Case Report

Hahn-Steinthal fracture: report of two cases

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Abstract. Isolated capitellar fractures are rare injuries accounting for only 1% of all elbow fractures. Type I or Hahn-Steinthal fractures require internal fixation to restore the anatomic integrity of the elbow joint. Many different fixation methods have been described and, independently of the method chosen, precise reduction is mandatory to maximize articular congruency and to diminish the potential for secondary osteoarthritis. The treatment and the outcome of two type I capitellar fractures are described in this study. One patient (April 1999) underwent open reduction and Kirschner wire fixation while the second patient (May 2004) underwent open reduction and Acutrak standard screw fixation. In both patients no complications occurred and normal elbow function was recovered. No signs of avascular necrosis (AVN), heterotopic ossifications and degenerative osteoarthritis were detected. We conclude that Acutrak screw fixation is a reliable method of treatment because it enables a good interfragmentary compression, earlier mobilization, faster functional elbow recovery, and metal work removal is rarely necessary. (www.actabiomedica.it)

Key words: Capitellum fracture, Hahn-Steinthal fracture, Acutrak screw, internal fixation

Introduction

Isolated capitellar fractures are rare and represent only 1% of all elbow fractures and 6% of distal humeral fractures (1-3).

Although elbow fractures have a high incidence in the paediatric population, fractures of the capitellum are almost exclusively observed in individuals older than 12 years of age (4).

The cause of this injury is a fall on the outstretched hand with an extended or semi flexed elbow. The most commonly accepted mechanism is the transmission of an axial force through the radius that shears off the capitellum in the coronal plane (5, 6).

It seems that this lesion occurs more frequently in cubitus valgus and cubitus recurvatum (7, 8), which is reflected by a female predominance (male to female ratio of about 1:4) reported in most series (9-11).

In 1853 Hahn (12) provided the first description of an isolated capitellum humeri fracture. After further reports by Kocher (13) in 1896, Steinthal (14) in 1898 and Lorenz (15) in 1905 a systematic classification of capitellum fractures evolved.

Bryan and Morrey (2) classified three fracture patterns. Type I, or the Hahn-Steinthal fracture, is a shear fracture involving a large osseous portion of the capitellum in the coronal plane of the distal humerus and occasionally the lateral lip of the trochlea. Type II, or the Kocher-Lorenz fracture, involves a shell of the articular cartilage with a thin layer of bone and it is usually referred to as an "uncapping" of the capitellum. Type III injuries are comminuted fractures.

The type I lesion is typically associated with the anterior displacement of the fracture fragment that may be associated with a certain degree of rotation (16) with subsequent impingement in flexion. Type II fractures are posteriorly displaced between the humerus and the olecranon, resulting in capsular irritation during extension (17).

The short-term risks of these traumas are joint stiffness and instability while the long-term risk is represented by post-traumatic osteoarthritis.

Different treatment options have been proposed. The treatment of type II and III lesions consists in the excision of the fragments since osteosynthesis is difficult and in most cases not feasible (18).

Controversy exists regarding the management of the Hahn-Steinthal type fractures. Before the advent of the modern internal fixation techniques, closed reduction, conservative treatment consisting in an immediate mobilization and early excision of the capitellum fragment were the treatments of choice (7, 19-21).

Presently type I injuries are usually surgically treated with open reduction and internal fixation. Many methods of fixation have been described including the use of compression screws, staples, bone pegs, Kirschner wires and reabsorbable pins (9, 11, 22).

This study describes the treatment and the outcome of Kirschner wiring and Acutrak screw fixation in two type I capitellar fractures.

Figure 1. Right Hahn-Steinthal type I fracture; preoperative X-ray and CT scans

Case reports

Case 1

A 17-year-old right-handed male fell on the palmar face of his right hand with an overstretched elbow (April 1999, motorcycle accident). He immediately complained of pain around the outer side of his elbow, which was triggered by movement. He presented himself to the emergency room two days after the accident. Clinically he presented with clinical signs of pain and minimal swelling; elbow movements were limited in flexion, extension, pronation and supination. Joint stability was considered normal and no neuro-vascular complications were observed. Radiographic and CT scan examinations (Fig. 1) confirmed the diagnosis of Hahn-Steinthal type capitellum fracture.

Four days after the trauma the patient was taken to the operating room to perform fracture fixation. Peripheral anaesthesia was used as well as nerve block for postoperative relief. Before surgery we unsuccessfully tried closed reduction under fluoroscopic control. The patient was placed in the decubitus position and a tourniquet was used.

A postero-lateral approach to the elbow was used as described by Kocher (23). The deep dissection proceeded in the interval between the anconeus and extensor carpi ulnaris muscles and was proximally enlarged through the partial elevation of the common extensor group of the forearm and wrist from the lateral epycondile. The forearm was pronated to move the posterior interosseous nerve away from the operative field. Capsulotomy showed a Hahn-Steinthal type I fracture without any other lesion of the radial head or of the medial facet of the trochlea. The fracture site was cleaned and the fragment was repositioned and a temporary clamp fixation was placed to maintain the reduction.

The final fixation was obtained with two Kirschner wires (1,6 mm of diameter) which were inserted through the center of the capitellum in the posterior side of the lateral condyle (Fig. 2). Stable osteosynthesis and satisfactory joint congruity were obtained.

The patient left the hospital 72 hours after surgery. Postoperatively his elbow was immobilized in plaster for 30 days until wire removal. This initial period was followed by three months of a progressive

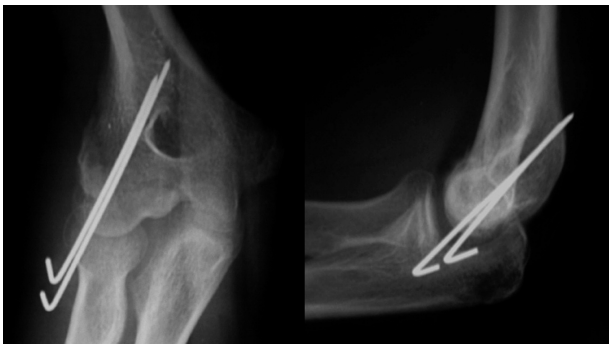

Figure 2. Postoperative X-ray after open reduction and internal fixation of the capitellar fragment using 2 Kirschner wires

Figure 3. X-ray after 5 years showing the fracture consolidation without signs of AVN, heterotopic ossifications and secondary osteoarthritis

mobilization programme that was guided by a physiotherapist. The fracture presented convincing signs of consolidation after 5 weeks and on the basis of radiographic appearance two months and a half after surgery the fracture was considered completely healed. The elbow range of motion (ROM) was considered normal after 4 months. At the five-year follow-up, radiographs (Fig. 3) did not show signs of AVN or degenerative osteoarthritis and the patient had an excellent ROM with full flexion, extension, pronation and supination (Fig. 4).

Case 2

A 54-year-old right-handed woman was admitted to our hospital one day after falling (May 2004, bicycle accident) on the palmar face of her right hand with her elbow in extension. The patient had an im-

Figure 4. Excellent clinical elbow outcome at the five-year follow-up evaluation

mediate occurrence of pain, swelling and functional disability of the right elbow. Clinically the pain was triggered by palpation and movement and she presented elbow haemarthrosis and localized tenderness over the lateral epicondyle. Elbow movements were limited to a ROM of 60° to 120°. No signs of elbow instability and neuro-vascular abnormalities were observed. Radiological examination (Fig. 5) and CT scans showed a typical Hahn-Steinthal fracture.

The following day the patient was taken to the operating room to perform fracture fixation. General anaesthesia was used as well as nerve block for postoperative relief. Before surgery we unsuccessfully tried closed reduction under fluoroscopic control. The patient was placed in the decubitus position and a tourniquet was used. A postero-lateral approach to the elbow was used (23). After capsulotomy we observed an isolated Hahn-Steinthal type I fracture. The fracture site was accurately cleaned. The fragment was repositioned and a temporary K-wire (1,1 mm of diameter) was placed to maintain the reduction.

The final fixation was performed with one cannulated Acutrak standard screw (22,5 mm of length)

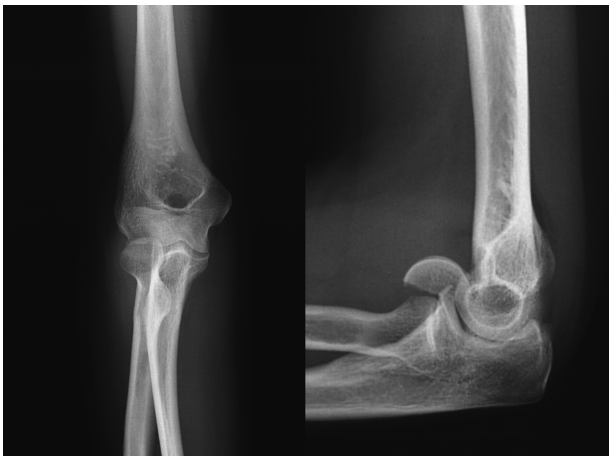

Figure 5. Right Hahn-Steinthal type I fracture; preoperative X-ray

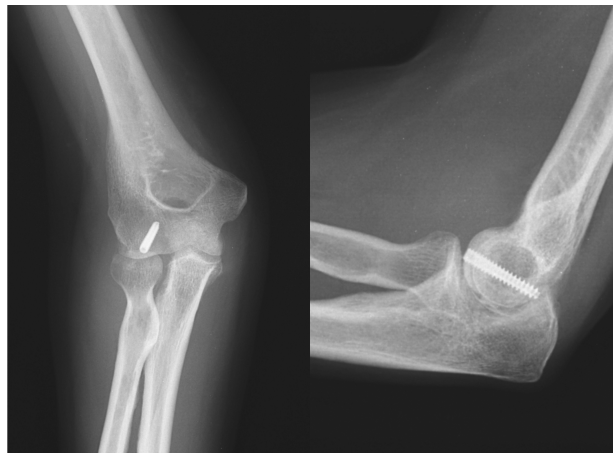

Figure 7. X-ray after 1 year showing the fracture consolidation without signs of AVN, heterotopic ossifications and secondary osteoarthritis

which was inserted, perpendicular to the fracture line, through the center of the capitellum in the posterior side of the lateral condyle (Fig. 6). An intraoperative dynamic examination showed satisfactory stability of the osteosynthesis and anatomic articular congruity.

The postoperative outcome was uncomplicated allowing the patient to leave the hospital 48 hours after surgery with her elbow placed in a dynamic splint (ROM 30°-100°). Immediate active and passive rehabilitation was started.

The dynamic splint was removed after 18 days before beginning 2 months of a more intensive mobilization programme guided by a physiotherapist. Two months after surgery the fracture was radiographically considered healed. The elbow ROM returned normal after 3 months. At the one-year follow-up, radiographic examination showed (Fig. 7) no evidence of AVN, heterotopic ossifications or degenerative changes and the patient recovered full flexion, extension, pronation and supination.

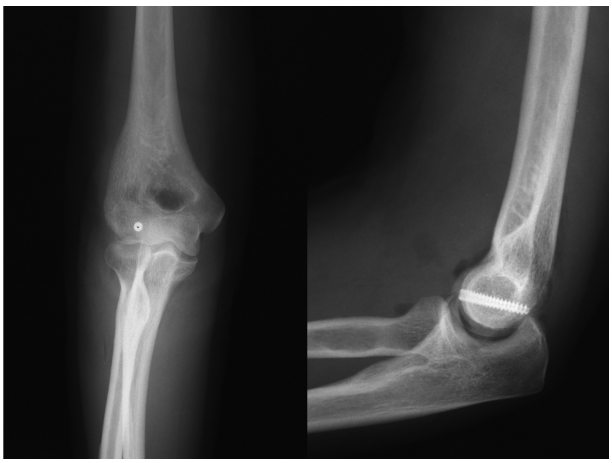

Figure 6. Postoperative X-ray after open reduction and internal fixation of the capitellar fragment using 1 Acutrak standard screw

Discussion

The capitellum humeri fractures prevalently occur in females and are almost exclusively observed in patients older than 12 years of age (4). Few authors report true fractures of the capitellum humeri in children (4, 24). As suggested by De Boeck (4), in the paediatric population, these fractures are usually associated with a lateral metaphyseal fragment and representing the "lateral condyle fracture in children". It is relatively frequent and accounts for 10-20% of all elbow fractures in the paediatric population. The lateral condyle fractures contain the epiphysis of the capitellum, the lateral epicondyle, a part of the distal humeral metaphysis and possibly a part of the trochlea. This is a Salter-Harris type IV fracture and should not be confused with a true capitellum fracture, which involves only the articular surface of the capitellar epiphy-

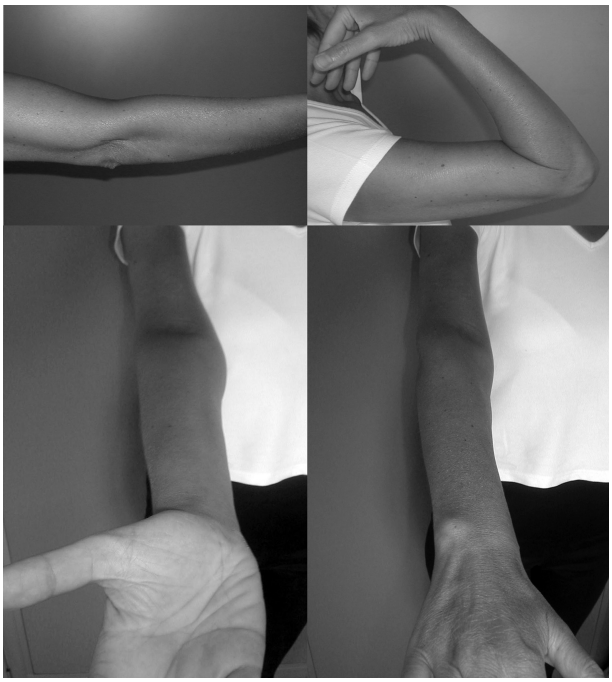

Figure 8. Excellent clinical elbow outcome at the one-year follow-up evaluation

sis.

Type I fractures or Hahn-Steinthal lesions are rare, accounting for only 1% of all elbow fractures (1). In our Department we observed only two cases in the last decade. Because of their rarity, reports with large numbers of cases are lacking.

These lesions are clinically characterized by pain, minimal swelling and tenderness on the lateral side of the elbow.

The clinical diagnostic suspect is generally confirmed by lateral radiographs of the joint, which show a semilunar fragment detached from the humeral condyle and lying anteriorly to the distal humerus (figure 1 and 5). The antero-posterior X-ray projection may appear normal. CT scans, possibly with three-dimensional reconstruction, are useful in studying the size and the orientation of the fracture fragment and in guiding preoperative planning and operative exposure.

A wide discussion appears in literature (1, 4-6, 11, 17, 18, 25) describing the treatment of these capitellum displaced fractures.

Closed reduction followed by plaster immobilization has been advocated. Hahn (12) firstly reported the unsatisfactory outcome after conservative management of a coronal shear fracture of the capitellum humeri. During the autopsy he found that the capitellum had been superiorly displaced and consequently united to the anterior side of the humerus, causing the restriction of elbow flexion. However, authors have shown that excellent results are achievable if closed anatomical reduction is attained and subsequently maintained up to the consolidation of the fracture (20). Typically few soft-tissue attachments remain on the fragment, making manipulation difficult and anatomic reduction unlikely to achieve. In our patients closed reduction always failed.

The conservative treatment consisting in an immediate mobilization may determine a limitation of elbow motion caused by remaining displaced articular fragments and also post-traumatic osteoarthritis due to articular incongruity and lateral instability. Some good results are described particularly in older patients (11, 26); however, this method should be avoided in young and active patients.

Fragment excision, which has been suggested in injuries where the fracture is comminuted (type III) or a type II lesion with insufficient subchondral bone, is not indicated in type I fractures.

Authors who are in favour of fragment excision argue that this treatment avoids complications inherent to the conservation of the capitellum, such as redisplacement, imperfect reduction and the risk of AVN (19, 27).

In agreement with Hardy (16) we believe that the isolated removal of the articular fragment as a primary treatment in Hahn-Steinthal lesions should be avoided because it may induce radio-humeral osteoarthritis and instability especially in cases of voluminous fragments.

The choice of open reduction and internal fixation can reflect the dissatisfaction with the inconsistent results of other methods of treatment.

Open reduction and internal fixation is in most cases a suitable method of maintaining a stable osteosynthesis and joint congruity while allowing an early mobilization. A wide variety of techniques of internal fixation are described such as Kirschner wires (1, 8), biodegradable pins (11), staples, bone pegs, and compression screws (1, 4, 17, 25).

Kirschner wires do not offer a strong compression

and a stable fixation at the fracture site and require subsequent removal. As described by Poynton (1), this method needs a longer postoperative period of immobilization interfering with early mobilization and rapid functional recovery.

The reabsorbable pins (17) have the advantage of not requiring subsequent removal.

Fixation using compression screws enables strong interfragmentary compression and stable ostesynthesis which are prerequisites in achieving good functional results. Depending on the fixation quality and the absence of any concomitant injuries, early mobilization can be started, thereby avoiding problems of elbow stiffness and disability that are commonly caused by prolonged cast immobilization.

In literature several authors report good results using Herbert screws (1, 17, 25). The major advantage of the Herbert screw system, and in general of all headless screws, lies in the fact that the screw is placed within the bone without any outside prominence, thereby avoiding unnecessary soft-tissues irritation. The second feature of the Herbert screws is the possibility of using a special jig alignment guide which allows us to direct the screw insertion in a posterior-anterior direction avoiding the penetration of the articular surface. Consequently, as described by Poynton (1), there is rarely the necessity for screw removal and the rehabilitation programme starts earlier, is uninterrupted and the functional recovery is faster. Problems related to headless screws might arise if AVN or chondrolysis occurs, exposing the metal implants to the adjacent radial head and possibly leading to erosion or arthritis within the joint. Fortunately, reports on the development of AVN are rare (21, 28, 29).

In our first patient (April 1999) the surgeon chose a fixation with two Kirschner wires. In the second patient (May 2004) a fixation with one Acutrak standard screw was performed. Both fractures healed without complications but the full ROM recovery was slower in the patient that was treated with Kirschner wires. In this patient the immobilization period was longer and physiotherapy started after the removal of the metal work.

The Acutrak headless compression screw, used in the second case, is a cannulated system which offers excellent compression. The cannulation provides the ability to accurately place the screw where desired, without the need for supplementary clamp fixation and the headless screw allows the device to be implanted below the surface of the bone or of the cartilage. In our patient the strong fixation obtained allowed immediate active and passive rehabilitation in a dynamic splint. Since the biomechanical testing has shown that the greater amount of force transmitted from the radial head to the capitellum occurs between 0° and 30° of elbow flexion (30), we ranged the splint in the interval between 30° and 100° of flexion.

We inserted an Acutrak screw through the center of the capitellum in the posterior side of the lateral epicondyle, perpendicular to the fracture line. This choice is responsible for minimal articular damage but the antero-posterior direction of the screw provides, as tested in a biomechanical study by Elkovitz (31), a more stable fixation. In both patients, respectively at one and five year follow-up, we did not observe X-ray signs of heterotopic ossifications, secondary osteoarthritis, or AVN (Figg. 3 and 7).

The Acutrak screw system, because of its cannulation, may also be used in the arthroscopic treatment of capitellum type I fractures as reported by Hardy (16). The arthroscopic approach should allow a better reduction and fixation of the articular fragment with a better evaluation of associated lesions compared to the classical open lateral approach, especially on the medial part of the joint. Furthermore, arthroscopic fixation should minimize the damage to the periarticular soft-tissues.

Conclusions

Open reduction and internal fixation is the actual preferred method of treatment for Hahn-Steinthal type I capitellum humeri fractures.

Modern fixation methods, in particular cannulated and headless screws, have given satisfactory results.

The Acutrak screw system is a reliable method of treatment because it enables strong interfragmentary compression, earlier mobilization, faster elbow functional recovery, and the metal work removal is rarely

necessary.

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