



## Natural history of medial clavicle fractures



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### ABSTRACT

**Background:** Fractures of the medial third of the clavicle comprise less than 3% of all clavicle fractures. The natural history and optimal management of these rare injuries are unknown. The aim of our study is to describe the demographics, management and outcomes of patients with medial clavicle fractures treated at a Level 1 Trauma Centre.

**Methods:** A retrospective review was conducted of patients presenting to our institution between January 2008 and March 2013 with a medial third clavicle fracture. Clinical and radiographic data were recorded including mechanism of injury, fracture pattern and displacement, associated injuries, management and complications. Functional outcomes were assessed using the Glasgow Outcome Scale Extended (GOS-E) scores from the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR). Shoulder outcomes were assessed using two patient reported outcomes scores, the American Shoulder and Elbow Society Score (ASES) and the Subjective Shoulder Value (SSV).

**Results:** Sixty eight medial clavicle fractures in 68 patients were evaluated. The majority of patients were male (n = 53), with a median age of 53.5 years (interquartile range (IQR) 37.5–74.5 years). The most common mechanism of injury was motor vehicle accident (n = 28). The in-hospital mortality rate was 4.4%.

The fracture pattern was almost equally distributed between extra articular (n = 35) and intra-articular (n = 33). Fifty-five fractures (80.9%) had minimal or no displacement. Associated injuries were predominantly thoracic (n = 31). All fractures were initially managed non-operatively, with a broad arm sling.

Delayed operative fixation was performed for painful atrophic delayed union in two patients (2.9%). Both patients were under 65 years of age and had a severely displaced fracture of the medial clavicle. One intra-operative vascular complication was seen, with no adverse long-term outcome.

Follow-up was obtained in 85.0% of the surviving cohort at an average of three years post injury (range 1–6 years). The mean ASES score was 80.3 (SD 24.8, range 10–100.), and the mean SSV score was 77.0 (SD 24.6, range 10–100).

**Conclusion:** Sixty eight patients with medial clavicle fractures were identified over a 5 year period, with excellent functional results seen following conservative management.

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### Introduction

Medial clavicle fractures are rare injuries, comprising less than 3% of all clavicle fractures [1]. They occur most commonly in the setting of high-energy trauma and are often associated with other significant injuries [2]. In-hospital mortality rates in this patient cohort have been reported to be as high as 20% [3]. This is predominantly due to concomitant intra-cranial and intra-thoracic

injuries [4]. Historically, most of these fractures have been managed non-operatively [5], given the close proximity of critical mediastinal structures [6] and the anticipated high union rate.

With advances in the management of the critically injured patient through the introduction of trauma systems, a higher proportion of patients is surviving their initial life-threatening injuries [7] and have associated long-term pain and disability arising from spine, pelvic and extremity fractures [8]. Some patients with medial clavicle fractures, initially managed non-operatively, later present with a painful non-union [9,10]. The natural history, as well as the role and timing of operative management for medial clavicle fractures, is not well established.

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The epidemiology, management and outcome following middle and distal third clavicle fractures have been well studied [1,11,12], yet few papers report on medial clavicle fractures. The aim of this study is to describe the epidemiology, management and outcomes of a large consecutive series of medial third clavicle fractures and thereby improve the understanding of the natural history of this uncommon injury.

## Materials and methods

### Setting

The State of Victoria, Australia has a population of 5.7 million people with an annual growth rate of 1.9%. The state has a highly organised and centralised trauma system with two major adult trauma centres [13]. The Alfred Hospital Emergency and Trauma Centre located in the city of Melbourne, Victoria, is a 300-bed university affiliated tertiary referral and level 1 trauma centre, which treats more than 1200 major trauma (ISS > 15) cases annually.

### Data collection

A retrospective case-series review was undertaken examining patients with a medial clavicle fracture, admitted to the Alfred hospital from January 2008 to March 2013. Clavicle fractures were identified from the hospital medical records department, using the International Classification of Diseases-10th Revision-Australian Modification (ICD-10-AM) [14]. All fractures as defined by this coding system were then radiographically evaluated independently by two of the authors to confirm that the anatomical fracture pattern correlated with the ICD-10-AM coding. If there was any disagreement between measurements, a consensus meeting with senior authors (AM, EE) was undertaken to determine the most accurate value.

A medial clavicle fracture was defined using the Allman classification [15]; a fracture predominantly within the anatomical medial third of the clavicle. Any fractures that were mainly middle or lateral third were excluded (with the exception of segmental fractures). Patients under 16 years of age, those with a pathological fracture, peri-prosthetic fracture or an isolated sternoclavicular joint dislocation including physeal injury were also excluded.

The Victorian Orthopaedic Trauma Outcomes Registry (VOTOR) [16] was used to identify the deaths and collect functional information for our patient cohort [17,18]. This registry prospectively collects data on all orthopaedic trauma admissions, with a length of stay of greater than 24 h, at four participating hospitals (including the Alfred). Functional outcome measures were assessed at 6 and 12 months post injury, including the Glasgow Outcome Scale Extended (GOS-E) as well as return to work in those working prior to injury [19]. The GOS-E is a global scale of patient functional status, assessed using a structured patient questionnaire. Functional outcome is divided into eight categories, ranging from death (GOS-E = 1) to 'upper good' recovery (GOSE = 8). Multiply injured patients had an associated injury to more than one organ system, in addition to their medial clavicle fracture [16] (Table 3).

Major trauma was defined as those that fulfilled at least one of the VSTORM (Victorian State Trauma Outcome Registry Monitoring Group) criteria: Injury Severity Score (ISS) > 12, were admitted to ICU/HDU for >24 h, died from their injuries, underwent urgent surgery for intracranial, intrathoracic, intraabdominal or pelvic/spinal injuries or whose length of stay was three days or more with injury as their principal diagnosis. Patients were also contacted directly by mail and requested to participate in a self-administered questionnaire regarding their shoulder function. This survey was

based on two validated shoulder questionnaires, the Subjective Shoulder Value (SSV) and the American Shoulder and Elbow Society (ASES) scoring systems [20]. The SSV looks at the percentage function of the injured shoulder, compared to a normal shoulder. The ASES combines a pain score on a visual analogue scale and the ability to perform various activities of daily living (ADL) to create a score out of 100. A follow up phone call was made to patients that had not returned the survey and the questionnaires were completed over the phone.

Data was also captured from a retrospective review of hospital records and imaging studies. This included patient demographics, fracture pattern and displacement, associated injuries and imaging modalities used. In addition to this, surgical data and neurovascular complications were recorded. Fracture patterns were divided into intra-articular, simple extra-articular or comminuted extra-articular. Fracture displacement was classified as minimal (<2 mm of fragment separation), moderate (2–10 mm) and severe displacement (>10 mm) [3]. Operative cases and complications were recorded.

Fracture union was assessed through both clinical and radiographic means. Clinical union was defined as, no pain, tenderness or movement at the fracture site. Radiological fracture union was assessed if follow-up radiographs were taken, and bridging callus was seen across the fracture site. Fractures that had failed to unite at three months were defined as delayed unions, while those that were not united at six months were defined as non unions.

### Statistical analysis

Descriptive statistics was used to describe patient characteristics. Data are presented as percentages for categorical variables, and either mean (SD) or median (interquartile range) for continuous variables, depending on the distribution of the data.

Baseline demographic data for patients with completed questionnaires were compared to those lost to follow-up, to evaluate whether non-responder-bias was present. Continuous variable including age, and categorical variables including gender, major trauma, funding source, cause of injury, fracture pattern and displacement, operative management and work prior to injury were evaluated. Univariate analysis was undertaken, with Chi square tests performed for categorical or dichotomous data, and the Mann-Whitney *U*-test performed for continuous data. A *p*-value of <0.05 was considered significant. All analysis was performed using Stata Version 11.2 (StataCorp, College Station, TX, USA).

### Ethics

Ethics approval was obtained from our hospital's office of ethics and research governance.

## Results

A total of 440 clavicle fractures in 440 patients were identified during the study period with 68 medial clavicles being identified. Reasons for exclusion of fractures can be seen in Fig. 1. Fifty-four were isolated to the medial third and fourteen were segmental, with ten having an associated lateral and four having a mid-shaft clavicle fracture. All fractures were closed and there were no preoperative vascular or neurological injuries.

The majority of patients were male (*n* = 53), with a median age of 53.5 years (IQR 37.5–74.5 years, range 16–94 years). The most common mechanism of injury was high-energy trauma, including motor vehicle (*n* = 28) and motorbike (*n* = 9) accidents. Only 8 patients had an isolated fracture of the medial clavicle, while 60

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