Chapter 4

Value of the additional 30-degree caudocephalad radiograph in treatment decisions for midshaft clavicular fractures: *an online survey among 102 surgeons*

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Abstract

Background

Midshaft clavicular fractures are usually diagnosed by anteroposterior radiography. An additional cephalic or caudal tilt radiograph is often not part of the standard diagnostic protocol because of cost considerations. We studied whether an additional 30-degree caudocephalad view affects the choice of treatment for complicated midshaft clavicular fractures.

Methods

In an online survey performed in August-September 2011, the members of the Dutch Society of Trauma Surgery were invited to indicate the preferred treatment for 15 randomly selected displaced or comminuted midshaft clavicular fractures presented on anteroposterior radiography. After presenting them with the additional 30-degree caudocephalad view radiograph, they were asked to indicate whether they would change their choice of treatment. Data were analysed using a repeated measures logistic regression model.

Results

The response rate was 46.3% and 102 returned surveys were eligible for analysis. After displaying the 30-degree caudocephalad radiograph, choice of treatment was changed in 24% of cases (95%-CI: 20.5 – 27.8) ($p<0.001$), mostly from non-operative to operative treatment.

Conclusions

Our results show that the additional 30-degree caudocephalad radiograph often results in a different choice of treatment than based on anteroposterior radiography alone. The standard protocol for diagnostic work-up of clavicular fractures should include radiological assessment in at least two planes.

Introduction

Midshaft clavicular fractures account for 3% to 10% of all adult fractures.[1,2] In the early literature low non-union rates were reported after non-operative treatment (<1%),[3,4] but more recent studies showed higher percentages (11-20%).[5-9] The incidences of delayed and non-union after operative treatment is considerably lower (1-3.9%).[5,7,8] Since non-union is assumed to be associated with clavicular shortening and displacement ad latum after trauma,[2,5,6,10,11] these aspects need to be assessed when deciding whether or not to operate. The extent of shortening and displacement ad latum can be evaluated using radiography. Both an anteroposterior (AP) view and a cephalic or caudal tilt radiograph have been suggested for evaluation of suspected clavicular fractures, because the extent of shortening[12] and especially the displacement ad latum may be underestimated if evaluated on the AP view alone.[11,13] In many hospitals, however, the cephalic or caudal tilt radiographs are not standard procedure after trauma. They may be omitted because of cost considerations and lacking evidence for its additional value.

In an online survey among the clinical members of the Dutch Society of Trauma Surgery we evaluated the effect of the 30-degree caudocephalad radiograph additional to the AP view, on treatment choice for midshaft clavicular fractures.

Materials and Methods

Patients and Radiographs

Fifteen patients were randomly selected from patients who had been treated in the Leiden University Medical Centre in Leiden, The Netherlands for a displaced or comminuted midshaft clavicular fracture in 2010. Their primary AP view and 30-degree caudocephalad tilt view radiographs, which had been routinely made, were retrieved from the hospital records. Figure 1 shows the radiographs of one of the included patients as an example. The 15 fractures were classified according to Robinson as 13 type 2B1 and 2 type 2B2 fractures.[2]

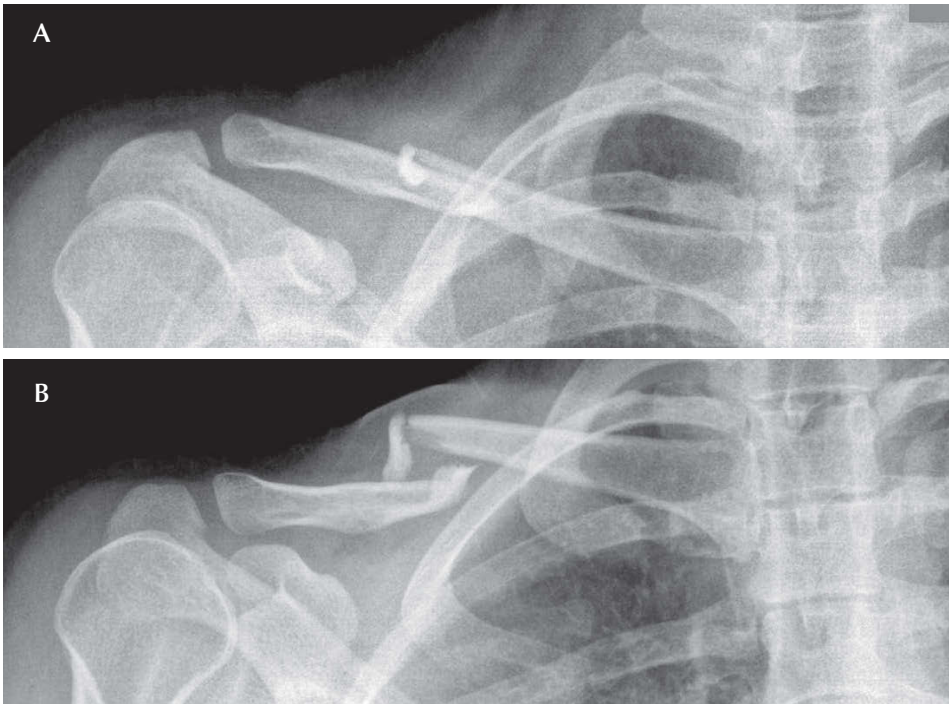

Figure 1. AP view (A) and 30-degree caudocephalad view (B) radiographs of one of the 15 midshaft clavicular fractures presented in the survey.

Survey

The 30 radiographs of the 15 fractures were presented to the 242 clinical members of the Dutch Trauma Society in an online survey in August 2011. In the survey the radiographs were shown one by one on separate pages for each patient. The respondents were first presented with the AP view, then with the 30-degree view. For each radiograph the respondents had to state which treatment he/she preferred for that particular fracture, considering it an isolated injury in a 50-year-old healthy male. Predefined treatment options were non-operative treatment with a sling, non-locking plate fixation, locking plate fixation, intramedullary fixation, and other. If opting for 'other treatment', the respondents were asked to specify the preferred treatment. Only after they had filled out their preferred treatment for the clavicular fracture in AP view, they were presented with the 30-degree view and asked for their choice of treatment again. The respondents could not to scroll back to the previous pages nor revise their answers once given. The survey was developed using LimeSurvey 1.91+ software.

Statistical analysis

For analysis, the responses were dichotomized into non-operative and operative treatment. (Change in) treatment choice was expressed as percentage and its 95% confidence interval (CI). Since the analysis involved repeated binary observations within patients by the same group of surgeons, a repeated measures logistic regression was performed using Generalized Estimating Equation (GEE) analysis in order to adjust the precision of the estimated (changes in) treatment choice. Resulting odds-statistics and their 95%-confidence limits were transformed into probabilities. Statistical analyses were performed using SPSS version 20 (Statistical Package for the Social Sciences Inc., Chicago Il, USA).

Results

Of the 242 invited members, 112 filled out the online survey (response rate 46.3%). Ten surveys were incomplete and excluded from analysis. The remaining 102 surveys rendered 3060 evaluations of the 15 fractures (AP view: 1530 evaluations, 30-degree view: 1530 evaluations). The vast majority of the respondents were trauma surgeons (n=71), the other respondents were orthopaedic surgeons (n=7), general surgeons (n=13), trauma fellows (i.e., surgeons subspecialising in trauma surgery after their general surgical training; n=5) and surgical residents (n=6).

Overall evaluation (n=1530 cases)

Based on the information of only the AP radiograph, conservative treatment was chosen in 803 of the 1530 (52.5%) evaluations of the 15 fractures. After the additional 30-degree radiograph was displayed, this number decreased to 468 evaluations (30.6%) (Table 1; Figure 2). Overall, the respondents changed their primary choice for either conservative or operative treatment in 24.0% of the cases (95%-CI: 20.5 – 27.8).

Table 1 Preferred treatment for 15 midshaft clavicular fractures by 102 surgeons (1530 fracture evaluations), based on only the AP view and on the combined AP and 30-degree radiographs.

			Treatment choice based on AP and 30-degree view				
		Total	Non-operative treatment	Non-locking plate fixation	Locking plate fixation	Intramedullary fixation	Other
Treatment choice based on AP view							
AP view	Non-operative treatment	803 (100%)	452 (56.3%)	65 (8.1%)	248 (30.9%)	31 (3.9%)	7 (0.9%)
	Non-locking plate fixation	168 (100%)	3 (2.1%)	141 (83.9%)	21 (14.9%)	3 (2.1%)	0 (0.0%)
	Locking plate fixation	432 (100%)	12 (2.8%)	4 (0.9%)	405 (93.8%)	11 (2.5%)	0 (0.0%)
	Intramedullary fixation	91 (100%)	0 (0.0%)	3 (3.3%)	21 (23.1%)	66 (72.5%)	1 (1.1%)
	Other	36 (100%)	1 (2.8%)	1 (2.8%)	4 (11.1%)	1 (2.8%)	29 (80.6%)
	Total	1530 (100%)	468 (30.6%)	214 (14.0%)	699 (45.7%)	112 (7.3%)	37 (2.4%)

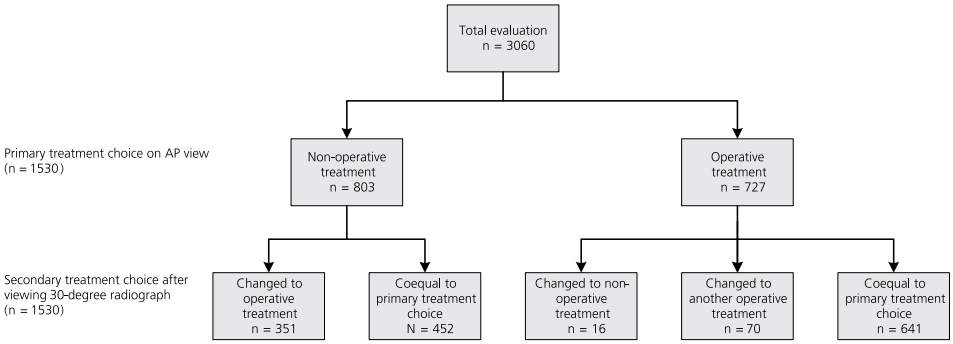

Figure 2. Flowchart of the 3060 evaluations of 102 surgeons based on only the AP view and on the combined AP and 30-degree radiographs.

Changes in treatment choice

For the 803 cases in which non-operative treatment was chosen based on the AP view, the respondents changed their treatment choice to operative treatment in 48.2% of cases after viewing the additional 30-degree radiograph (95%-CI: 42.5 – 53.9) (Figure 2). On the contrary, for the 727 cases in which operative treatment was chosen based on the AP view, the respondents changed their treatment choice to conservative treatment in only 2.3% of cases after viewing the additional 30-degree radiograph (95%-CI: 1.4 – 3.8). In addition, the respondents changed the preferred type of operative treatment in 8.4% of these 727 cases (95%-CI: 5.8 – 12.0) after viewing the corresponding 30-degree radiograph (Figure 2). These changes involved a switch from intramedullary fixation or non-locking plate fixation to locking plate fixation in 60% of the cases, and from locking plate fixation to intramedullary fixation in 15.7% of the cases (Table 1).

Discussion

The results of our survey showed that the 30-degree radiograph had a considerable effect on treatment decisions for complex midshaft clavicular fractures, in addition to the AP view radiograph. Overall, 24.0% of the treatment decisions were changed after viewing the additional radiograph, mostly from non-operative to operative treatment. We may conclude that adding an extra view to the conventional AP radiograph leads to more support for operative treatment, and may also lead to a different choice in surgical technique in some cases.

A standard AP view with an additional 30-degree caudocephalad tilt radiograph provides more insight into the degree of comminution and displacement as illustrated in Figure 1. The current study confirms that an AP view radiograph alone is not sufficient to decide on the type of treatment in about 25% of the cases. It is even questioned in the literature whether radiographs in two directions are sufficient for clinical decision making. Austin et al. assessed the additional value of the 4-view radiograph (AP, 20-degree cephalad, and additional orthogonal views: 45-degree cephalad, and 45-degree caudad) compared to the 2-view radiograph for treatment decisions.[14] Surgeons were likely to operate 12% more cases after reviewing 4-view radiography than after reviewing 2-view radiography. From our study it would seem that more is gained from adding one additional view to the AP radiograph than from adding two additional views to two-way radiography. Jones et al. found that AP and 30-degree caudocephalad radiographs are not sufficient to determine the need for surgical intervention,[12] however surgical intervention is not only determined on fracture characteristics. Patients' and surgeons' specific wishes and conditions, such as co-morbidities, occupation, daily activities and sports, also play a role in clinical decision making.[15-17] This may even be more important than the number of views. The question remains which number of views is optimal when balancing the additional clinical benefit and additional cost. In this trade-off, potential adverse outcomes of operative treatment such as complications and need for reoperation and the risk of non-union after non-operative treatment should also be taken into account.[7,15,18]

Despite the relatively low response to the survey, the answers of the respondents are likely to represent the opinion of Dutch surgeons with an interest

in upper extremity fractures. All clinical members of the Dutch Society of Trauma Surgery received an invitation to participate in the survey, thus including surgeons with different backgrounds and working in different types of hospitals throughout the country. We demonstrated a clear tendency to operate on displaced and comminuted fractures after adjudicating the additional 30-degree view. This tendency may have been triggered by the largest randomised controlled trial on midshaft clavicular fractures[5] published at that time which operative treatment showed overall better results than non-operative treatment. This Canadian study has had a considerable impact on the treatment of clavicular fractures in clinical practice.[19] Another limitation of our survey was that the surgeons were not aware of patient-specific characteristics when they evaluated the radiographs online, which may have influenced their choice of treatment. Some respondents pointed out in the survey, that they would have treated the patient differently if he was active in sports. These considerations where not taken into account for analysis.

Conclusion

Our results show that 2-view radiography leads to a more deliberate decision for treatment of midshaft clavicular fractures than only the standard AP view. In clinical practice it is advisable to perform an AP view and an additional 30-degree angulated view of the clavicle in all cases of suspicion of a fracture, for determination of the treatment strategy.

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