing of such an investigation. The use of isotopes varies from assessment of suspicious cases in the presence of negative two-week radiographs (3, 4, 21, 24), to the management of the case entirely on the results of early isotope scanning (24). The technique is of course costly, invasive, requires substantial irradiation and is rarely available at short notice.

Isotope bone scanning was not used in our study to ascertain for sure the presence of a scaphoid fracture. Given a specificity of only 87% for this technique (9), a number of 'false positive' diagnoses would have led to patients being unnecessarily immobilised. Macro-views in this study highlighted two such cases in patients who had subtle radial styloid fractures not seen on initial radiographs. Furthermore, as no patients with negative macro-views went on to develop a nonunion of the scaphoid, isotope bone scanning would have been of little help.

Other techniques such as tomography and CT scanning are also costly and relatively unavailable, but may offer improved diagnostic accuracy. An excellent technique for the assessment of bone vascularity after injury is MRI scanning, but it is both costly and pointedly unavailable at short notice (2, 12).

The present study demonstrates the value of macro-views in the early diagnosis of scaphoid fractures in two ways. Firstly, when demonstrating the absence of a scaphoid fracture, it allows a conservative management protocol to be confidently followed, preventing the unnecessary use of plaster immobilisation of the wrist. Secondly, the technique appears to detect scaphoid fractures missed on conventional initial radiographs. In this



study two distal-pole and four undisplaced waist fractures of the scaphoid were detected. An interesting sideline, although not designed into this study, was the diagnosis of subtle radial styloid fractures using the same technique.

The authors are aware that other centres are using similar techniques to ours with mixed results (15, 22), and that radiological purists would insist that magnification radiography is only possible with machines capable of producing tiny focal spots. Our technique does not have this, but does rely on high resolutions and careful attention to detail. One criticism of the technique is the high radiation dose (18), which could be addressed by the use of fine-grain sensitive film such as is used in mammography. A further criticism by the same author (18) relates to a loss of geometric sharpness, but in a situation such as presented here, i.e. a 'yes/no' qualitative exercise of fracture diagnosis, such distortions do not pose a problem.

Patients with a definite scaphoid fracture on their initial plain radiographs were excluded from this study. We were unable reliably to ascertain the actual number of scaphoid fractures seen on initial plain radiographs treated at our hospital. This makes it impossible to give the incidence of scaphoid fractures not detected on the initial radiographs. Given that the average U.K. District General Hospital would have expected to have seen approximately 70 definite scaphoid fractures in the two year time period of this study (3) and that the quality of the initial plain films was deemed to be satisfactory, an estimated incidence of missed fractures of 8.6% would seem higher than expected.

The numbers in this study were small and future larger studies would need to address these criticisms. We are also alert to possible criticisms of poor proportions of patients attending for follow-up. Patients with minor wrist injuries are reluctant to reattend a clinic and such a rate of follow-up is not unusual in conditions of this sort.

We are also aware that the review of patients by experienced orthopaedic surgeons can favourably influence management of these patients (11). This however has been our unit policy since before the study and the study has merely emphasised improvements that can be made to such a level

of service. It is common practice in the UK to refer patients with proven or suspected scaphoid fracture to an orthopaedic clinic within 24 hrs. Poor quality initial radiography and the presence of a plaster cast makes diagnosis at this point awkward. In the absence of a reliable diagnostic tool, the temptation is to leave the plaster cast in place and to review the patient ten to fourteen days later. This study shows that there is such a reliable diagnostic tool, and that many casts are therefore unnecessary. There is a cautionary point however, that competent radiological staff must be available to perform the macro-views, otherwise fractures may be missed.

The authors would recommend this technique as a way to make firm diagnoses within 24 hours of injury and therefore to avoid unnecessary casting. If the technique is to be safe and useful there are two crucial requirements :

1. Assessment of the patient clinically by an experienced orthopaedic traumatologist within 24 hours of injury.
2. Access to competent and dedicated radiological staff, properly equipped to offer a reliable macro-radiography service.

Studies which claim to show neither false negative nor false positive results should always be regarded with suspicion, yet it appears that this small preliminary study has succeeded in demonstrating such results. The authors regard macro-views as offering a useful investigation in the early diagnosis and treatment of scaphoid fractures allowing excellent predictive accuracy and the senior author was using it as the basis of his practice\*. A larger study is needed to establish the statistical relevance of this promising technique.

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\* Between completion of this study and submission for publication, Mr. R. Krishan Suman, Consultant Orthopaedic and Hand Surgeon, sadly died after a short illness.

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### SAMENVATTING

*A. J. FURLONG, L. R. IRWIN, R. K. SUMAN (†).  
Macroradiografieën bij de diagnose van scaphoidfracturen.*

Een continue reeks van 40 patiënten met het vermoeden van scaphoidfractuur werd prospectief gedurende minstens één jaar gevolgd, gebruik makend van macroradiografieën. Met deze techniek is de diagnose met zekerheid te stellen zodat gipsimmobilisatie overbodig wordt bij vermoedde fracturen zonder radiologisch bewijs. De techniek is eenvoudig en interessant voor de diagnose van deze fracturen die met andere middelen soms moeilijk in het licht te stellen zijn.

### RÉSUMÉ

*A. J. FURLONG, L. R. IRWIN, R. K. SUMAN (†).  
Utilité des macro-radiographes pour le diagnostic des fractures du scaphoïde carpien.*

Une série continue de 40 patients présentant une suspicion de fracture du scaphoïde carpien a été évaluée prospectivement en utilisant une technique de macro-radiographie et a été suivie pendant au moins un an. En utilisant cette technique, un diagnostic de certitude est possible, ce qui dispense d'immobiliser en plâtre des poignets où une fracture du scaphoïde est suspectée mais n'est pas prouvée radiologiquement. La technique est simple et constitue un outil intéressant pour le diagnostic de fractures difficiles à mettre en évidence par les moyen habituels.