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Reliability of the Robinson classification for displaced comminuted midshaft clavicular fractures☆,☆☆

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ABSTRACT

This study aimed to assess the reliability of the Robinson classification for displaced comminuted midshaft fractures. A total of 102 surgeons and 52 radiologists classified 15 displaced comminuted midshaft clavicular fractures on anteroposterior (AP) and 30-degree caudocephalad radiographs twice. For both surgeons and radiologists, inter-observer and intra-observer agreement significantly improved after showing the 30-degree caudocephalad view in addition to the AP view. Radiologists had significantly higher inter- and intra-observer agreement than surgeons after judging both radiographs ($\kappa_{multirater}$ of 0.81 vs. 0.56; $\kappa_{intra\text{-}observer}$ of 0.73 vs. 0.44). We advise to use two-plane radiography and to routinely incorporate the Robinson classification in the radiology reports.

1. Introduction

Classification systems for fractures serve as a basis for treatment choice and outcome prediction. Classification systems for clavicular fractures have been developed by Allman [1] for the anatomical site, by Neer [2] for the lateral third fractures, and by Craig [3] for the lateral and medial third fractures. The Robinson classification [4] has been established as the most appropriate classification method for the midshaft clavicular fractures [5] with the highest prognostic value for treatment outcome in terms of union and non-union. The Robinson classification differentiates between two main types of midshaft clavicular fractures, i.e., undisplaced (type A) fractures and displaced (type B) fractures (Fig. 1). In daily practice, the differentiation between displaced simple comminuted fractures (type 2B1) and segmental comminuted fractures (type 2B2) is the most challenging. To our knowledge, the reliability of the Robinson classification system for this distinction has not been analyzed. The aim of our study was to assess the inter-observer and intra-observer agreement on the Robinson classification for type B midshaft clavicular fractures among surgeons with an interest in fracture surgery and radiologists with an interest in skeletal imaging.

2. Material and methods

2.1. Radiographs

Fifteen displaced and comminuted midshaft clavicular fractures of adult patients were selected randomly from the electronic hospital registry. These fractures had been classified according to the Robinson clavicle fracture classification (Fig. 1) [4] by an expert panel consisting of 2 trauma surgeons and a radiologist. Both the anteroposterior (AP) trauma radiograph and the 30-degree caudocephalad radiograph of the fractures were retrieved from the medical records. For examples, see Fig. 2.

2.2. Survey

The 30 radiographs of the 15 displaced and comminuted midshaft clavicular fractures were presented in an online survey developed with LimeSurvey 1.91+ software. For each fracture, the radiographs were presented on separate pages, starting with the AP radiograph and followed by the corresponding 30-degree caudocephalad radiograph. The respondents had to classify each midshaft clavicular fracture presented on the radiographs and were not able to revise previously given answers. Eight weeks after the initial assessment, the survey was presented again in a different case in order to determine the intra-observer reliability.

☆ Conflict of interest: No competing interests declared.
☆☆ All work was committed at the Leiden University Medical Center.

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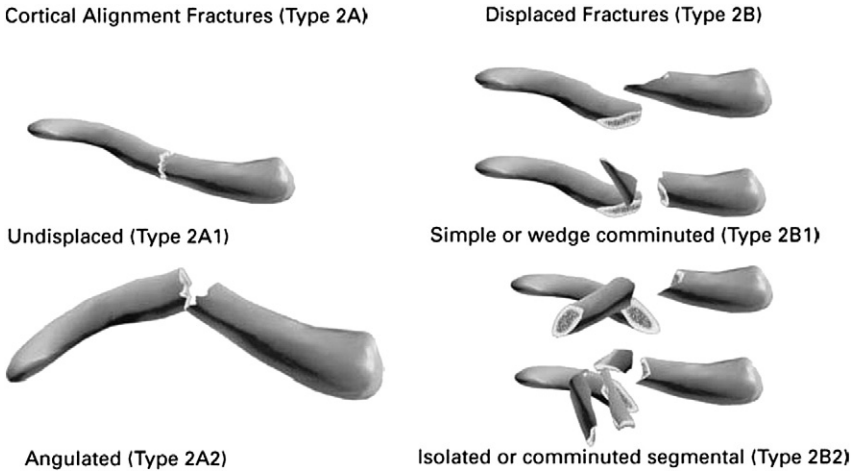

Fig. 1. Robinson classification for midshaft clavicular fractures. Reprinted with permission of C. M. Robinson [4].

2.3. Respondents

The online survey was performed in the Netherlands and Belgium among the clinical members of the Dutch Trauma Society, members of the Dutch Society of Radiology, and members of the muscular and skeletal imaging division of the Royal Belgian Society of Radiology in August 2011. Members of these societies with an active e-mail address were invited to participate in the survey. A reminder e-mail was sent if the respondent had not filled out the survey.

2.4. Statistical analysis

The inter-observer agreement on the Robinson classification for the AP radiographs and 30-degree caudocephalad radiographs was calculated using the free-marginal multirater kappa ($\kappa_{multirater}$) for categorical data [6] for the respondent group as a whole and separately for surgeons and radiologists. The strength of the inter-observer agreement was determined using the table of Landis and Koch that indicates kappa ≤ 0 as poor agreement, 0.01–0.20 as slight agreement, 0.21–0.40 as fair agreement, 0.41–0.60 as moderate agreement, 0.61–0.80 as substantial agreement, and 0.81–1.00 as almost perfect agreement [7]. For each $\kappa_{multirater}$, the 95% confidence interval (95% CI) was calculated. If the 95% CI values for the $\kappa_{multirater}$ estimates of the surgeons and radiologists did not overlap, the inter-observer agreement between the respondent groups was considered statistically different.

The intra-observer agreement was calculated using Cohen's kappa ($\kappa_{intra\text{-}observer}$) for each respondent. The mean intra-observer agreement was calculated for the group of respondents as a whole and separately for surgeons and radiologists. This was calculated for the AP radiographs and 30-degree caudocephalad radiographs. Differences between estimates of the intra-observer agreement for the two

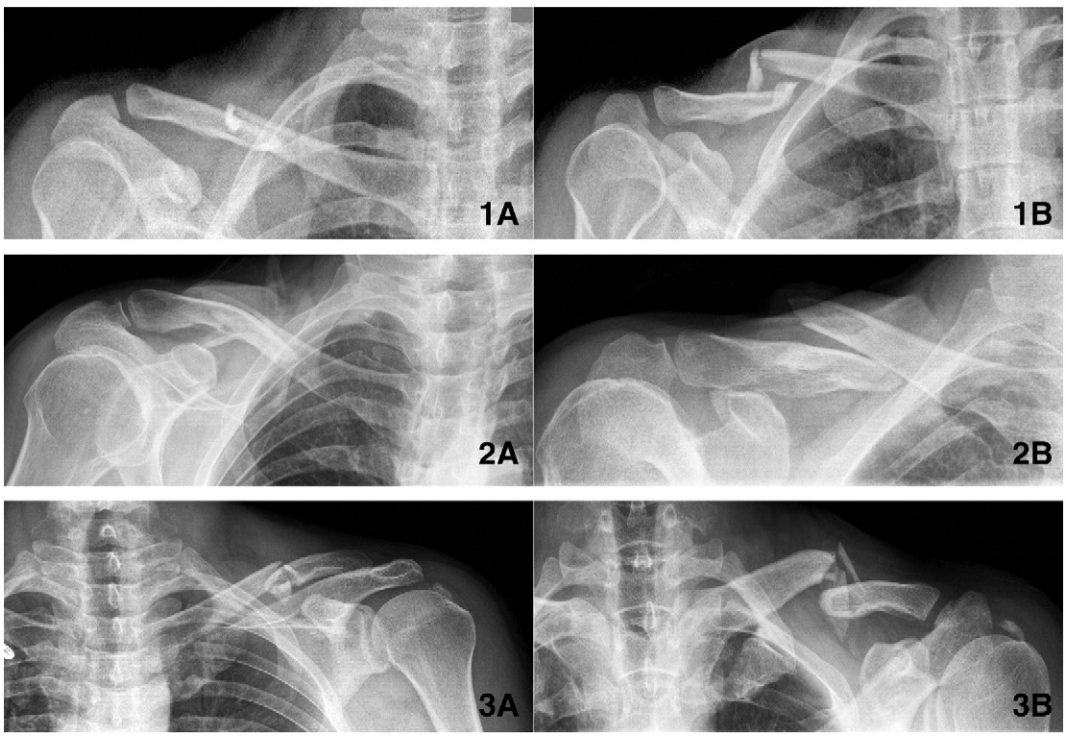

Fig. 2. Three series of AP (A) and 30-degree caudocephalad (B) radiographs of midshaft clavicular fractures.