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Scaphoid fractures: anatomy, diagnosis and treatment

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Chapter 14

Summary & Discussion



Buijze GA

Overview

In this thesis, current issues in diagnosis and treatment of scaphoid fractures have been addressed. The general aims are to improve the understanding of the anatomy of the scaphoid and its ligaments, to improve diagnostic methods and classification of scaphoid fractures, and to improve treatment of scaphoid fractures. This thesis has been divided in three main parts: anatomy, diagnosis and treatment. The current chapter consists of a summary of each of the previous chapters followed by discussion, a general conclusion and future perspectives.

ANATOMY

Precise anatomical knowledge of the scaphoid and its ligaments is crucial for wrist surgery and it paves the way to a better understanding of the biomechanics involved in destabilization of scaphoid fractures. However, anatomic descriptions are controversial and imprecise.

Anatomy of the Scaphoid: *Controversial Literature*

In Chapter 2, the anatomical literature on the scaphoid ligaments has been systematically reviewed. The aim of the study was to clarify the various concepts and classifications of wrist ligaments and describe, according to the available literature, the ligaments related to the scaphoid. The literature search resulted in 555 potentially eligible descriptive reports, 58 of which met the inclusion criteria and were included in the review. There were many inconsistencies; none of the scaphoid ligaments other than the scaphocapitate ligament have been described consistently. The most important areas of controversy in the scaphoid ligament attachments included the radial collateral ligament, the dorsal radiocarpal ligament, the dorsal intercarpal ligament, the volar scaphotriquetral ligament, and the scaphotrapezium-trapezoid ligament.

The anatomy of the scaphoid is crucial for the understanding of carpal kinematics, yet it is notable that the controversies are extensive. Variations in the anatomic descriptions appear to be due in part to the difficulty of indentifying individual ligaments or ligament bundles that interdigitate with each other, As previously reported, important limitations of dissecting such complex soft tissue are the difficulty of appreciating ligament delineation by macroscopic dissection and the need for disrupting ligaments to visualize or improve visualization of other ligaments.¹ Another reason for disparity in anatomic descriptions is the fact that the anatomy of wrist ligament substantially varies between individuals, as shown in larger series.^{2,3} To improve understanding, an accurate method of ligament detection is required to verify the ligament attachments



with the most controversial descriptions while addressing the inter-individual variability of ligament attachments and morphology.

Anatomy of the Scaphoid: *3D Imaging*

In Chapter 3, three-dimensional (3D) imaging has been used to provide an accurate and quantitative description of the morphology of the ligaments attaching to the scaphoid. Eight fresh-frozen human cadaver wrists were examined with computer tomography (CT) and an imaging cryomicrotome. Detection of ligaments and their surface areas was performed by manually marking the course and attachment points for each ligament using dedicated visualization software. The imaging technology had an accuracy of 0.1 mm. Based on the acquired data, a 3D representation of the wrist was created to depict the scaphoid ligament attachment areas and paths. The dorsal intercarpal ligament had the most inter-individual variability and the scaphocapitate ligament had the highest thickness of all ligaments attaching to the scaphoid.

The study provided valuable data for comparison with previous studies in order to elucidate some of the inconsistencies; for example whether or not the radioscapocapitate (RSC) ligament attaches to the scaphoid.^{1,4,5} This study shows that it does; most fibers of the RSC ligament followed an arcuate course around the volar side of the scaphoid waist, whereas only few fibers attached to the scaphoid tubercle. Other controversial ligaments such as a volar⁴ or dorsal⁶⁻⁹ radioscapoid ligament were not detected in the study. Neither could any attachment of the radial collateral ligament to the scaphoid be confirmed.^{1,2,10-12} Instead a capsular-like structure was detected that bypassed the scaphoid in radial-dorsal direction along its surface with its fibers directed towards distal.

The morphology of scaphoid ligaments is complex and variable between individual wrists. The results of this study enhance the knowledge of scaphoid ligament anatomy as they corroborate previous findings and they were used to provide a precise 3D representation.

DIAGNOSIS

There is a wide variety of diagnostic protocols and there is no consensus on the most optimal protocol. This could be improved by determining diagnostic test performances and developing clinical decision rules. However, diagnostic test performances are difficult to determine because of a lacking gold standard for a true scaphoid fracture.

Latent Class Analysis

In Chapter 4, the use of latent class analysis has been evaluated in attempt to bypass the issue of the lacking gold standard for diagnosing scaphoid fractures. Diagnostic performance characteristics calculated using latent class analysis were compared to those calculated using standard formulas based on a reference standard for the diagnosis of true fractures among suspected scaphoid fractures. Data from two prospective studies were used; one study of 34 patients who had MRI and CT and one study of 78 patients who had MRI and bone scintigraphy, as well as a structured physical examination. The diagnostic test performance calculated using both methods differed in each of the two cohorts. In the first cohort, the calculated sensitivity and specificity with latent class analysis was different than it was with traditional reference standard based calculations for both the CT in the scaphoid planes (sensitivity: 0.78 vs. 0.67; specificity: 1.0 vs. 0.96) and the MRI (sensitivity: 0.80 vs. 0.67; specificity: 0.93 vs. 0.89). In the second cohort, the largest differences were in the sensitivity of the MRI (0.84 vs. 0.75) and the sensitivity of the various physical examination maneuvers (range, 0.63-0.73 vs. 1.0).

Latent class analysis is increasingly used to study diagnostic tests for diseases lacking a consensus reference standard (gold standard).¹³⁻¹⁸ This study shows that diagnostic performance characteristics calculated with latent class analysis are notably different from those calculated using traditional methods based on a reference standard. It is not possible to state which performance values are more accurate, but the differences emphasize that we are dealing with probabilities of fracture rather than certainty and that our choice of the reference standard can affect those probabilities. Using latent class analysis, the most commonly used reference standard for a scaphoid fracture (6 weeks radiography) was only 80% sensitive and 97% specific.¹⁹ It is notable that all diagnostic performance values calculated by latent class analysis were closer to the average diagnostic performance values based on an extensive pool of data from a recent meta-analysis.¹⁹ This could suggest that latent class analysis is more accurate.

The situation of an imperfect or debated reference standard is commonplace in orthopedic surgery and latent class analysis may merit wider utilization if in fact it provides more accurate information that leads to better patient care. Given the inherent uncertainty of the diagnosis, it may be appropriate that patients and doctors base decisions on the probability of fracture rather than the traditional all-or-none concept. It may be better to inform patients of the lacking certainty of a fracture and advising them on repeated clinical evaluation and/or protective cast immobilization. Acknowledging that we can only deal in probabilities, the development of clinical prediction rules will help to better define and narrow those probabilities.



Predictors of Scaphoid Fractures

In Chapter 5, clinical prediction rules have been developed for acute scaphoid fractures by incorporating demographic and clinical factors predictive of a fracture. A prospective study of 260 consecutive patients with a clinically suspected or radiographically confirmed scaphoid fracture was performed. Two weeks after injury, 223 patients returned for evaluation and formed the basis of the analysis. Patients were evaluated within 72 hours of injury and at two and six weeks after injury using clinical assessment and radiography. No single clinical sign demonstrated high sensitivity and specificity on conventional or latent class analysis derived diagnostic performance characteristics. A logistic regression model identified male sex ($p=0.002$), sports injury ($p=0.004$), anatomic snuffbox pain on ulnar deviation of the wrist within 72 hours of injury ($p<0.001$), and scaphoid tubercle tenderness at two weeks ($p<0.001$) as independent predictors of fracture among the entire cohort. When these four independent significant factors were positive, the risk of fracture was 91%.

The study identified demographic and clinical risk factors associated with a scaphoid fracture, which were used to develop clinical prediction rules. Implementation of these rules increases the prevalence of true scaphoid fractures among suspected fractures. When the pre-test probability of a true fracture is around 40% or greater, tests such as MRI, CT or bone scan have superior diagnostic performance characteristics, which means that they provide more useful and accurate information to help guide treatment.^{20,21} Given this fact, the best strategy may be to limit the use of sophisticated imaging to high risk patients e.g. men with a sports injury, anatomic snuffbox pain on ulnar deviation at presentation, and thumb-index pinch pain (39% probability of a fracture if three are present, 74% with all four). Lower risk patients may better be splinted initially and re-evaluated one or two weeks after injury.

Implementation of such a protocol to optimize management may require health providers, patients, and society to accept a small probability of missing a true fracture (e.g. $\leq 1\%$). If we can accept such a small risk, it would improve the management of patients with suspected scaphoid fractures by limiting unnecessary immobilization and protection, as well as limiting the use of expensive radiological imaging and radiation exposure.

Displacement and Instability: *CT vs Radiography*

In Chapter 6, the diagnostic performance characteristics of radiographs and CT in diagnosing displacement and instability of scaphoid waist fractures has been evaluated using intra-operative visualization as the reference standard. Forty-four adult patients with a scaphoid waist fracture elected arthroscopy-assisted operative fracture treatment at a mean of 9 days after injury (range, 2 to 22 days). All patients had radiographs and CT reconstructions of the scaphoid. The reference standard revealed

22 displaced fractures (prevalence 50%) and 29 unstable fractures of the scaphoid waist (prevalence 66%). All intra-operatively displaced fractures were unstable as were 7 of the 22 nondisplaced fractures. Among the 44 patients, radiographs demonstrated displacement in 11 patients (25%) and CT in 20 (45%). CT was significantly more accurate than radiographs at determining intra-operative fracture displacement ($p < 0.05$) and instability ($p < 0.05$). However, neither was accurate at diagnosing intra-operative fracture displacement or instability.

This study provides new insight in the concept of stability of scaphoid fractures. Traditionally, radiologically nondisplaced scaphoid waist fractures were considered stable and displaced fractures unstable, although there was no evidence for this assumption.²²⁻²⁶ It seems spurious that a static imaging device can diagnose a dynamic problem. This study shows that scaphoid fractures can be statically nondisplaced in neutral wrist position but dynamically displaceable when the fragments are gently manipulated. Among patients in this cohort with intra-operatively unstable fractures only 62% had malalignment on CT. This raises questions regarding the influence of fracture instability on the risk of nonunion. If previous studies of conservative treatment for radiographically nondisplaced acute scaphoid waist fractures had similar percentages of unstable fractures, then one would assume that the majority of unstable fractures heal conservatively.^{22,27-29} Fracture displacement is a known risk factor for nonunion, but additional research is necessary to determine if the same is true for fracture instability. A future prospective trial could be designed to test whether there is difference in the rate of union after conservative treatment between nondisplaced stable and nondisplaced unstable scaphoid waist fractures. Ideally, CT or MRI should be used to rule out fracture displacement and a dynamic modality such as fluoroscopy or arthroscopy should be used to assess fracture stability.

Displacement and Instability: *Predictors*

In Chapter 7, the relationship between fracture location relative to the apex of the scaphoid and intra-operative displacement or instability has been evaluated. A prospective database of 58 adult patients with a scaphoid fracture that elected arthroscopy-assisted operative fracture treatment was studied, including the cohort studied in Chapter 6. Nineteen (70%) displaced fractures and 20 (65%) nondisplaced fractures were located distal of the apex of the scaphoid. Twenty-seven (71%) unstable fractures and 12 (60%) stable fractures were located distal of the apex of the scaphoid. These differences were not significant for either displacement ($p = 0.081$) or instability ($p = 0.172$). There was a significant correlation between radiographic comminution (more than two fracture fragments) and intra-operative displacement and instability ($p < 0.001$). Radiographic comminution, but not location predicts intra-operative displacement and instability of a scaphoid fracture.



Theoretically, an acute scaphoid fracture distal to the apex on the dorsal ridge could result in flexion of the distal fragment³⁰⁻³³ because the apex coincides with the attachment of the dorsal intercarpal ligament and the dorsal part of the scapholunate interosseous ligament, both important stabilizers of the scaphoid.³ We found no such relationship based on arthroscopic diagnosis of displacement and instability. This study suggests that fracture comminution on radiographs is the only variable predictive of intra-operative displacement and instability. The next steps would be to determine whether fracture instability is a risk factor for nonunion and whether fracture comminution is a relative indication for surgery.

Displaced Scaphoid Fractures

In Chapter 8, it has been tested if training could improve inter-observer reliability for the diagnosis of scaphoid fracture displacement on radiographs and CT-scans. Sixty-four orthopedic and trauma surgeons rated a set of radiographs and CT-scans of 10 displaced and 10 nondisplaced scaphoid fractures for the presence of displacement. Prior to rating, observers were randomized to a training group (34 observers) and a non-training group (30 observers). There was a small but significant difference in the inter-observer reliability for displacement ratings in favor of the training group. Ratings of radiographs and CT-scans combined resulted in moderate agreement for both groups. The average sensitivity, specificity and accuracy of diagnosing displacement of scaphoid fractures were slightly higher for the training group.

Inter-observer reliability for displacement of scaphoid fractures is poor to moderate.³⁴⁻³⁶ The results of this study suggest that training can improve inter-observer reliability and accuracy for the diagnosis of scaphoid fracture displacement, but only slightly. Given the potential consequences of inadequate treatment of a displaced fracture, underdiagnosing is more of a concern than overdiagnosing. Therefore it was attempted to simplify the definition for the observers in the training group by defining displacement as anything more than a crack. This study shows us that even though observers are encouraged and trained to classify fractures using clear and simplified guidelines, many observers still see things that others don't see, irrespective of their experience. These findings encourage towards future research regarding inter-observer variation and how to reduce it further. Another possible method to address this is by a joint discussion session or Delphi procedure to discuss cases and achieve consensus where possible.

United Scaphoid Fractures

In Chapter 9, the inter-observer reliability and diagnostic performance characteristics of CT-scans for the diagnosis of union in scaphoid waist fractures has been evaluated. A group of 59 orthopedic and trauma surgeons rated a set of 30 sagittal CT-scans

for the presence of union. The selection of CT-scans consisted of 20 healing scaphoid waist fractures (6-10 weeks after injury) treated non-operatively and known to have eventually achieved union, and 10 operatively confirmed ununited scaphoid waist fractures (>6 months after injury). The inter-observer reliability among 59 raters was substantial ($\kappa=0.66$). The average sensitivity, specificity and accuracy of diagnosing union of scaphoid waist fractures on sagittal CT-scans were 78%, 96%, and 84%, respectively. Assuming a 90% prevalence of fracture union of the scaphoid, the positive predictive value of a diagnosis of union on CT-scan was 0.99 and the negative predictive value was 0.41.

These results suggest that CT-scans are accurate and reliable for diagnosis of union but inadequate for predicting nonunion of scaphoid waist fractures between 6 and 10 weeks after injury. The inter-observer agreement of sagittal CT-scans for diagnosing scaphoid waist fracture union found in the current study ($\kappa=0.66$) is substantially higher than what Dias et al. found for radiographs ($\kappa=0.39$).³⁷ The fact that CT-scans obtained between 6 and 10 weeks after fracture are more reliable than radiographs might contribute to a reduced duration of immobilization—something which merits additional study. The disadvantages of CT-scans over radiographs include higher costs, less availability and greater radiation exposure. Given that the union rate of adequately protected nondisplaced scaphoid waist fractures approaches 100%, it is not recommended to add CT to the routine management of these fractures. It should be reserved for specific circumstances such as delayed diagnosis, inadequate immobilization, and equivocal radiographic findings.

TREATMENT

There is no consensus regarding the most adequate treatment of nondisplaced scaphoid fractures. Firstly, there is debate about the choice of surgical or conservative treatment. Secondly, when opting for conservative treatment it remains unclear whether the thumb and elbow need to be immobilized. Finally, there is discussion about optimal treatment of scaphoid nonunions.

Surgical versus Conservative Treatment

In Chapter 10, the evidence from randomized controlled trials (RCTs) comparing surgical versus conservative treatment for acute nondisplaced and minimally displaced fractures of the scaphoid has been evaluated. A systematic literature search of the medical literature from 1966 to 2009 was performed. Four-hundred seventeen patients were included in 8 trials (205 fractures were treated surgically and 212 conservatively). Most trials lacked scientific rigor. The primary outcome (standardized functional outcome) significantly favored surgical treatment ($p<0.01$). With regard



to the secondary outcome, heterogeneous results were found that favored surgical treatment for satisfaction, grip strength, time to union and time off work. In contrast, no significant differences between surgical and conservative treatment for pain, range of motion, rate of nonunion and malunion, and total treatment costs were found. The rate of complications in the surgical treatment group (23.7%) was not statistically higher than in the conservative group (9%, $p=0.13$). However, there was a near-significant ($p=0.05$) higher rate of scaphotrapezial osteoarthritis in the surgical treatment group.

The socioeconomic argument of delay in return to work or sports is becoming more important in current algorithms to decide between conservative and surgical treatment of suspected scaphoid fractures, and the same is true for other fracture sites. Two previous meta-analyses on this subject concluded that there were no significant differences in treatment methods.^{38,39} However, since the publication of their studies, several other RCTs have been conducted and published.^{29,40-42} Based on limited methodological quality primary studies, functional outcome and time off work suggested favoring surgical treatment for acute non- and minimally displaced scaphoid fractures but surgery may engender more complications. Thus, long-term risks and short-term benefits of surgery should be carefully weighted in clinical decision making. In other words, the choice should be based on surgeon and patient preferences. For example, an athlete or manual worker might prefer surgical treatment with a fast return to function and a desk-based employee might rather opt for cast-immobilization in order to avoid surgery with a seemingly higher complication risk.

Conservative Treatment Methods

In Chapter 11, the evidence from RCTs comparing conservative treatment methods for acute scaphoid fractures was systematically reviewed. A systematic search of the medical literature from 1966 to 2010 resulted in five potentially eligible trials of which four met the inclusion criteria. In total, 523 patients were included in four trials including two evaluating below-elbow casting versus above-elbow casting; one trial comparing below-elbow casting including the thumb versus excluding the thumb; and one trial comparing fractures with a below-elbow cast excluding the thumb with the wrist in 20-degrees flexion versus the wrist in 20-degrees extension. According to the best available evidence, this meta-analysis revealed that (1) none of the conservative treatment modalities for acute scaphoid fractures demonstrated significantly lower rates of nonunion; and (2) there were no significant differences with regard to pain, grip strength, time to union, avascular necrosis, immobilization time and range of motion; with the exception of the range of wrist extension which was significantly smaller in patients that were immobilized with the wrist in 20-degrees flexion compared to patients that were immobilized with the wrist in 20-degrees extension.⁴³⁻⁴⁶

Given the limitations of the data set, the only recommendation is that all the treatment variations studied seem acceptable so that patients and surgeons can continue to follow their preferences pending better data. Future trials need a clear and reproducible definition of the scaphoid waist (e.g. middle third), accurate and reliable methods for diagnosing and excluding displaced fractures (e.g. using CT reconstructions), accurate and reliable methods for diagnosing nonunion (e.g. four-view radiographs at a minimum of 6 months after injury), and optimal quality of design and reporting (e.g. following CONSORT guidelines).

Cast Immobilization: *Thumb vs No Thumb*

In Chapter 12 it has been evaluated whether or not the thumb needs to be immobilized in cast treatment of nondisplaced scaphoid fractures. Sixty-two patients with a CT or MRI-confirmed nondisplaced fracture of the scaphoid were enrolled in a prospective multi-center RCT comparing the two cast modalities. There were 55 waist and 7 distal fractures. For the primary outcome, there was a significant difference in the extent of union on CT at ten weeks (85% vs. 70%; $p=0.048$) favoring treatment with a cast excluding the thumb. At six months after injury, there were no significant differences between the groups for wrist motion, grip strength, Mayo Modified Wrist Score, Disabilities of the Arm, Shoulder and Hand score, visual analogue scale for pain, and radiographic union. The union rate was 98% overall when adhering to intention-to-treat (1 nonunion in the thumb-cast group) and 100% with conservative treatment; as one patient with a waist fracture treated with a thumb-cast elected operative treatment one week after enrollment, subsequently used crutches and developed nonunion.

These results show that the rate of union six months after conservative treatment can be as high as 100%, regardless of thumb immobilization. The major difference of the present study with the previous RCT on thumb immobilization of scaphoid fractures⁴³ is that in this study patients with either displaced or proximal fractures (known risk factors for nonunion) were excluded. These additional exclusion criteria may explain the higher total rate of union with conservative treatment (100%) as compared to the previous study which found a total rate of union of 90% in both groups.⁴³ Another important finding of this study was that four patients with fractures rated <24% of bony bridging on the 10-week CT, healed clinically and radiographically at 24 weeks after injury without additional treatment. These findings are consistent with the findings of Chapter 9 and previous studies.⁴⁷⁻⁴⁹ In Chapter 9 it was found that CT-scans are accurate and reliable for diagnosis of union but inadequate for predicting nonunion of scaphoid waist fractures between 6 and 10 weeks after injury.⁴⁷ Therefore it may be unnecessary to operate on patients with scaphoid fractures that show no sign



of union on CT after 12 weeks of cast immobilization, which is a commonly applied management strategy.^{28,29}

Consistent with study described in Chapter 11 and the study of Clay et al.,⁴³ this study suggests that immobilization of the thumb is unnecessary for CT or MRI-confirmed nondisplaced fractures of the scaphoid. It is recommended to offer patients with a nondisplaced fracture of the scaphoid treatment in a short arm cast without immobilization of the thumb.

Scaphoid Nonunion Management

In Chapter 13, the current concepts of managing scaphoid nonunions have been reviewed. The diagnosis of nonunion is made on radiographs but CT or MRI scans are useful to assess deformity and blood supply. Typical radiographic signs of nonunion are widening of the fracture cleft, cyst formation and sclerosis of the fracture surfaces.⁵⁰ The goals of treatment for scaphoid nonunion include union, correction of deformity, relief of symptoms, and limitation of arthrosis.⁵¹ The main factors that adversely affect outcome in scaphoid nonunion include a long duration of nonunion, no punctate bleeding of the proximal pole with the tourniquet released at surgery, and failed previous surgery.⁵² It is not clear whether stable, well aligned nonunions lead to arthrosis or cause related symptoms.

Surgery of scaphoid nonunion has short-term and long-term goals; however, most studies focus on union alone and not much is known about the ability of surgery for scaphoid union to diminish symptoms in the short term and limit arthrosis in the long-term. There are many variations to nonunion surgery, which reflects the lack of satisfaction or consistency with any one strategy. Future research should elucidate these areas of debate including the role of vascularized bone grafts and the transition from attempts to gain union to salvage procedures. Data from randomized controlled trials comparing vascularized to non-vascularized bone grafting for scaphoid nonunion would be of great value for future management.

Conclusion

This thesis deals with current issues in anatomy, diagnosis and treatment of scaphoid fractures. Anatomical inconsistencies are elucidated by accurate 3D imaging. Sophisticated diagnostic imaging cannot solve the problem of the suspected scaphoid fracture because there is no gold standard for a true fracture, and there likely never will be. Acknowledging that we can only deal in probabilities, the development of clinical prediction rules will help to better define and narrow those probabilities. Fracture displacement and instability cannot be accurately diagnosed or predicted on CT or radiographs. CT is more accurate than radiographs at diagnosing displacement,

and training of observers can increase the reliability. Adequate treatment of scaphoid fractures can result in high rates of union (95-100%). The choice of surgical or conservative treatment should be based on surgeon and patient preferences. If conservative treatment is opted, there is no need to immobilize the thumb.

Future Perspectives

One of the main goals for the future is to establish the most accurate and resourceful algorithm for the diagnosis of a true scaphoid fracture as well as fracture displacement. A key factor in determining treatment strategy seems to be documenting that the scaphoid waist fracture is nondisplaced using computed tomography. When displacement is accurately diagnosed and adequate treatment is provided, the union rate approaches 100%. With an increasing trend towards informed and shared clinical decision making, patients with nondisplaced scaphoid fractures are suggested to be offered the choice of surgical versus conservative treatment. The current trend towards the choice of surgical treatment in these fractures is generally due to the shorter immobilization time implying a faster return to work and sports. This trend could potentially be reversed considering the fact that cast immobilization is a more appealing option when the elbow and thumb are not included in the cast as well as if the duration of cast immobilization is reduced. Radiologically nondisplaced fractures are usually stable and probably require less protection than is traditionally advised. Some encouraging work in this field has shown that the vast majority of nondisplaced fractures consolidate within 4 weeks of cast immobilization. Given the growing evidence that patients with nondisplaced fractures do not benefit from immobilization of the elbow and thumb, additional study is merited to confirm that these less cumbersome approaches to immobilization are safe and effective. For example, it would be interesting to determine whether distal pole fractures – where fracture healing is expected to be less problematic – would have a similar high healing rates if treated symptomatically in a removable wrist splint.

In the future, it is expected that the patient with a suspected scaphoid fracture will be offered a reliable diagnostic algorithm leading to a more accurate probability of a true fracture; and it is expected that the patient with a true scaphoid fracture will be offered a wider spectrum of treatment options ranging from percutaneous surgical fixation to an effective method of conservative treatment in a more functional cast and for a shorter period of time.



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