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Forearm post-traumatic deformities: Classification and treatment

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ABSTRACT

Introduction: There is no classification for acquired forearm deformities. A clinical-radiographic study was conducted to classify these deformities and evaluate the results.
Materials and methods: Thirteen patients with forearm deformities following traumas or their treatment were included (11 men and two women, from 2000 to 2010). Mean age was 31 years (range 10–75 years). Initial treatment was conservative in five patients and surgical in eight patients. One segment was affected in seven patients (the radius in four patients, the ulna in three), and both segments were affected in six patients. Location assessment: 2 projections X-rays, including wrist and elbow. Deformity location: proximal, diaphisary, distal, defined with the abbreviation, in distal sense, R1, R2, R3 for the radius, and U1, U2, U3 for the ulna. Primary and secondary deformities were distinguished: secondary deformities occurred later in a different location than the primary one. Six patients were treated with plate and screws. An external fixator was used in six patients. One patient was treated with bone resection. Iliac crest bone graft was used in 10 patients, and vascularised fibula graft in one patient.
Results: The primary deformity affecting the radial diaphysis (R2) determined a secondary deformity in four patients: in the distal ulna (U3) with ulnocarpal dislocation in three patients and in the distal radius (R3) in one patient. Results of osteosynthesis treatment were excellent in one patient, satisfactory in four and unsatisfactory in one. External fixation was excellent in one patient and satisfactory in five. Bone resection was satisfactory in one patient.
Discussion: Surgical treatments with osteosynthesis are the major cause of acquired forearm deformities in adults. Location and aetiology of the deformities are essential for the surgical indication and the result. It is important to restore the length of the deformed segment, realigning the anatomical axis. X-rays enable clinicians to distinguish between primary and secondary forearm deformities.
Conclusion: Characteristics and locations of post-traumatic deformities were identified. The major location is diaphisary and distal, the elbow is rarely affected. The functional consequence is a limitation in the range of motion of the hand. The best results are achieved with short-term treatment.

Introduction

The forearm is an essential segment for the functionality of the upper limb. Many pathological conditions, either acquired[11] or congenital, can affect the radius and the ulna, provoking severe biological and mechanical alterations that result in deformities. Forearm deformity can severely affect stability and functionality of the arm because of the importance of the radius and ulna in pronosupination, and their close relations with the elbow and wrist joints.[12] The treatment of forearm deformity is complicated: the aim of treatment is to correct the deformity and restore the physiological relations between the bones of the forearm, thereby avoiding disabling functional outcomes. Congenital forearm deformities are well known, and are easily classified and diagnosed.[1–3] Nevertheless, in the last decades there has been an increasing incidence of forearm deformities following road and work accidents[10] or their treatment (either surgical or conservative). Sometimes these secondary deformities are considered acceptable post-traumatic conditions, particularly if the range of motion of the hand is at least partially preserved. There are many studies on congenital forearm deformities, but there is no classification or anatomical-topographic description of acquired forearm deformities, which means that the surgical treatment of the latter can be inadequate. For this purpose, we conducted a clinical-radiographic study on a group of patients who were recently treated in our department to present a clear picture of this pathology and the treatment results.

Materials and methods

We included 13 consecutive patients with forearm deformities who were treated in our department between 2000 and 2010. The case study included eleven men and two women. Mean age was

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31 years old (from 10 to 75 years old). All forearm deformities followed traumatic events, or they were post-traumatic conditions following the treatment (either surgical or conservative). The primary fracture affected both forearm bone segments (radius and ulna) in six patients: distal fracture in three patients and diaphyseal fracture in three patients. One segment only was affected in seven patients, the radius on the diaphysis in four patients, and the proximal ulna in three patients. Initial fracture treatment was conservative in five patients and surgical in eight patients. Open reduction and internal osteosynthesis with plate and screws was performed on one radius, on two ulnas and twice for a fracture of both bones. Four patients were treated with a rush nail, in the radius in three patients, and in both bones in one patient. The range of motion of the elbow was limited in one patient, and the range of motion of the wrist was limited in seven patients. The deformity was present on both bones in six patients, on the radius in three patients, and on the ulna in four patients. The assessment of the deformity site was performed on the forearm X-rays using the antero-posterior and the latero-lateral projections including the elbow and the wrist. The deformity site was classified as proximal, diaphyseal or distal using a modified Vince and Miller classification,[4] adding the longitudinal division between radius and ulna. Therefore, the deformity site has been defined respectively with the abbreviations, in the proximal-distal direction, R1, R2, R3 for the radius, and U1, U2, U3 for the ulna (Fig. 1). In all deformities we distinguished between the primary deformities, due to the primitive pathology, and the secondary deformities that occurred subsequently and in a different place than the primary one, but on the same segment. We also assessed the varus and the valgus for the wrist and elbow articular deformities, and the incurvatum and excurvatum angulation for the diaphyseal deformities. We focused on the relation between the radial bowing and the functional results. To this purpose, we used the method of Schemitsch and Richards to estimate the degree and the site of the greater radial bowing.[5] The surgical operation to correct the post-traumatic deformity was performed within 90 days of the first traumatic event in two patients, within 120 days in one patient and within six months in four patients. In the remaining six patients, surgery occurred in the 8–12 months following the first traumatic event. Six patients were treated with internal osteosynthesis with plate and screws. One of these patients presented a severe distal (R3) radial dorsal deformity and was treated with a wrist arthrodesis and a metacarpal-radial plate. An external fixator was used in six patients, and one patient who was previously treated for a comminuted distal radial fracture was treated with an ulnar bone resection. An iliac crest bone graft was used in ten patients, and a vascularised fibula graft was used in one patient. Forearm functional results following treatment were assessed according to the Anderson outcome evaluation scale[6] after a 2-year follow-up in all patients. This is an evaluation based on the clinical examination of the functional results rated according to the limitations in the flexo-extension and pronosupination in the elbow and wrist joints, and on the bone union versus non-union.

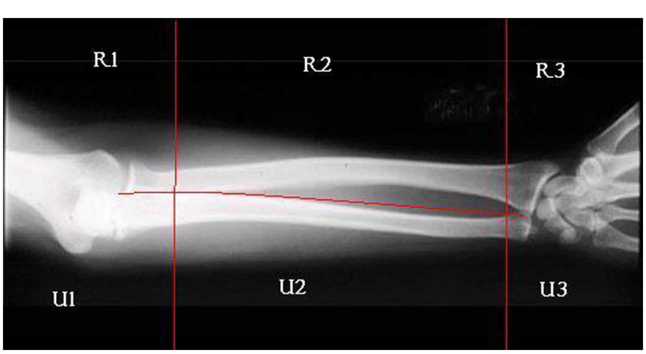

Fig. 1. Forearm X-ray with diagram of classification system.

Results

In our group of 13 patients with acquired forearm deformities, the primary deformity determined a secondary deformity in four patients. The primary deformity affected the radial diaphysis (R2) in all four patients: in three of these patients it led to a secondary deformity in the distal ulna (U3), determining an ulnocarpal dislocation, and in the remaining patient, the secondary deformity was on the radius itself, but distally (R3). Considering the six patients with a previous fracture of both bones, the deformity was in both radius and ulna in three patients, on the radius alone in two patients, and on the ulna alone in one patient. Three of the ulnar deformities were in the category U1, the proximal deformities, and one was diaphyseal (U2). The distal segment (U3) was affected in three primary deformities and three secondary deformities that were due to a primary radial diaphysis (R2) deformity.

There were no patients with a proximal radius (R1) deformity. There were six primary deformities in the diaphysis (R2) (Fig. 2a–c), four of which led to a secondary deformity: three in U3 and one in R3. Four patients had an R3 deformity: in three patients the primary deformity also affected the U3 segment, and in one patient it was secondary to an R2 deformity. There was one deformity in elbow flexion caused by a U1 deformity. In the wrist, there were six deformities in varus and radial deviation, two of them because of a primary U3-R3 deformity (one was also dorsiflexed), and four caused by a secondary deformity (one R3

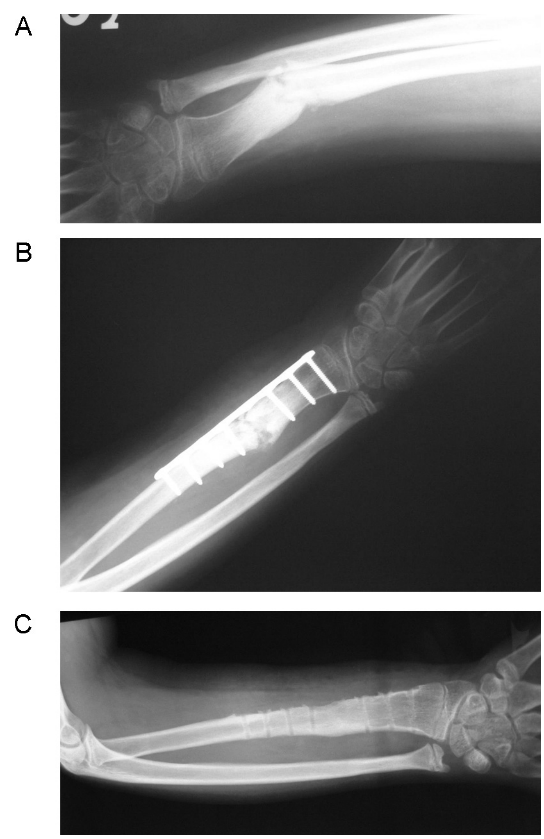

Fig. 2. 11-year-old boy. (a) Post-traumatic radial diaphyseal deformity (R2). (b) Treatment with plate and screws and iliac bone graft, (c) final result after synthesis removal.