

Prospective evaluation of clinical assessment in the diagnosis and treatment of clavicle fracture: Are radiographs really necessary?

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ABSTRACT

Introduction: Current recommended treatment for middle-third clavicle fractures is limited to the use of ice, analgesics, a sling, and rest. Radiography for these fractures would be superfluous if physicians could accurately identify them by clinical examination alone. The primary purpose of this study was to determine whether emergency physicians can accurately diagnose clavicle fractures, and whether they can differentiate middle-third fractures from medial- or lateral-third fractures by clinical assessment alone.

Methods: We enrolled a convenience sample of patients who presented to our rural emergency department with possible clavicle fracture between Nov. 1, 2001, and Apr. 30, 2002. Prior to viewing radiographs, physicians scored their clinical certainty of diagnosis on a 10-cm visual analogue scale. When certain of fracture, physicians determined the location of the fracture, the nature of the fracture and their hypothetical comfort in treating the injury without radiography.

Results: In 51 of 77 enrolled patients (66%; 95% confidence interval [CI], 54.6%–76.6%), treating physicians were certain of the diagnosis of clavicle fracture prior to radiography. In these 51 cases, radiography revealed a fracture in 50 cases (98.0%; 95%CI, 89.6%–99.9%). The physicians were 100% accurate for 4 fractures clinically identified as lateral-third fractures (95% CI, 39.7%–100%) and for 41 fractures identified as middle-third fractures (95% CI, 91.4%–100%). They were correct on only 1 of 5 injuries (20%; 95% CI: 1%–72%) they clinically identified as medial-third fractures. Despite high clinical accuracy with middle-third fractures, they stated in 27 of 42 cases (64%; 95%CI, 48.0%–78.5%) that they would have been uncomfortable treating the patient without a radiograph.

Conclusions: This study provides evidence that experienced emergency physicians are highly accurate when they are clinically certain of clavicle fracture. Further, when emergency physicians do clinically diagnose clavicle fracture, they can accurately identify the patient subgroup that will be responsive to conservative treatment. Routine radiography of obvious middle-third clavicle fractures does not appear to improve diagnostic accuracy or treatment decisions.

Key words: fracture; clavicle; radiograph; injuries

RÉSUMÉ

Introduction : Présentement, le traitement recommandé pour les fractures du tiers moyen de la clavicule se limite au recours à la glace, aux analgésiques, au port d'une attelle et au repos. Les ra-

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diographies pour ce type de fracture seraient superflues si les médecins pouvaient l'identifier avec précision uniquement à partir de l'examen clinique. L'objectif principal de cette étude était de déterminer si les médecins d'urgence peuvent diagnostiquer avec exactitude les fractures de la clavicule et s'ils peuvent différencier les fractures du tiers moyen des fractures du tiers interne ou externe uniquement à partir de l'évaluation clinique.

Méthodes : Nous avons inclus un échantillon de convenance de patients reçus à notre département d'urgence rural pour une fracture possible de la clavicule entre le 1^{er} novembre 2002 et le 30 avril 2002. Avant de regarder les radiographies, les médecins notèrent leur certitude clinique quant à leur diagnostic sur une échelle visuelle analogue de 10 cm. Lorsqu'ils étaient certains qu'il y avait fracture, les médecins en déterminaient l'emplacement, la nature et leur niveau de confort hypothétique à traiter la blessure sans radiographies.

Résultats : Parmi 51 des 77 patients inclus (66 %; intervalle de confiance [IC] 95 %, 54,6 %–76,6 %), les médecins traitants étaient certains de leur diagnostic de fracture de la clavicule avant les radiographies. Parmi ces 51 cas, les radiographies révélèrent une fracture chez 50 d'entre eux (98 %; IC 95 %, 89,6 %–99,9 %). Les médecins avaient vu juste à 100 % pour quatre fractures identifiées cliniquement comme des fractures du tiers externe (IC 95 %, 39,7 %–100 %) et pour 41 fractures identifiées comme des fractures du tiers moyen (IC 95 %, 91,4 %–100 %). Ils avaient raison pour seulement une blessure sur cinq (20 %; IC 95 %, 1 %–72 %) qu'ils avaient identifiées cliniquement comme des fractures du tiers interne. Malgré l'exactitude clinique élevée pour les fractures du tiers moyen, les médecins affirmèrent dans 27 cas sur 42 (64 %; IC 95 %, 4 %–100 %) qu'ils n'auraient pas été à l'aise de traiter le patient sans radiographies.

Conclusions : La présente étude démontre que le jugement clinique des médecins d'urgence expérimentés en présence de fractures de la clavicule est excellent. De plus, quand les médecins d'urgence diagnostiquent cliniquement une fracture de la clavicule, ils peuvent identifier avec exactitude le sous-groupe de patients qui répondra favorablement au traitement conservateur. Les radiographies de routine pour les fractures évidentes du tiers moyen de la clavicule ne semblent pas améliorer l'exactitude diagnostique ni les décisions de traitement.

Introduction

Radiography for known or suspected fractures and dislocations has, until recently, been routine. Over the last decade, studies have shown that routine radiographs for ankle injuries, knee injuries, C-spine injuries and (pre-reduction) shoulder dislocations are unnecessary. In place of indiscriminate radiography for all such injuries, clinical decision rules or guidelines have been established for determining when radiography will provide additional, relevant information to the clinical picture.¹⁻⁵ This rational approach to ordering radiographs selectively has resulted in a substantial reduction in unnecessary radiographs, with concomitant savings in costs and resources and, in some cases, reduction in pain and inconvenience to the patient.

Radiographs for suspected clavicle fractures may be performed first to identify the presence of a fracture, then to demonstrate the characteristics of the fracture that might affect treatment decisions. But if physicians can accurately determine by clinical examination alone that the clavicle is fractured, then a radiograph is necessary only if treatment decisions are changed by the particular characteristics of a given fracture. In a pilot survey on the use of radiography in suspected clavicle fractures, we found that 5 of 6 physicians indicated that they "never" or "rarely" omit clavicle radiog-

raphy, even when they are certain of the diagnosis and certain that the radiographs will not affect the treatment. The most common reasons cited for performing radiographs were perceived patient expectations or "standard of care."

The primary purpose of this study was to determine whether emergency physicians can, by clinical exam alone, accurately diagnose clavicle fractures and differentiate middle-third fractures from medial- or lateral-third fractures. Our secondary purpose was to determine which, if any, clavicle injuries emergency physicians are comfortable managing without radiography.

Methods

Setting and patients

This prospective observational study was conducted at Mineral Springs Hospital, a rural community hospital that treats 15 000 patients annually and is staffed by 6 full-time specialty-trained emergency physicians, each of whom has been in practice for more than 5 years. The hospital is located in Banff, Alta., a mountain community of 7760 inside a national park. Because of its location, many people visit Banff to pursue outdoor recreational activities.

From Nov. 1, 2001, to Apr. 30, 2002, a convenience sample of patients presenting with isolated possible clavi-

cle fractures were identified by the triage nurse. Patients were excluded if they had injuries involving non-musculoskeletal organ systems or if the treating emergency physician determined on initial exam that they "certainly" did not have a clavicle fracture.

Data collection

A data collection form was initiated by the triage nurse at the time of initial patient contact and completed by the attending emergency physician at the time of patient assessment. After evaluating the patient, and before obtaining clavicle radiographs, the physician documented clinical certainty of diagnosis on a 10-cm visual analogue scale (VAS) anchored by the terms "certain fracture" and "certain no fracture." When they were certain of fracture (i.e., a score of 10 on the VAS), physicians described the location of the fracture, the nature of the fracture and their hypothetical comfort in treating the injury without radiography. Following radiography, physicians documented the presence and location of any fractures, and whether the radiographs altered their treatment plan. Emergency physicians' radiographic assessments were compared to the gold standard of the radiologist's dictated report. Patient management was left to the discretion of the treating physician. The study was approved by the provincial Research Ethics Committee, which deemed consent not to be required.

Data analysis

Data were entered into a Microsoft Excel 2000 spreadsheet, and Excel was used to generate all descriptive statistics. Binomial 95% confidence intervals (CIs) for proportions were calculated using Stata (Version 5.0 MacIntosh).

Results

During the study period, 77 patients were identified as possibly having an isolated clavicle fracture and were enrolled in the study. After study completion, a hospital records search located 20 patients with clavicle fractures who had not been enrolled, and comparative data were collected on this group. Baseline characteristics were similar, and a medical record review did not reveal any significant differences between the unenrolled and enrolled groups. To our knowledge, no unenrolled patient was mistakenly excluded because the emergency physician had misdiagnosed the injury.

Clinical accuracy

Table 1 outlines the characteristics of the study population, and Table 2 summarizes the diagnostic accuracy of the physicians' clinical assessments. In 51 of 77 enrolled pa-

tients (66%; 95% CI, 54.6%–76.6%), the treating physician was certain of the diagnosis of clavicle fracture (i.e., 10/10 certainty on the VAS scale) prior to radiography. In these 51 cases, radiography revealed a fracture in 50 cases (98.0%; 95% CI, 89.6%–99.9%). The single incorrect diagnosis was in a patient with pain, tenderness and swelling over the medial third of the clavicle, which was subsequently diagnosed as a sternoclavicular sprain. Clinical judgement was also highly accurate for fracture location: the physicians were 100% accurate for 4 fractures clinically identified as lateral-third fractures (95% CI, 39.7%–100%) and for 41 fractures identified as middle-third fractures (95% CI, 91.4%–100%). They were correct on only 1 of 5 injuries (20%; 95% CI, 1%–72%) they clinically identified as medial-third fractures. Of these, 3 were actually middle-third fractures, 1 was a medial-third fracture and 1 was a soft-tissue injury. When asked about their ability to clinically identify fracture comminution and wide displacement, physicians were uncertain in 30 of 51 cases (59%) and in 23 of 51 cases (45%) respectively.

Table 1. Clinical and demographic characteristics of study patients (n = 77)

Characteristic	No. of patients* (and %*)
Mean age, yr (range)	29.5 (10–66)
Male	64 (83)
Activity	
Ski	19 (24)
Snowboard	43 (56)
Other	15 (20)
Injury	
Medial-third fracture	1 (1)
Middle-third fracture	54 (70)
Lateral-third fracture	6 (8)
Acromioclavicular separation	9 (12)
No fracture – Other	7 (9)

*Except where otherwise indicated.

Table 2. Accuracy of physicians' clinical assessments for clavicle fractures prior to radiography*

Physician assessment	Result of radiography	
	Fracture	No fracture
Clinically certain of fracture (VAS = 10)	50	1
Not clinically certain of fracture (VAS < 10)	11	15

*Sensitivity: 50/61 = 82.0% (95% confidence interval [CI], 70.0%–90.6%);
Specificity: 15/16 = 93.8% (95% CI, 69.8%–99.8%);
Positive predictive value: 50/51 = 98.0% (95% CI, 89.6%–99.9%);
Negative predictive value: 15/26 = 57.7% (95% CI, 36.9%–76.6%).
VAS = Visual Analogue Scale

Impact of imaging

Table 3 illustrates the anticipated and actual influence of radiography on patient management. Physicians expected that radiography would affect their treatment in 13 of 51 fractures, including 11 of the 42 middle-third fractures. In fact, radiography helped guide treatment in 9 of these 13 cases, and in 1 case when they thought it would not affect management. The latter involved a patient whose clinical diagnosis was a medial-third clavicular fracture and whose x-ray was normal. Radiography did not lead to any unexpected management changes in patients with middle- or lateral-third fractures.

Physicians reported that they would be comfortable treating without radiographs in 17 of 51 patients in whom they were certain of diagnosis. This included 15 of the 42 patients in whom middle-third fracture was diagnosed clinically. In the 27 patients with middle-third fractures where physicians indicated they would be uncomfortable treating without a radiograph, reasons for discomfort included concerns about fracture displacement ($n = 12$), patient expectations for imaging ($n = 6$), degree of comminution ($n = 5$), the perceived standard of care ($n = 4$), the possibility of pneumothorax ($n = 4$), the need to clarify fracture location ($n = 2$) and other ($n = 6$). Note that, in several cases, physicians expressed more than one cause for concern.

Discussion

Clavicle fractures are common injuries accounting for approximately 5% of all fractures,⁶ 13% of injuries in mountain bikers,⁷ 11% of shoulder girdle injuries in skiers,⁸ and 10% of injuries in in-line skaters, roller skaters and skateboarders.⁹ Our study demonstrates that experienced emergency physicians are frequently "certain" of the diagnosis by clinical examination alone and that, when they are certain, their clinical assessment is highly accurate. Our physicians were also accurate in their determination of

fracture location for lateral- (4/4) and middle-third (41/41) fractures; however, in 5 cases when physicians clinically identified medial-third fractures, they were correct only once. Despite high levels of certainty and accuracy, physicians frequently reported that they would be uncomfortable managing patients without radiography.

A recent pilot study also concluded that emergency physicians could accurately predict the presence and location of clavicle fractures,¹⁰ but this study did not determine whether the physicians were confident enough to treat without radiography or under what circumstances they might consider doing so. In the current study, physicians were less than "certain" about the presence of fracture in 26 (34%) of 77 patients and, in uncertain cases, only 11 patients (42%) had fractures. These data suggest that if imaging was limited to cases of diagnostic uncertainty, there is potential to reduce the proportion of patients undergoing radiography by 66%.

Treatment of clavicle fractures

Few controlled trials have addressed the treatment of clavicle fractures, and none have controlled for fracture character (i.e., degree of displacement), fracture site (dominant v. non-dominant limb) and patient characteristics (e.g., age, fitness, activity level).¹¹⁻¹⁵ There is no good evidence that manipulation, operative intervention or other aggressive modalities provide better functional or cosmetic outcomes than simple arm support alone.^{6,16}

Eighty percent of clavicle fractures involve the middle third,¹⁶ and treatment of middle-third fractures typically consists of rest and the use of ice and a sling, although some physicians may still use a figure-of-8 bandage or "clavicle strap" and some may attempt reduction for selected cases. Surgical intervention is rarely indicated, even when there are multiple or widely displaced fragments. Lateral and medial fractures, accounting for 15% and 5% of clavicle fractures respectively, have a higher incidence of complications and occasionally require surgical intervention;¹⁶ although even with these injuries, there are no clear guidelines indicating when to recommend rest, when to attempt reduction or when to surgically intervene.

X-ray utilization

Our data suggest that, in many cases, radiography adds little to clinical evaluation, but confirmation of diagnosis may not be the only reason to obtain x-rays. Radiographs may be helpful if they provide information that influences treatment or if they enable the physician to advise the patient regarding prognosis. Although our physicians were accurate in identifying and localizing fractures, they were

Table 3. Accuracy of physician expectation that results of radiography would affect treatment*

Expectation of physician	Effect of radiology	
	Treatment altered	Treatment not altered
Results of radiograph would influence treatment	9	4
Results of radiograph would not influence treatment	1	37

*Sensitivity: 9/10 = 90.0% (95% confidence interval [CI], 55.5%–99.7%);
Specificity: 37/41 = 90.2% (95% CI, 76.9%–97.3%);
Positive predictive value: 9/13 = 69.2% (95% CI, 38.6%–90.9%);
Negative predictive value: 37/38 = 97.4% (95% CI, 86.2%–99.9%).

uncertain about the degree of comminution in 30 of 51 cases (59%), and about the degree of displacement in 23 of 51 cases (45%). In these cases, radiographs clearly eliminated uncertainty and might have influenced treatment choices, but it is important to point out that radiographic appearance has not been shown to relate to prognosis.

In 27 (64%) of 42 middle-third fractures, physicians stated they were uncomfortable treating without a radiograph. Discomfort is understandable if radiographic findings are likely to influence treatment, but even in the 31 cases (74%) when physicians believed radiography would not affect treatment, they stated they would have been comfortable omitting radiography in only 15 (48%). Of note is the fact that radiographs altered treatment in 0 of 31 middle-third fractures when the physician expected that they would not. In 37% of cases, our physicians identified "patient expectation" or "standard of care" as obstacles to eliminating potentially unnecessary radiographs. These concerns could be overcome with appropriate evidence or decision rules, as has been demonstrated in the reduced use of radiographic imaging for ankle injuries.¹

Lack of certainty about the character of the fracture, coupled with uncertainty regarding best treatment, undoubtedly plays a role in physicians' discomfort in omitting a radiograph. It is possible that if the issue of appropriate treatment could be clarified, physicians might then feel confident that radiography of the fracture was unnecessary in selected cases.

Limitations

Our emergency department population includes a high proportion of fit young adults with sports injuries, and our data are most generalizable to similar patients. The emergency physicians who participated in this study have all practised for more than 5 years in this setting and may be unusually skilled in the clinical assessment of musculoskeletal trauma. Physicians who see fewer such injuries may be less comfortable and less able to identify and localize clavicle fractures by clinical exam alone. These limitations may affect the generalizability of our results.

Conclusions

This study shows that experienced emergency physicians can accurately identify and localize clavicle fractures, and that routine radiography (particularly for obvious middle-third fractures) is unlikely to improve diagnostic accuracy, treatment decisions or patient outcome. Despite this, physicians are often uncomfortable omitting radiographs for patients with clavicle fractures.

Competing interests: None declared.

Study authorship: Dr. Shuster proposed the study. All authors contributed to the study design. Drs. Shuster, Boyd, Gauthier, Mergler, Shepherd and Turner collected the data. Drs. Shuster and Abu-Laban interpreted the data, and Dr. Abu-Laban performed the statistical analysis. Dr. Shuster wrote the initial draft of the manuscript, and Drs. Shuster, Abu-Laban and Boyd participated in revising the manuscript.

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