



## Socioeconomic deprivation predicts outcome following radial head and neck fractures

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### ARTICLE INFO

#### Article history:

Accepted 19 February 2012

#### Keywords:

Radial head fractures  
Radial neck fractures  
Outcome predictors  
Social deprivation

### ABSTRACT

**Introduction:** There is increasing evidence demonstrating an association between fracture epidemiology and socioeconomic status. However, the influence of socioeconomic deprivation on fracture outcome has not been documented before. The aim of this study was to determine if socioeconomic deprivation influenced the short-term outcome following a fracture of the radial head or neck.

**Methods:** We identified from a prospective database all patients who sustained a radial head or neck fracture over an 18-month period. The primary outcome measure for this study was the patient-reported short musculoskeletal function assessment (SMFA). The Index of Multiple Deprivation (IMD) was used to quantify deprivation, and any correlation with functional outcome was determined. Multivariate regression analysis was used to determine the influence of deprivation on outcome once other significant demographic and fracture characteristics had been accounted for.

**Results:** There were 200 patients in the study cohort, of which 107 (53.5%) were female and the mean age was 44 years (16–83). At a mean follow-up of 6 months the median SMFA score was 0.54 (0–55.4). The SMFA was found to be influenced by the IMD, with increasing deprivation associated with a poorer outcome ( $p = 0.006$ ). On multivariate analysis, the AO fracture classification, compensation and increasing deprivation were the only independent predictors of outcome (all  $p < 0.05$ ).

**Conclusions:** We have shown a clear correlation between functional outcome and socioeconomic status, with the most deprived patients reporting a poorer outcome. Future work should be aimed at determining which aspects of deprivation influence patient outcome, with modifiable factors targeted in future health-care planning.

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### Introduction

Fractures of the proximal forearm account for over 5% of all fractures, with radial head and neck fractures the most common type of fracture occurring around the elbow.<sup>1,2</sup> Factors that have been found to influence outcome are age, fracture classification, comminution and operative management.<sup>3–5</sup>

The importance of socioeconomic status in health has been shown with both chronic diseases and in trauma patients,<sup>6–9</sup> with recent data suggesting the most deprived spend a significant amount of their lives with illness or disability.<sup>10</sup> There is now increasing literature examining the correlation between fractures and deprivation, with influences on incidence, severity and management already reported.<sup>11–15</sup> However, the influence of socioeconomic deprivation on fracture outcome has not been clearly documented in the literature before, with no study

incorporating the influence of demographic and fracture characteristics on outcome.

The aim of this study was to determine if socioeconomic deprivation influenced the patient-reported outcome following a fracture of the radial head or neck. We also aimed to determine the interaction of deprivation with other potential prognostic factors.

### Patients and methods

We performed a retrospective review of a prospective study assessing all patients who presented to our trauma centre from September 2003 to February 2005 with a radial head or neck fracture.<sup>4</sup> Inclusion criteria were a closed isolated radial head or neck fracture confirmed radiographically within 2 weeks of injury. Patients with an associated ipsilateral elbow dislocation were included. Exclusion criteria were a concomitant fracture or significant soft-tissue injury affecting the skeleton, including visceral injuries and polytrauma patients. Using these criteria, 237 patients were identified over an 18-month period. There were 113

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(48%) males and 124 females (52%) with a mean age of 44 years (range, 16–91 years).

#### Initial assessment

Demographic data were documented at initial presentation including age, gender, co-morbidity, smoking, mechanism of injury and injury dominance. Employment was recorded and categorised (1 = office work, 2 = light manual, 3 = heavy manual, 4 = unemployed and 5 = retired), as was self-employment. The Index of Multiple Deprivation (IMD 2009) was used to assess socioeconomic deprivation.<sup>16</sup> This methodology assesses deprivation through income, crime, employment, health, housing, education and access to local services. The local region is divided into data zones that reflect households of similar income.<sup>17</sup> The data zones are ranked in order of decreasing deprivation and each data zone is allocated to one of the five quintiles based on this rank. The first quintile includes the most deprived and the fifth quintile comprises the least deprived. Each patient was allocated to a data zone based on their postcode.<sup>17</sup>

A full clinical assessment of the affected elbow and ipsilateral limb was performed. Radiographic assessment used standard antero-posterior (AP) and lateral radiographs of the elbow. Fractures were classified according to the modified Mason (Broberg and Morrey) and AO classification systems.<sup>18,19</sup> Two trauma-trained fellows independently assessed and classified each fracture, with any disagreements resolved by discussion with the senior authors.

#### Management

Treatment was determined by the supervising consultant, all of whom were orthopaedic trauma surgeons. Non-operative management used immobilisation in a sling for approximately 1 week followed by physiotherapy as indicated. Indications for operative intervention were a mechanical block to forearm rotation, severe displacement and/or comminution. Replacement was performed if the fracture was too comminuted to be reconstructed using open reduction and internal fixation (ORIF).

#### Follow-up

Patients were reviewed prospectively at 2 weeks, 6 weeks, 12 weeks, 6 months and 1 year post-injury. Patients who attained a good or excellent outcome prior to this point were discharged. Eight patients were lost to follow-up after their initial presentation. Twenty-eight patients, of which 25 sustained a Mason type-I fracture, were lost at the 2-week point. One patient was excluded as they were from out of our local catchment area. This left 200 (84%) patients for analysis (133 radial head and 67 radial neck), of which 107 (54%) were female and the mean age was 44 years (range, 16–83). The final mean follow-up was 6 months (1.5–12).

At each follow-up visit, both clinical and radiographic follow-up were carried out by the senior authors. Request for compensation related to the patient's injury was also recorded ( $n = 9$ ). Seven patients undertook compensation proceedings within 6 weeks of injury, one within 3 months and one within 6 months. A full outcome assessment was then completed by a dedicated research physiotherapist not involved with the patient's management. Range of motion in the affected elbow was measured in triplicate using a standard full-circle goniometer, with the mean documented to minimise intra-observer bias. The patient was then asked to complete the short musculoskeletal function assessment (SMFA) questionnaire.<sup>20,21</sup> The SMFA is a validated assessment tool that includes 46 questions used to assess the patient-reported outcome for a range of musculoskeletal disorders, including upper limb trauma. Questions are categorised as dysfunction (34 items) or

bother (12 items), with each question rated by the patient on a scale of one (good function/not bothered) to five (poor function/extremely bothered). The overall score is converted to a final score on a scale of 0–100, with a higher score indicating a poorer outcome.

#### Statistical methods

Statistical Package for the Social Sciences (SPSS) version 17.0 (SPSS, Chicago, IL, USA) was used to undertake statistical analysis. Age was found to be normally distributed. Flexion arc, rotation arc and SMFA score were found to have a skewed distribution. Variables were analysed to determine significant patient and fracture characteristics that were predictive of outcome according to the SMFA score. A Student's unpaired *t*-test was used to analyse parametric continuous data. The Mann-Whitney *U*-test was used to analyse non-parametric continuous data. Categorical binary data were analysed using either the chi-square test ( $n > 5$ ) or Fisher's exact test ( $n \leq 5$ ). The analysis of variance (ANOVA) test was used to analyse continuous data for several groups, with the Kruskal-Wallis test used for non-parametric continuous data. The Spearman correlation was used to analyse the relationship between deprivation quintiles and outcome according to the SMFA score, with further analysis performed to determine the age and gender-adjusted means.

Patient and fracture characteristics found to be significant or near-significant ( $p < 0.10$ ) predictors of the SMFA on univariate analysis were incorporated and underwent stepwise multivariate linear regression analysis. Age, gender, existing co-morbidity, smoking, employment status, injury dominance, mode of injury, the Mason classification, the AO classification, compensation and deprivation quintile were the variables examined. Significance was determined as a *p* value of  $< 0.05$  in all analyses, with confidence intervals (CI) at 95%.

#### Results

Two hundred patients were analysed, of which 107 (54%) were female with no gender predominance seen ( $p = 0.32$ ). The mean age of females was 52 years (range, 16–83 years), which was significantly older ( $p < 0.001$ ) than the mean age of males (36 years; range, 17–76 years) at the time of injury. Falls from a standing height were the most common mechanism of injury (Table 1). The distribution of fractures according to the modified Mason and AO classifications are shown in Table 2.

#### Social deprivation and patient/fracture characteristics (Table 3)

No significant association was found between age, gender or mechanism of injury (0.477) and the deprivation quintiles. Patients in the most deprived quintiles were more likely to have associated medical co-morbidities than those in the least deprived ( $p = 0.001$ ). No association was found between deprivation quintile and employment status, self-employment or compensation proceedings

**Table 1**  
The mechanism of injury for the 200 fractures analysed.

Mechanism of injury	No. (%) of cases
Twist	3 (1.5)
Fall from standing height	120 (60)
Fall down stairs	13 (6.5)
Fall from height	13 (6.5)
Direct blow	5 (2.5)
Sport	43 (21.5)
RTA	2 (1.0)
Other	1 (0.5)

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