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ORIGINAL ARTICLE

Intraobserver and interobserver reliability of recategorized Neer classification in differentiating 2-part surgical neck fractures from multi-fragmented proximal humeral fractures in 116 patients

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The proximal humeral fracture randomized controlled trial protocol has been approved by the Regional Ethics Committee of Tampere University Hospital (approval No. R10127).

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Background: Optimal fracture classification should be simple and reproducible and should guide treatment. For proximal humeral fractures, the Neer classification is commonly used. However, intraobserver and interobserver reliability of the Neer classification has been shown to be poor. In clinical practice, it is essential to differentiate 2-part surgical neck fractures from multi-fragmented fractures. Thus, the aim of this study was to evaluate whether surgeons can differentiate 2-part surgical neck fractures from multi-fragmented fractures using plain radiographs and/or computed tomography (CT).

Methods: Three experienced upper limb specialists and trauma surgeons (B.O.S., A.P.L., and V.L.) independently reviewed and classified blinded plain radiographs and CT scans of 116 patients as showing 2-part surgical neck fractures or multi-fragmented fractures. Each imaging modality was reviewed and classified separately by each surgeon, after which each surgeon reviewed both modalities at the same time. This process was repeated by all surgeons after 24 weeks. Intraobserver and interobserver analyses were conducted using Cohen and Fleiss κ values, respectively.

Results: The κ coefficient for interobserver reliability showed substantial correlation (0.61-0.73) and was as follows: 0.73 for radiographs alone, 0.61 for CT scans alone, and 0.72 for radiographs and CT scans viewed together. After 24 weeks, the process was repeated and intraobserver reliability was calculated. The κ coefficient for intraobserver reliability showed substantial correlation (0.62-0.75) and was as follows: 0.62 for radiographs alone, 0.64 for CT scans alone, and 0.75 for radiographs and CT scans viewed together.

Conclusion: Clinicians were able to differentiate 2-part surgical neck fractures from multi-fragmented fractures based on plain radiographs reliably.

Level of evidence: Basic Science Study; Validation or Development of Classification System

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Keywords: Proximal humeral fracture; Neer classification; recategorized; interobserver; intraobserver; reliability

Proximal humeral fracture (PHF) is one of the most common fractures among elderly persons.¹⁸ A Swedish population-based study was recently published that reported a national PHF incidence of 122 per 100,000 person-years in 2012, with the highest fracture incidence and surgical treatment rate observed in individuals aged 60 years or older.²⁶

The optimal treatment for PHF has been controversial. This is especially true for the treatment of PHFs in patients older than 60 years. A recent Cochrane review, as well as a high-quality review from Finland, reported on current randomized controlled trials (RCTs) that have compared different treatment options for elderly patients with 3- or 4-part PHFs.^{9,15} Both reviews suggested that the functional outcome after operative treatment is not superior to that after nonoperative treatment. In recent years, reverse total shoulder arthroplasty (RTSA) has gained popularity in the treatment of multi-fragmented PHFs, and 1 RCT stated its superiority over hemiarthroplasty.²⁴ It is interesting that no published RCT has compared the commonly used treatment options of plating and nonoperative treatment in 2-part surgical neck fractures that constitute the majority of displaced PHFs in the elderly population,⁵ although 1 trial protocol has been published.¹⁶ Case series have shown promising results after surgery with locking plates,¹⁰ and the incidence of plating has increased significantly in many countries.^{12,26} When the scientific evidence on these varying treatment options is taken into account, it seems that it is essential to differentiate 2-part surgical neck fractures from multi-fragmented fractures.

The Neer classification (NC)²⁰ is probably one of the most popularized and most used classification systems. However,

the 4-segment classification system defines PHFs by the number of displaced segments (humeral head and shaft, greater and lesser tuberosity), with additional categories for articular fractures and fracture-dislocations, making 16 different categories in total (Fig. 1). According to the original publication, a fracture is defined as displaced if there is more than 1 cm of distance between segments or 45° of angulation.²⁰ A limitation of the NC is the arbitrary definition of “displacement,”²¹ the detrimental effect of which is amplified in 3- and 4-part fractures as to whether all fractured segments should be displaced according to the NC definition.² Intraobserver and interobserver studies of the NC are abundant, many of which have concluded fair to moderate agreement.^{3,19}

Fracture classification systems should be easy to implement, and they should guide the decision-making process to select an adequate method of treatment based on high-quality evidence. On the basis of the current evidence, treatment recommendations for 2-part surgical neck and multi-fragmented fractures may vary, and thus it is essential to differentiate these categories. The NC with 16 categories seems too complicated in clinical practice, and according to a study by Court-Brown et al,⁵ two-thirds of the displaced fractures fall into 3 categories: surgical neck (2-part) fracture and 3- and 4-part fractures.

With the limitations of the NC and recent scientific evidence on the treatment of PHFs being taken into account, the aim of this study was to assess the intraobserver and interobserver reliability of a simplified and recategorized NC in which we recategorized 3- and 4-part fractures into a single category of multi-fragmented fractures while otherwise retaining the original NC and its criteria. Radiographs and

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