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The epidemiology of closed reduction for simple elbow dislocations and the incidence of early subsequent open reduction

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Background: Simple elbow dislocations are often treated with closed reduction (CR); however, the rate of CR failure and factors that may predict failure have been largely underinvestigated. The objectives of this study were (1) to determine the incidence of elbow dislocations treated by CR in a universal health care system and (2) to identify patient characteristics associated with failed CR, defined as the subsequent need for open reduction.

Methods: Patients ≥16 years old who underwent elbow CR by a physician between 1994 and 2010 were identified from administrative databases. Concurrent elbow fractures were excluded. The incidence density rate (IDR) of CR per 100,000 eligible person-years among the general population was calculated. Failed CR was defined as subsequent open reduction with or without ligament repair or reconstruction within 90 days. Patient and provider characteristics were modeled in a multivariate logistic regression for failure.

Results: The cohort consisted of 4878 patients (median age, 41 years) who underwent CR (IDR, 2.65 per 100,000 person-years), and 75 (1.5%) underwent subsequent open reduction with or without ligament repair or reconstruction (median time, 15 days). Young men (≤20 years) had the highest IDR (7.45 per 100,000 person-years), twice that of young women ($P = .005$). Patient characteristics associated with failed CR included older age ($P = .001$), admission to the hospital ($P < .0001$), >1 attempted CR ($P = .001$), and new orthopedic consultation in the 4 weeks after the CR ($P = .02$).

Conclusion: Young men are at highest risk for CR for simple elbow dislocations; however, older patients are more likely to require open intervention, as are those with markers of a difficult reduction signifying potentially greater soft tissue damage. A comprehensive understanding of the epidemiology of simple elbow dislocation will aid management decisions.

Level of evidence: Epidemiology Study, Database Analysis.

Keywords: Elbow; trauma; elbow dislocation; epidemiology; incidence

The Research Ethics Board at Sunnybrook Health Sciences Centre, Toronto, Ontario (through the Institute for Clinical Evaluative Sciences), approved this study.

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The elbow is the second most commonly dislocated adult joint.[10] Elbow dislocations are classified as simple or complex. Simple implies a pure dislocation, although small avulsion fractures may be present. Complex dislocations are associated with fractures of the olecranon, radial head, or coronoid process.[3] The goal of treatment in all dislocations is to obtain a concentric and stable reduction to allow early movement of the elbow joint and to restore function. The best available literature on this topic consists of weak epidemiologic data and small case series.[1,5-7,9,13,14,17] Furthermore, there is no evidence that describes risk factors related to failed closed reduction (CR).

Acute simple elbow dislocations are usually treated by CR, typically under sedation, followed by stability testing. If the elbow is stable within a functional range of motion after reduction, early active motion can be commenced after a brief period of elbow immobilization to regain mobility.[21] Simple dislocations, however, are thought to be benign injuries if they are reduced early, with most patients recovering good function and having minimal residual symptoms.[3] Persistent instability may necessitate surgery, which has been reported in 1% to 2% of cases.[7,15] The first goal of surgery is typically soft tissue repair, which may include the medial or lateral collateral ligaments in addition to flexor/extensor origins. If the repair is secure and the elbow is stable, protected range of motion is started early. If instability persists, an external fixator may be applied to maintain a concentric reduction and to protect the soft tissue repairs.

The primary objective of our study was to determine the incidence of simple elbow dislocations undergoing CR in the general population and to stratify risk by demographic subgroups. The secondary objective was to calculate the rate and patient characteristics associated with early failed CR, defined as the need for subsequent open reduction of the elbow with or without ligament repair or reconstruction.

Methods

The data for this study were contained in provincial (Ontario) health records databases and accessed through the Institute for Clinical Evaluative Sciences (ICES; www.ices.on.ca). The cohort included patients who were ≥16 years old and underwent a CR of an elbow dislocation by a physician in the province between July 1, 1994, and February 28, 2010. Procedures were identified from the Ontario Health Insurance Plan (OHIP) database of physician fee code reimbursement (Appendix 1). OHIP provides universal health care coverage for all citizens in the province of Ontario (population 13.5 million, 2012), with an estimated 95% of physician services captured in the system overall and an even higher proportion of emergency services.[25] OHIP fee codes have high validity on chart review.[25] Exclusion criteria included non-Ontario residents (lack of 90-day follow-up), potentially invalid codes, patients who underwent surgical (open) reduction initially, associated OHIP fee code or *International Classification of Diseases, Ninth Revision* (ICD-9, before April 2002) or *Tenth Revision* (ICD-10, after April 2002) diagnostic code for periarticular fracture (i.e., olecranon/ulna, distal humerus, radius/radial head or neck), and history of elbow CR or elbow fracture by OHIP fee code (dating to July 1991) (see Appendix 1). Demographic data were obtained from the Registered Persons Database associated with the OHIP.

Main outcome

The primary outcome was open reduction with or without ligament repair or reconstruction (OR ± LR/R) performed ≤90 days of the initial CR (defined in Appendix 2).

Covariates

Patient characteristics included age, sex, rural/urban home address by postal code, comorbidity score, and income quintile (derived from the median household income for each patient's dissemination area, the smallest geographic unit available for the Statistics Canada census).[16] Comorbidity score was calculated by the Collapsed Aggregated Diagnostic Groups[24] criteria, whereby each individual was assigned to any number of 12 different disease categories on the basis of ICD-9 and ICD-10 codes derived from all hospital admissions, emergency department visits, or OHIP physician services during the 3 years preceding the respective index event.[2] Hospitalization data were obtained from the Canadian Institute for Health Information Discharge Abstract Database.

In addition, provider characteristics included the subspecialty of the physician who performed the CR, whether a patient had new orthopedic consultation in the 4 weeks after the index event (yes/no), whether a repeated elbow radiograph was obtained in the 4 weeks after the index event (yes/no), and whether an additional attempted CR was performed within 2 weeks of the index event. The subspecialty of the physician performing the index elbow CR was determined on the basis of the Royal College of Physicians and Surgeons of Canada status contained within the ICES physicians database. Specialty was classified as "orthopedic surgeon" or "other," which included emergency medicine specialists and family and general medicine practitioners. Finally, whether the reduction was performed in the setting of a hospital admission was recorded.

Statistical analysis

Descriptive statistics were compiled for each covariate and the main outcome. Each covariate was entered into both a univariate and a multivariate logistic regression model to determine the odds ratio (OR) and 95% confidence interval (CI) for requiring subsequent open reduction within 90 days. The α value was set at .05. Results are presented from the multivariate analysis.

The population incidence density rate (IDR) was calculated for each complete study calendar year (1995-2009) by the following method. The numerator was the total number of persons entered into the cohort (in that year). The denominator was the total eligible person-years based on all persons with valid OHIP insurance coverage and meeting age criteria. Partial or fractional contributions to both the numerator and denominator were allowed for each year based on eligibility, allowing the most accurate calculation. Potential causes of partial contribution included death, age <16 years for part of a year, and loss of provincial resident status or OHIP coverage. The mean annual IDR per 100,000 person-years was reported.