Original article

Radiographic evaluation of acute scaphoid fractures

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Abstract

Introduction: Scaphoid fracture is the commonest carpal bone fracture. Various radiographic views have been proposed for diagnosing it. This study was conducted to determine which radiographic view/s among five different views showed scaphoid fracture consistently.

Methods: This prospective study was carried out in Department of Orthopedics, IOM, TUTH from February 2012 to June 2013. Twenty six patients with scaphoid fracture were included in the study who had five scaphoid views done viz. postero-anterior, ulnar deviated PA, pronation oblique, supination oblique and lateral. Each view was assessed with respect to demonstrating a fracture and the clarity of demonstration. Statistical analysis of data obtained was done using SPSS 17.0 version.

Results: This study included 26 patients, 18 to 54 years of age (27.5±9.5 years). Average duration after injury was 6.73± 8.64 days. Out of five different views, pronation oblique showed fracture in 69.2% of patients followed by ulnar deviated PA in 61.5% patients. Pronation oblique showed fracture in all patients who had demonstrated fracture in supination oblique and lateral views also. Pronation oblique and ulnar deviated PA were the only views to show fracture in 5 patients each. Fracture in middle 1/3rd of the scaphoid was present in 53.8% patients while no patients had proximal 1/3rd fracture.

Conclusion: Pronation oblique and ulnar deviated PA are the most important views among the other views of scaphoid series. Supination oblique and lateral views are the least important views to detect a scaphoid fracture.

Keywords: Pronation oblique, Scaphoid fracture, Scaphoid series, Ulnarly deviated PA

Introduction

Average time for healing of a non-displaced scaphoid fracture in a cast is 8 to 12 weeks, accounting for a considerable loss of time and productivity in this young and active population.[1-3]

Because the potential complications of scaphoid fracture; including nonunion, avascular necrosis, and osteoarthritis, are made more likely by a delay in diagnosis and treatment, early diagnosis and treatment for these fractures are critical to improve outcomes. The diagnosis of a scaphoid fracture can be usually established on the basis of clinical examination and radiographs, which typically include four views: postero- anterior, lateral, semipronation oblique, and ulnar deviated PA[4]. However, in the acute phase after injury, some fractures are radiographically occult. To avoid undertreatment of these occult fractures, patients with suspected scaphoid fractures (high clinical probability of a scaphoid fracture but negative or equivocal radiographs) usually are treated with cast immobilization followed by repeat clinical examination and radiographs[4].

There have been many studies in defining the most accurate radiographic view in regards to scaphoid fracture but the controversy still prevails[1]. This study, however, tries to evaluate the radiographic views for scaphoid fracture which consistently show fracture line. This study also determines the demographic profile (age, sex, occupation, geographical distribution) of patients with scaphoid fracture, the distribution of scaphoid fracture according to the site in the scaphoid, average duration of symptoms before radiographic evaluation of the patient and the view in scaphoid series which is least reliable in detecting a scaphoid fracture.

Methods

Study design: Prospective Observational Study.

Duration of study: February 2012 to June 2013.

Place of Study: Department of Orthopedics, TUTH, Kathmandu, Nepal.

Ethical approval: Approval was taken from Institutional Review Board (IRB), institute of medicine, Kathmandu, Nepal.

Patient consent: All the radiographically diagnosed patients of scaphoid fracture who presented to our institute in the study duration and who met the inclusion criteria were requested for the informed written consent.

INCLUSION CRITERIA:

1) Patients of age group more than 18 years presenting with wrist injury with clinical suspicion of scaphoid fracture and whose radiograph (scaphoid series) shows fracture line.
2) Initially radiographically normal but clinically suspicious cases of scaphoid fracture who show the fracture of scaphoid in repeat radiograph after 2 weeks.

EXCLUSION CRITERIA:

1) Radiographs showing open physis.
2) Previous wrist disorders hampering proper scaphoid views.
3) Polytrauma.

Sampling: No sampling method was used. All the twenty-six patients meeting the inclusion criteria were enrolled for the study.

Statistical analysis: Chi-square test was applied to test for the significance of the data obtained. Other descriptive analysis like mean and standard deviation were also used.

Software used: Statistical Package for the Social Sciences (SPSS) 17.0

If the initial radiograph of the clinically suspected scaphoid fractures were negative, patients were immobilized in scaphoid cast. Such patients were re-evaluated clinically after removing the cast and out of cast scaphoid series was advised. Patients were enrolled in the study if the repeat radiograph showed scaphoid fracture. All the patients whose scaphoid series demonstrated fracture in any of the five views within 4 weeks of injury were enrolled in the study.

Results:

Out of 26 patients 21 (81%) were males and 5 (19%) were females.Age range was from 18 to 54 years, with mean age of 27.5 years ± 9.5. The maximum incidence of scaphoid fracture appears to occur in the 2nd and the 3rd decade of life (65.4%). The average duration at which patients presented to our OPD or emergency with chief complain of pain in wrist region was 6.73 ± 8.64 days (Maximum: 28 days, minimum: 1 day).

Thirteen patients (50%) had their right side involved while the remaining patients (50%) had left sided complains. Twenty-two patients (84.6%) had fallen from standing height on outstretched hand while remaining 4 patients (15.4%) had direct impaction over their wrist region.

Out of 26 patients, 25 patients (96.2%) had anatomical snuff box fullness and tenderness while 17 patients (65.4%) had scaphoid tubercle tenderness. Similarly only 18 patients (69.2%) had pain in axial loading of thumb of affected hand.

Out of the five views taken for scaphoid series,pronation oblique view showed fracture in 18 (69.2%) patients followed by postero-anterior view with ulnar deviation which showed fracture line in 16 (61.5%) out of 26 patients. The view that showed least number of fracture was lateral view(7.7%). (Table 1)

Table 1 Number of fractures detected in different views of scaphoid series.

View	Yes	No	p value
Pronation oblique	18 (69.2%)	8 (30.8%)	
PA with ulnar deviation	16 (61.5%)	10 (38.5%)	
Postero anterior	6 (23.1%)	20 (76.9%)	<0.001
Supination oblique	4(15.4%)	22 (84.6%)	
Lateral	2 (7.7%)	24 (92.3%)	

Fourteen (53.8%) of 26 patients had fracture in middle 1/3rd of the scaphoid while 11 (42.3%) had fracture line in distal 1/3rd and only 1 (3.8%) had scaphoid tubercle fracture.In 5 (19.23%) out of 26 patients, pronation oblique was the only

view to show fracture. Similarly ulnar deviated PA was the only view to show fracture in 5 (19.23%) patients. Therefore these two views were the only views to detect fracture in 10 (38.46%) of the total 26 patients.

For every lateral or supination oblique view showing fracture, there was always another view that showed fracture in the same patient and pronation oblique view consistently showed fracture in every cases which had fracture demonstrated in lateral and supination oblique view.

Table 2 Correlation of Anatomical Snuff Box (ASB) fullness with different views of scaphoid series.

		Anatomical Snuff Box Fullness		p-value
		Present	Absent	
PA	Positive	6	0	0.57
	Negative	19	1	
PAUD	Present	16	0	0.19
	Absent	9	1	
PO	Present	17	1	0.49
	Absent	8	0	
SO	Present	3	1	0.017
	Absent	22	0	
Lat	Present	2	0	0.768
	Absent	23	1	

Out of 25 patients who had Anatomical Snuff Box fullness, 22 patients didn't show fracture in supination oblique view (Table 5) ($p<0.05$) which is statistically significant.

Table 3 Correlation of Scaphoid Tubercle tenderness with different views of scaphoid series.

		Scaphoid Tubercle tenderness		p-value
		Present	Absent	
PA	Positive	5	1	0.29
	Negative	12	8	
PAUD	Present	12	4	0.19
	Absent	5	5	
PO	Present	12	6	0.84
	Absent	5	3	
SO	Present	2	2	0.48
	Absent	15	7	
Lat	Present	0	2	0.04
	Absent	17	7	

All the patients who had scaphoid tubercle tenderness didn't show fracture in lateral view (Table 3) ($p<0.05$) which is statistically significant.

Table 4 Correlation of mechanism of injury with different views of scaphoid series.

		Mechanism of injury		p-value
		Hyper extension	Direct trauma	
PA	Positive	5	1	0.92
	Negative	17	3	
PAUD	Present	15	1	0.10
	Absent	7	3	
PO	Present	15	3	0.786
	Absent	7	1	
SO	Present	2	2	0.04
	Absent	20	2	
Lat	Present	1	1	0.06
	Absent	21	3	

Out of 22 patients with hyperextension injury, 20 patients didn't show fracture in supination oblique (Table 4) ($p<0.05$) which is statistically significant.

Table 5 Correlation of mechanism of injury and site of fracture

		Site of Fracture			p-value
		middle 3rd	distal 3rd	tubercle fracture	
Mechanism of injury	Direct Impact	0	**4**	0	0.04
	Hyperextension	14	**7**	1	
Total		14	11	1	

All the 14 patients with fracture in the middle 1/3rd of the scaphoid had hyperextension injury with axial loading (Table 5) ($p<0.05$)which is statistically significant.

Discussion

Although various articles have made different suggestions as to the number of views that should be taken to comprise adequate "scaphoid views" for safe practice, this is the study which attempts to assess the ability of each view to detect a fracture

If an initial definitive diagnosis can be made, this would allow the number of attendances to be reduced. If a positive diagnosis is made at initial presentation then there is no requirement for a review at 2 weeks. Instead, the patient can be reassessed at a later stage for removal of plaster, clinical review and further imaging.

In this study age range was from 18 to 54 years, with mean age of 27.5 years ± 9.5. The maximum incidence of scaphoid fracture appears to occur in the 3rd decade of life (65.4%). This finding was similar to a study done by Cheung et al[5] who had done retrospective review of radiographs for acute scaphoid fracture of 113 patients. They had patients with mean age of 34.3 years ± 18.4 years. The higher incidence of scaphoid fracture in younger age group is probably due to their involvement in more vigorous physical activities. Moreover as thepatients age, the wrist ismuch more likely to fail at the distal radial metaphysis than at the scaphoid. Therefore scaphoid fracture in old age is rare.

In this study majority of patients were male. Out of 26 patients 21 (81%) were males and the remaining 5 (19%) were females. This was similar to the study done by Cheung et al[5] in which 82 (72.5%) patients were male and

31 (27.5%) were females. Higher incidence of scaphoid fracture in males is likely due to males participating more in high demand activities than females.

In this study the average duration at which patients presented to our OPD or emergency with chief complain of pain in wrist region was 6.73 ± 8.64 days (Maximum: 28 days, minimum: 1 day). In a similar study by Cheung et al[5] the average duration was 2 ± 3.9 days. The delay in presentation at our set up is probably due to misdiagnosis at other local centers because of few symptoms and few clinical findings, tendency to neglect the injury until it's difficult to bear pain or because of lack of appropriate health care centers in nearby locality.

In our study 22 patients (84.6%) had fall from standing height on outstretched hand while remaining 4 patients (15.4%) had direct trauma over their wrist. This is similar to the study done by Leslie and Dickson[6] where 162 (73%) of the patients had fall on outstretched hand while only 2.6 % patients had direct trauma to wrist. Similar result was obtained in another study by Duckworth A.D, Jenkin PJ et al[7] where low energy fall from standing height in outstretched hand was the most common mechanism of injury seen in 40.4% of 151 patients.

Out of the five views of scaphoid series postero-anterior view with ulnar deviation showed fracture line in 16 (61.5%) out of 26 patients while pronation oblique view showed fracture line in 18 (69.2%) patients. The view to show least number of fracture line was lateral view (2 patients; 7.7%). Individual views were treated as unit variables and cross tabulated against overall detection of scaphoid fractures. The resulting cross tabulation and a subsequent Chi square test revealed that there is a significant difference in the detection rate of fractures by different views. ($p<0.001$)

But in the similar study by Leslie and Dickson[6], fractures were visible on the postero-anterior view in 75% of cases, on the semipronated view in 77% of cases, on the lateral view in 22% and in semisupinated view in 22% cases. Similarly in the study by Cheung et al[5] pronation oblique view showed fracture in 94% of cases followed by postero-anterior view showing fracture in 73% of cases and ulnar deviated PA, lateral and supination oblique views showing fracture in 47%, 37.2% and 33% of cases respectively. Therefore these studies showed that maximum number of fracture was visible in pronation oblique view while least number of fracture was visible in supination oblique and lateral views respectively. These findings are similar to our study.

In our study 14 (53.8%) out of 26 patients had fracture in middle 1/3rd of the scaphoid while 11 (42.3%) had fracture in distal 1/3rd and only 1 (3.8%) had scaphoid tubercle fracture. There were no patients who had proximal pole fracture of the scaphoid. However it was 4%, 59%, 11% and 26% for proximal 1/3rd, middle 1/3rd, distal 1/3rd and scaphoid tuberosity respectively in the study by Cheung et al[5]. Similarly, in the study by Leslie and Dickson[6] it was 6%, 66%, 11% and 17% respectively for proximal 1/3rd, middle 1/3rd, distal 1/3rd and scaphoid tuberosity. Therefore, middle 1/3rd of the scaphoid being the most common site of fracture and the proximal 1/3rd being the least common site is demonstrated in our study which is similar to the study done by Leslie and Dickson and Cheung et al[5].

In our study the single scaphoid tuberosity fracture was demonstrated in only pronation oblique view. In the study byCheung et al[5],on five occasions, the pronation oblique was the only view on which a tuberosity fracture could be seen.

In the study, for all types of fractures, whenever either a lateral orsupination oblique views were taken, the fracture was always clearly visible on at least one of the other views. This finding is similar to the study by Cheung et al[5]. In our study it was pronation oblique view which showed fracture in all the cases that had fracture visible in either supination oblique or lateral view.

Statistically analyzing the correlation between ASB fullness and different views in scaphoid series using chi square test it was found that supination oblique view was least likely to detect a fracture in patients with ASB fullness ($p=0.017$) (table 2) .

Similarly correlating Scaphoid Tubercle tenderness with different views it was found that lateral view was least likely to detect a fracture in patients with Scaphoid Tubercle tenderness ($p=0.043$) (table 3).

Correlation between mechanism of injury and different views demonstrated that supination oblique view was least likely to detect a fracture in patients who had hyperextension injury with axial loading ($p = 0.037$) (table 4).

Correlation between mechanism of injury and site of fracture in the scaphoid showed that patients with hyperextension injury were most likely to have a scaphoid fracture in middle 3rd ($p = 0.04$) (table 5).

Conclusion

Pronation oblique view showed scaphoid fracture most consistently among the five different views (69.2%) followed by PA with ulnar deviation (61.5%). All the fractures detected by supination oblique and lateral views were also detected by pronation oblique view. Hence pronation oblique and ulnar deviated PA are the most important views among the other views and should be included in scaphoid series. Postero-anterior view, in one occasion, was the only view to detect scaphoid fracture and therefore is also recommended to be included in the series.

Supination oblique and lateral views are the least important views to detect a scaphoid fracture. However, lateral view should be included during the initial workup of scaphoid fracture to detect any carpal malalignment. Supination oblique view can be omitted from the scaphoid series.

Therefore the radiographic views to be included in the scaphoid series are postero-anterior, ulnar deviated PA, lateral and pronation oblique.

Conflict of interests: None declared.

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