



# Treatment of unstable elbow dislocations with hinged elbow fixation—subjective and objective results

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**Background:** The aim of this study was to provide subjective and objective results of surgical treatment of unstable elbow dislocations with the hinged external fixation technique.

**Methods:** Twenty-six patients were available for re-examination after treatment. Parameters used to quantify the subjective functional results were the Mayo Elbow Performance Score, the shortened Disabilities of the Arm, Shoulder, and Hand questionnaire, and the stability of the elbow joint. In addition, we measured the medial and lateral joint space by varus and valgus stress ultrasound examinations of the elbow.

**Results:** The mean Mayo Elbow Performance Score was 93.5 ( $\pm 8.3$  standard deviation), and the shortened Disabilities of the Arm, Shoulder, and Hand questionnaire showed an average of 7.3 points ( $\pm 8.9$  standard deviation). We saw 18 patients with stable joints and 8 patients with slight instability. In the ultrasound stress test, we saw a significant difference of the affected joint under varus stress ( $7.8 \pm 1.7$  mm) compared with the healthy joint ( $5.8 \pm 1.2$  mm) laterally. Furthermore, medially the gap was significantly larger ( $4.8 \pm 0.9$  mm; treated elbow) than contralaterally under valgus stress ( $3.3 \pm 0.7$  mm) ( $P < .001$ ).

**Conclusion:** Closed reduction and hinged external fixation of unstable elbow dislocations resulted in good and very good results. We could identify a slight difference in the stability of the affected elbow compared with the contralateral side in all patients without clinical relevance.

**Level of evidence:** Level IV, Case Series, Treatment Study.

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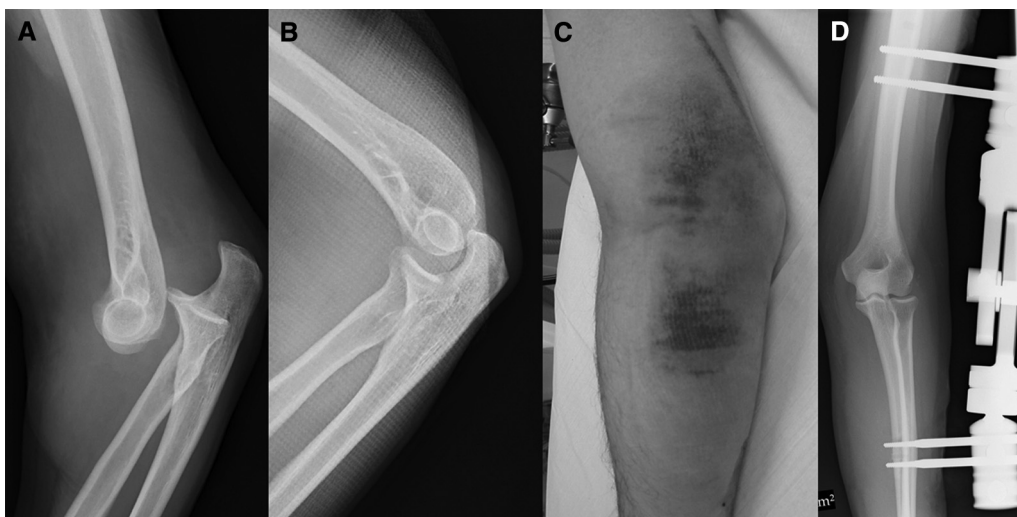
**Keywords:** Elbow dislocation; external fixation; ultrasound

Primary and secondary stabilizers such as bone structures, ligaments, and the capsule as well as flexor and extensor muscles provide elbow joint stability.<sup>29</sup> Elbow dislocation is the second most common joint dislocation in adults with an

annual incidence of 13 per 100,000.<sup>17</sup> After a closed reduction, clinical examination under anesthesia determines joint stability, and several further treatment options are discussed. A plaster immobilization for a short period with subsequent functional physiotherapy should be chosen for stable elbows.<sup>11</sup> Instability may lead to surgical intervention, such as direct ligament repair,<sup>28,32</sup> or further closed therapy with a hinged external fixator. Some authors favor a combination of direct ligament repair with external fixation.<sup>8</sup> Furthermore,

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**Figure 1** (A) Radiograph of a dislocated elbow. (B) After preliminary reduction and casting, the unstable elbow could not be held in a cast and turned to a rotation and subluxation. (C) Clinical aspect of soft tissue of the dislocated elbow in the operating room. (D) Post-operative radiograph with a dynamic elbow fixator holding the elbow joint in place.

external fixation and ligament repair may be combined with an open reduction and internal fixation in cases of fracture-dislocation.<sup>12,23,38</sup> An ulnar and radial lift-off and a positive result of the lateral pivot shift test in the case of posterolateral rotatory instability<sup>5,33</sup> are crucial in the decision-making process of the treatment of elbow instability during fracture-dislocation. Even though there are studies with good results for direct ligament repair or external fixation in these cases, no decisive recommendation exists.

Clinical results for surgical treatment of isolated uncomplicated unstable elbow dislocations are rare but show good functional outcomes. Besides the currently used elbow scores and the stability testing of the treated joint during clinical examination, objective or measurable results of the achieved stability do not exist.<sup>12,37</sup>

The aim of this study was to provide subjective and objective results after surgical treatment of unstable elbow dislocations with the hinged external fixation technique. This includes the parameters of the subjective functional outcome in addition to the objective results of long-term joint stability.

## Material and methods

This is a retrospective case series of 32 patients with isolated unidirectional or multidirectional elbow instability after joint dislocation. Two surgeons in a single institution treated all patients with a hinged elbow fixator (Orthofix; Orthofix Orthopedics International, Bussolengo, Verona, Italy). We re-examined 26 of 32 patients, and 6 patients were lost to follow-up. The remaining 26 patients (14 men, 12 women) were examined an average of 51.7 months (range, 6-107 months) after initial treatment. The average age of patients was 53.3 years (range, 18-91 years). Patients with fracture-dislocations of the elbow, such as radial head fractures, olecranon fractures, and coronoid fractures (type II or III according to Regan and Morrey<sup>35</sup>), were excluded from the study.

Six patients had additional fractures of the upper limb not pertaining to the elbow joint (4 distal radial fractures, 2 distal ulna fractures). Primary diagnostics included history, clinical examination, radiographs in 2 planes, and a computed tomography scan in the case of remaining diagnostic concerns, such as small bone avulsions or occult fractures. In total, we were able to detect 3 patients with small avulsion fractures of the lateral humeral condyle and 3 patients with a coronoid tip fracture (Regan and Morrey type I<sup>35</sup>) that were not fixed additionally. The initial treatment contained a closed reduction with stability testing under general anesthesia and the application of a plaster cast in 90° to full extension in our emergency department. At this point, further surgical treatment was not possible for logistic reasons. In a second procedure, we performed surgical treatment on elbow joints with a medial or lateral instability with the tendency of redislocation under varus or valgus stress seen on fluoroscopic examination, a positive result of the lateral pivot shift test again with the tendency of redislocation during fluoroscopic examination, or a tendency of redislocation in the initial applied cast in an angle of 90° (Fig. 1, B). In these cases, we applied a hinged elbow fixator (Orthofix) after a mean of 2.5 days (range, 0-7 days) in the technique described by Pennig<sup>34,41</sup> (Fig. 1, A-D). In all cases, surgeons performed no direct ligament repair. During the first 4 days, we prohibited motion; afterward, flexion and extension were not limited. We left dynamic fixation for a period of 6 weeks with periodic follow-up examinations and regular pin care. The patients received indomethacin 50 mg twice a day for 4 weeks to prevent heterotopic ossification.<sup>42</sup> We reviewed and assessed the post-operative period according to personal history and the hospital's information system, with special attention paid to cases of post-operative prolonged recovery and wound complications. In addition, intrinsic variables (age, gender), injury-related variables (mechanism of injury, direction of dislocation, intraoperative stability), and surgical delay were extracted, and the number of redislocations and secondary procedures was assessed. The authors analyzed the initial radiographs and, if available, computed tomography scans to determine the direction of dislocation and to detect initial bone lesions.

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