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## Outcome of intramedullary pinning of isolated radial neck fractures in adulthood

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**Background:** The treatment of radial neck fractures is controversial and typically depends on displacement. Surgical procedures based on open reduction–internal fixation (ORIF) may lead to several complications, such as avascular necrosis of the radial head, nonunion, malunion, and elbow stiffness. Closed reduction with intramedullary pinning of radial neck fractures, which is commonly used in children, is a viable option for these fractures in adults and may allow for a lower complication rate compared with ORIF. The aim of this study was to report the functional outcome of closed reduction and intramedullary stabilization in isolated radial neck fractures.

**Methods:** Fourteen cases were retrospectively reviewed between January 2007 and December 2016. The inclusion criteria were isolated radial neck fractures of type I to III according to the Mason classification, absence of previous injuries of the elbow, and a minimum of 1 year of follow-up. The Mason classification was used to classify these injuries. At final follow-up, functional assessment was established based on functional scores: Morrey Elbow Score, Elbow Self-Assessment Score, and QuickDASH (short version of Disabilities of the Arm, Shoulder and Hand questionnaire) score. Range of motion was evaluated similarly.

**Results:** The mean follow-up period was 86 months. The mean age was 44.2 years. Regarding the functional outcome, 78% of patients claimed satisfaction. Concerning the functional scoring, the mean visual analog scale score was 0.2 (range, 0–4) and the mean Morrey Elbow Score was 95.7 (range, 85–100). The mean QuickDASH score was 6.4 (range, 7–22). The complication rate was 35%. Malunion was observed in 7% of patients.

**Conclusion:** Intramedullary pinning of radial neck fractures represents a viable technique in adults because of its safety and simplicity. The complication rates are lower than those in other reports of ORIF.

**Level of evidence:** Level IV; Case Series; Treatment Study

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Management of isolated radial neck fractures is controversial because of the rarity of these injuries and absence of standard surgical options.<sup>5</sup> In fact, the occurrence of these injuries is less than 1% of all fractures in adulthood.<sup>6</sup> Generally,

Sahloul University Hospital Human Research Ethics Committee approved this study.

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indications depend on the degree of displacement of the radial neck: Nondisplaced fractures may be treated conservatively with early elbow mobilization to avoid stiffness, whereas displaced fractures should be treated operatively with open reduction–internal fixation (ORIF).<sup>26</sup> Nevertheless, damage to tissue and the vascular supply through the surgical approach may lead to avascular necrosis of the radial head apart from osteosynthesis device–related complications.<sup>14</sup> Closed reduction and intramedullary fixation of radial neck fractures

may have the benefit compared with ORIF. Intramedullary pinning of the radial neck, as described for fractures in children, seems to improve functional outcomes because it reduces the drawbacks of ORIF (eg, head necrosis, malunion, nonunion, heterotopic ossification, and poor forearm motion).<sup>21</sup> In fact, the Métaizeau technique has been shown to be an effective method of minimally invasive surgical management of pediatric radial neck fractures. Its success may hinge on the ability of the elbow joint to hold the radial head in position while the implant is driven into the proximal radius in a retrograde fashion.<sup>16</sup> The aim of our retrospective study was to evaluate functional outcomes of closed reduction and intramedullary pinning of radial neck fractures in adults.

## Methods

### Patients

We retrospectively reviewed 14 cases of isolated radial neck fractures treated with closed reduction and intramedullary pinning using K-wires between January 2007 and December 2016. The mean follow-up period was 86 months (range, 12-120 months). The inclusion criteria were isolated radial neck fractures of type I to III according to the Mason classification,<sup>15</sup> absence of previous injuries of the elbow, and a minimum follow-up of 1 year. Nine fractures were slightly displaced; five others were nondisplaced but considered unstable due to comminution of the proximal radial metaphysis.

### Surgical technique

All patients were treated with intramedullary pinning according to the surgical procedure as described in children by Métaizeau et al.<sup>16</sup> The procedure was achieved in the operating room with the patient under general anesthesia and placed in a supine position, with the injured forearm on a radiolucent table. Both experienced surgeons and residents had operated on these patients. In contrast to the pediatric procedure, a 0.5-cm lateral skin incision was made 3 cm proximally to the styloid process of the distal radius without the fluoroscopic control used in children to avoid damage to the radial metaphysis. The superficial branch of the radial nerve should be visualized and protected through the mini-approach. After careful dissection, exposure of the radial bone was performed using a drill with a diameter of 3.2 mm. The K-wire was then prepared and curved (mean diameter, 2.04 mm) and was introduced through the entry point and advanced by rotational steps on the intramedullary radial bone until fracture localization under fluoroscopic control. No elastic nails were used. Reduction of the displaced head was ensured with gentle external movements under fluoroscopic control. At the time of reduction, the K-wire was advanced, according to the same procedure, far from the fracture and fixed 3 mm below the radial cartilage. Finally, the elbow was immobilized using a plaster splint for 2 weeks. All K-wires were removed with the patient under general anesthesia after bone healing at least 2 months postoperatively.

### Rehabilitation

The same physiotherapy recommendations were indicated for all cases, which consisted of early active mobilization of the

elbow after removal of the plaster splint. Flexion and extension tasks were commenced after plaster splint removal, with a full arc of motion. Passive and active-assisted tasks were indicated after 2 weeks. Active elbow flexion-extension tasks and active-assisted arm pronation-supination tasks were recommended at the beginning of the third week postoperatively. Using the elbow for light functional tasks was encouraged. After removal of the K-wires, physiotherapy was performed and proprioceptive neuromuscular facilitation was added. Heavy loading activities were not allowed for the first 3 months and were then gradually introduced based on performance during strength and endurance evaluation.

## Clinical and functional assessments

Evaluation was established based on subjective and objective scoring: On one hand, subjective assessment was graduated using the Elbow Self-Assessment Score,<sup>3</sup> with patients rating their satisfaction with elbow use on a scale of 1-6 (1, very good; 2, good; 3, satisfied; 4, sufficient; 5, insufficient; and 6, poor). Objective assessment was based on comparison of active range of motion (flexion, extension, pronation, and supination), as well as in the injured and uninjured elbow. Other functional scores, such as the Morrey Elbow Score,<sup>17</sup> visual analog scale score, and QuickDASH (short version of Disabilities of the Arm, Shoulder and Hand questionnaire) score,<sup>9,12</sup> were calculated. In addition, postoperative complications were identified, including nerve palsy, local infection, granuloma at the entry point, nonunion, and malunion. Some specific complications should be considered, especially damage to the superficial radial nerve and infection around the K-wire at the entry point.

## Postoperative radiologic assessment

Postoperative radiologic evaluation was established using both the anteroposterior and lateral views of the elbow: Time to union of the radial neck fracture, capsular ossification, alignment of the capitellar joint, and K-wire positions were found and presented as the mean of standard deviation values. Other complications, such as nonunion and malunion, were diagnosed and analyzed. Removal of the K-wire was indicated at the time of complete healing of the fracture confirmed using radiologic views of the elbow.

## Results

### Demographic features

At the time of follow-up, the mean age was 44.2 years (range, 28-67 years); the male-female ratio was 1.33. The mean delay until surgery was 2.14 days (minimum, 1 day; maximum, 4 days). The mean K-wire diameter was 2.04 mm (minimum, 1.8 mm; maximum, 3 mm). According to the Mason classification, 4 cases were type I (28%), 7 were type II (50%), and 3 were type III (22%). The mean operative time was 22.3 minutes (range, 16-37 minutes).

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