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ORIGINAL STUDY

Online radiographic survey of midshaft clavicular fractures : no consensus on treatment for displaced fractures

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The choice of treatment for midshaft clavicular fractures is not straightforward, but depends on fracture characteristics such as comminution, angulation and displacement. An online survey was conducted amongst trauma and orthopaedic surgeons to determine the preferred treatment for midshaft clavicular fractures, based on anteroposterior radiographs, for 17 randomly selected displaced or comminuted midshaft clavicular fractures. The background and experience of the respondents were documented. Data were analyzed using a Generalized Estimating Equations (GEE) model. The 102 respondents preferred non-operative treatment more frequently for displaced fractures than for comminuted fractures (OR 3.24, 95% CI 2.55-4.12). Locking plate fixation was more often preferred over other surgical modalities for comminuted than for displaced fractures (OR 1.50, 95% CI 1.17-1.91). In clinical practice, there is no consensus between surgeons on the choice of treatment for displaced or comminuted midshaft clavicular fractures. This lack of agreement calls for evidence-based treatment guidelines for these fractures.

Keywords : survey ; clavicle ; fractures, comminuted ; radiography ; patient care.

INTRODUCTION

A clavicular fracture can readily be diagnosed with physical examination and radiography (*16*). The decision whether and how to operate a clavicular fracture, however, is not straightforward and is influenced by factors such as neurovascular compromise, soft tissue compromise, tenting of the skin over the displaced fracture or accompanying injury as a scapular neck fracture (*7*). Fracture characteristics like displacement, shortening and comminution seem to predispose for unfavourable results after non-operative treatment (*3*,*5*,*6*,*10*,*14*,*15*), but treatment guidelines have not been published. In clinical practice, undisplaced fractures are generally treated non-operatively, but for displaced fractures the choice of treatment seems to be based on the position of the fracture fragments on the anteroposterior (AP) radiography and the clinical condition of the patient.

Based on two large retrospective studies in the late 1960s (*13*,*18*) it was believed that operative treatment of clavicular fractures increased the risk of non-union. The rate of non-union after non-operative treatment was considered to be less than one per cent (*1*,*3*,*13*,*18*,*19*,*22*). The complication rates in these surgical studies were high, probably due to

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less optimal fixation techniques (*16*). Since the last decade the negative attitude towards operative treatment has changed. Several large studies suggested that operative treatment results in better functional outcome and lower non-union and malunion rates than previously assumed (*2*,*9*,*10*,*11*,*16*). On the basis of these studies, the preference for operative treatment seems to have increased. We conducted an online survey amongst the members of the Dutch Trauma Society to determine the preferred treatment for displaced and comminuted midshaft fractures, based on evaluation of AP trauma radiographs. Secondarily, we analysed whether treatment choice was related to the surgeon's background or experience.

MATERIALS AND METHODS

In the Netherlands, about 80% of fracture care is performed by trauma surgeons and 20% by orthopaedic surgeons. The membership of the Dutch Trauma Society therefore consists mainly of trauma surgeons. In August 2011, all physician-members of the Dutch Trauma Society were invited by email to participate in an online survey. In September, a reminder was sent to the members who had not responded. In the survey, each participant was asked to give his or her preferred treatment for 20 angulated, displaced or comminuted midshaft clavicular fractures, based on radiographs and standardized clinical information. The 3 angulated fractures were left out of the analyses, leaving 17 displaced or comminuted fractures.

The 17 fractures were randomly selected from the electronic registry of our hospital. The anteroposterior (AP) view radiograph of these fractures, taken on the day of trauma, were classified by an expert panel of 2 experienced trauma surgeons and 1 radiologist as fourteen displaced (type 2B1 according to the Robinson classification (*17*)) and three comminuted (type 2B2) fractures (Fig. 1). This ratio reflects the distribution of displaced and comminuted clavicular fractures that is normally seen in the emergency department.

The 17 anonymous radiographs were presented one by one in random order in an online questionnaire, which was developed using LimeSurvey 1.91+ software. The respondents were asked to state the preferred treatment for each fracture. No additional clinical data of the patients was presented to the respondents in order to prevent that this information would influence the choice of treatment. Instead, the respondents were asked to consider each radiograph as that of an isolated injury in a 50 year old, otherwise healthy male. Predefined treatment options in the survey were non-operative treatment with a sling, non-locking plate fixation, locking plate fixation, intramedullary fixation, and other. If opting for 'other treatment', the respondent was asked to specify the preferred treatment. When filling out the questionnaire, it was not possible to scroll back in order to view or revise previously given answers.

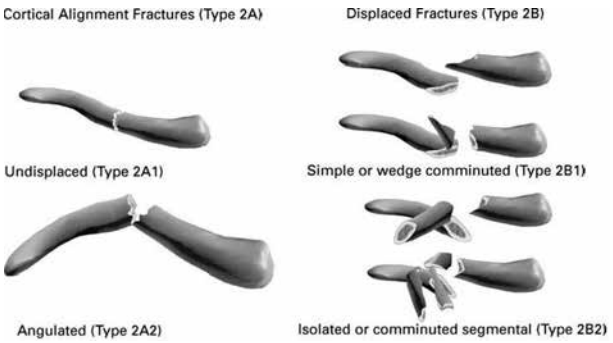

Fig 1. — Robinson classification of midshaft clavicular fractures. Reprinted with permission of C.M. Robinson (*17*).

The 242 physician-members of the Dutch Trauma Society with an active email address received an invitation to fill out the questionnaire. Six respondent groups were distinguished according to background and experience : orthopaedic surgeons, trauma surgeons, trauma fellows (general surgeons subspecialising in trauma surgery), general surgeons, and surgical residents.

Statistical analysis

Treatment choice was analysed for the total fracture group and by 2B fracture type. Analyses were performed for the total group of respondents and by background. Results were presented as proportion or odds ratio (OR) with their 95% confidence interval (CI). Since the analysis involved multiple observations by the same group of surgeons, Generalized Estimating Equation (GEE) analyses were performed in order to adjust the precision of the estimations. Statistical analyses were performed using SPSS version 20 (Statistical Package for the Social Sciences Inc., Chicago Il, USA).

RESULTS

After sending 242 invitations, a total of 134 of questionnaires (55%) were returned. Of these, 32 were excluded from the analysis, mainly because

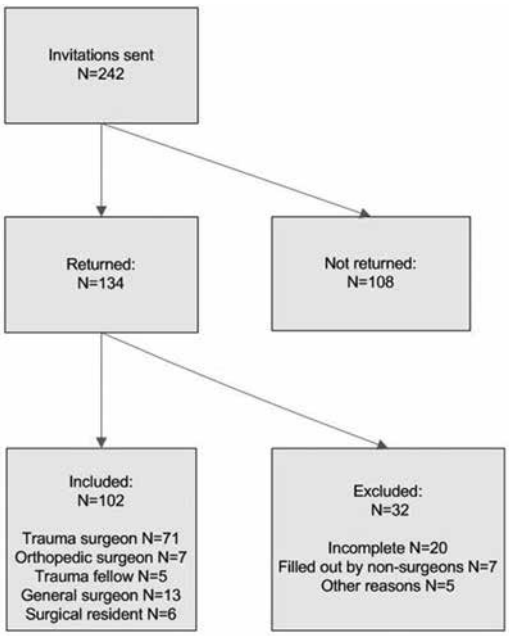

Fig 2. — Flowchart of invitations sent and numbers of response per professional subgroup.

they were incomplete (Fig. 2). The majority (70%) of the remaining 102 respondents were trauma surgeons (n = 71), the other respondents were orthopaedic surgeons (n = 7), general surgeons (n = 13), trauma fellows (n = 5) and surgical residents (n = 6).

Choice between non-operative and operative treatment

For all 17 fractures together non-operative treatment was chosen by 49% of the respondents (95% CI 4356). Non-operative treatment was more often preferred for the displaced type 2B1 fractures than for comminuted type 2B2 fractures (OR 3.24, 95% CI 2.55-4.12). The percentage of respondents choosing operation ranged from 34% for surgical residents, to 73% for trauma fellows (Fig. 3a). The difference between these two professional groups was statistically significant (P = 0.045).

Choice between surgical modalities

Within the subgroup of cases for which operative treatment was opted, locking plate fixation was chosen in 61% of the cases (95% CI 56-73), non-locking plate fixation in 23% (95% CI 14-29), intramedullary fixation in 12% (95% CI 6-15) and other surgical modalities in 4% (95% CI 2-9). Locking plate fixation was more often preferred to other surgical modalities for comminuted type 2B2 fractures than for displaced type 2B1 fractures (OR 1.50, 95% CI 1.17-1.91). Intramedullary fixation was more often chosen for type 2B1 fractures (OR 4.06, 95% CI 1.88 to 8.81). None of the orthopaedic surgeons and trauma fellows opted for intramedullary fixation for any of the presented fractures (Fig. 3b). No differences in preferred type of fixation were found with respect to professional background and experience (P > 0.10).

DISCUSSION

The results of our online survey showed that there is no consensus between surgeons on the choice of treatment for displaced or comminuted midshaft clavicular fractures, visualised by AP-radiography. Non-operative treatment was chosen in 49% of the cases. In general, locking plate fixation was the most preferred type of fixation, in particular for comminuted type 2B2 fractures. No differences were found between the specific backgrounds of the professionals regarding the preferred type of treatment.

Two recent meta-analyses on the treatment of displaced midshaft clavicular fractures comparing different surgical methods to non-operative treatment, showed that after the first year the non-union rate was higher in the non-operatively treated group (14.2% versus 1.4%), whereas disability and function between both groups were comparable (*12*,*26*). The number needed to operate in order to prevent one non-union and symptomatic mal-union was 4.6, and for non-union alone 7.6 (*12*), which is relatively high. Despite several randomised controlled trials, no definite answer has yet been given to the question what type of fixation is the most appropriate for displaced midshaft clavicular fractures (*2*,*4*,*8*,*20*, *21*,*25*). This could clarify the diversity in answers given by the respondents in the current study.

Most of the respondents in our study were trauma surgeons, since in the Netherlands 80% of the

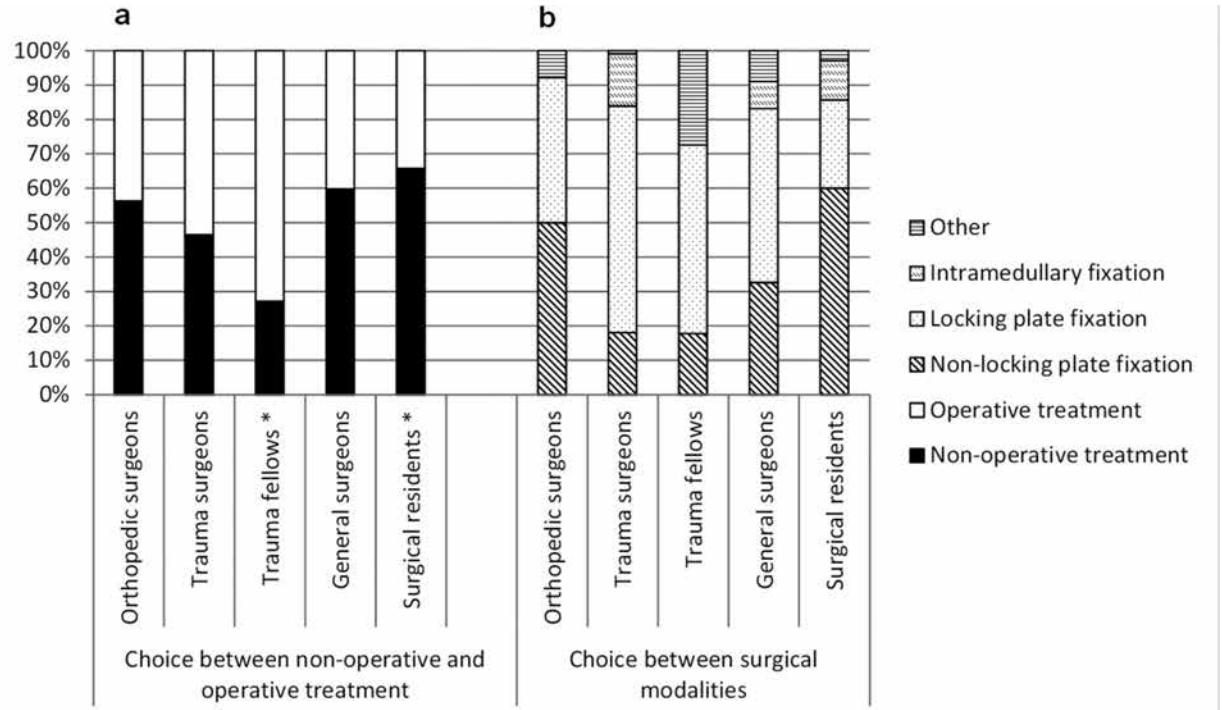

Fig 3. — Choice of treatment for type 2B fractures by profession : (A) choice between non-operative and operative treatment, and (B) choice between surgical modalities.
* P=0.045 for comparison of choice for operative treatment between trauma fellows and surgical residents.

fracture treatment is performed by trauma surgeons. The results of our survey suggested that the preference for non-operative treatment and for specific types of fixation depends on the background and experience of the surgeon, but the differences were not statistically significant. This may have been due to the fact that the power to detect relevant differences between the professional groups was low because of the small number of orthopaedic surgeons, trauma fellows and surgical residents in the survey, which presents a limitation of this study. With respect to the choice between surgical fixation techniques, the given answers were quite divers. Intramedullary fixation was not at all chosen by orthopaedic surgeons as treatment for displaced fractures, whereas trauma surgeons did so in nearly 10% of the cases. Familiarity with this particular technique or material may account for these results.

Another limitation of this study is the relatively low response rate (55%), which may in part be due to the fact that some of the invited surgeons were retired or no longer practising in a trauma-related profession. With respect to the surgeons who responded to the survey, it is likely that they represent the opinion of those with an interest in upper extremity fractures.

Our study aimed to determine the preferred treatment for type 2B midshaft clavicular fractures based on evaluation of the AP-radiograph. In practice, clinical decision making for midshaft clavicular fractures is also based on characteristics of the patient, such as age, the level of sports activity or profession (*23*,*24*). If early mobilization is wished for, surgery may be preferred because non-operative treatment involves two weeks of immobilization without any weight bearing activities for at least six weeks whereas after surgical fixation of the fracture early abduction until 90 degrees without any weight bearing is possible after the first couple of days and mobilization is less painful. Choice of treatment may also be affected by the preference of the surgeon for a specific type of fixation. Furthermore, the patient's views and wishes may also play a role in determining the treatment

strategy, such as cosmetic considerations, or the patient's appreciation of the risk of wound infection after operative treatment, the risk of a potential re-intervention, and the risk of re-fracture within the first three months after operation. These aspects of decision making were not taken into account in this survey. This may limit the generalizability of our results to the daily clinical practice.

In conclusion, there is no consensus on the choice of treatment for displaced or comminuted midshaft clavicular fractures. The choice for non-operative or operative treatment seems to depend on the professional background and experience of the surgeon, the preference for method of surgical fixation does not. The obvious influences of personal preferences and the lack of consensus call for evidence-based treatment guidelines for displaced or comminuted midshaft clavicular fractures.

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