The influence of lateral and anterior angulation of the proximal ulna on the treatment of a Monteggia fracture

AN ANATOMICAL CADAVER STUDY

W. Grechenig,
H. Clement,
W. Pichler,
N. P. Tesch,
G. Windisch

From the Medical
University of Graz,
Graz, Austria

We have investigated the anatomy of the proximal part of the ulna to assess its influence on the use of plates in the management of fractures at this site. We examined 54 specimens from cadavers. The mean varus angulation in the proximal third was 17.5° (11° to 23°) and the mean anterior deviation 4.5° (1° to 14°). These variations must be considered when applying plates to the dorsal surface of the ulna for Monteggia-type fractures. A pre-operative radiograph of the contralateral elbow may also be of value.

Fractures of the proximal ulna combined with a dislocation of the radial head bear the eponym of Monteggia, who first described this type of injury in Milan in 1814.¹ Bado² coined the term 'Monteggia lesion' to encompass a number of injuries which had in common, at any level, disruption of the radiohumeral ulnar joint in conjunction with a fracture of the ulna.

We have examined the variations in anatomy of the proximal ulna in cadavers in order to demonstrate how they may affect the reduction of a fracture, leading to an unsatisfactory functional result. There have been few descriptions of the anatomy of the proximal ulna.³⁻⁵

Materials and Methods

We studied 54 cadaver forearms (27 men, 27 women), preserved according to Thiel's method.⁶ There were 28 left and 26 right. The mean age of the cadavers was 72.5 years (59 to 98). Limbs with arthritis, evidence of trauma or other pathological changes were excluded. After complete dissection of the bone from soft tissue, the total length of the ulna was measured using a standard metal sliding caliper (Helios, Rosenheim, Germany). The lateral and anterior angulations of the proximal ulna were determined in degrees by a goniometer (Figs 1 and 2). Finally, the distance from the tip of the insertion of triceps to the angle of the ulna was measured. All specimens were photographed in two views.

Results

The mean length of the ulna was 26.2 cm (21.7 to 29). There was no significant statistical correlation between the length of the ulna and

other data. We observed a mean varus angulation of the proximal third of 17.5° (11° to 23°) in 83% (45) of the bones. The mean length from the tip of the insertion of triceps to the vertex of the ulnar angle was 7.32 cm (4.5 to 11). In 70% (38) there was a mean anterior deviation at the junction of the middle and proximal thirds of 4.5° (1° to 14°). There was no significant statistical correlation between the lateral and the anterior angulation (Student's *t*-test, $p \leq 0.05$; Figs 3 and 4).

Discussion

In adults, reduction and stable fixation of Monteggia-type fractures is mandatory. The fracture of the ulna must be reduced anatomically and stabilised securely in order to give accurate reduction of the head of the radius.³⁻⁵

Various publications have dealt with the influence of the morphology of the proximal ulna on the operative treatment,⁷⁻⁹ but none has yet described the lateral and anterior angulation of the proximal ulna with its dimensions and characteristics. Neither clinical examination nor assessment of the radiographs of the fracture provide information about the anatomy of the proximal ulna before the injury. As a result of considerable variations in the lateral and anterior angulations of the middle and proximal thirds, problems may be encountered in maintaining an accurate reduction when using a straight plate. If the bone is adjusted to accommodate the plate an anatomical reduction cannot be achieved. In the presence of marked anterior deviation it is almost impossible to obtain an exact anatomical position with the use of a longitudinal straight plate on the dorsal aspect of the ulna. Tightening of the

■ W. Grechenig, MD, Professor
■ H. Clement, MD, Orthopaedic Surgeon
■ W. Pichler, MD, Orthopaedic Surgeon
Department of Traumatology
Medical University of Graz,
Auenbruggerplatz 7A, A-8036
Graz, Austria.

■ N. P. Tesch, MD, Professor
■ G. Windisch, MD, Anatomist
Anatomical Institute
Medical University of Graz,
Harrachgasse 21, A-8010 Graz,
Austria.

Correspondence should be sent
to Dr W. Pichler; e-mail:
wolfgang.pichler@klinikum-
graz.at

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Fig. 1

Photograph of a locking compression plate held to demonstrate the anterior deviation.

Fig. 2

Posterior view of a left elbow joint. The white line displays the varus angulation of the proximal third of the ulna.

Fig. 3

Vertical boxplot of varus angulation (°).

Fig. 4

Vertical boxplot of anterior deviation (°).

screws of conventional plates may also lead to a disruption of the fracture if the implant is not shaped to accommodate the bone. Once fixation has been achieved, the surgeon must ensure the stability of the head of the radius by fully flexing and extending the elbow and rotating the forearm, preferably under image intensification.³⁻⁵ Instability or incomplete reduction of the head usually indicates malreduction of the ulnar fracture.¹ Strauss et al¹⁰ have attributed the poor functional outcome to the high-energy nature of the injury with the associated soft tissue and ligamentous damage from the accompanying ulnohumeral dislocation, and to the higher incidence of associated fractures of the head and neck of the radius. However, we suggest that in some cases an inadequate reduction may be the cause of the poor functional outcome.

Radiographs of the contralateral side should be taken before operation in order to measure the angles of the proximal ulna on the uninjured side. After reduction and stabilisation the post-operative radiographs should be compared with those of the opposite side.

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