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Terrible triad of the elbow: is it still a troublesome injury?

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KEYWORDS

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ABSTRACT

Background: Terrible triad injury (TTI), one of the main patterns of complex elbow instability, is difficult to treat and yields conflicting surgical results. We analyzed prospectively a series of patient affected by TTI and treated according to the current diagnostic and surgical protocols to investigate whether their application allow to obtain more predictable outcomes.
Material and methods: We analyzed 26 patients with a mean age of 52 years. Preoperative X-rays and CT were performed; all patients were operated by the same elbow surgeon and underwent the same surgical and rehabilitation treatment. Final functional outcome was assessed by the Mayo Elbow Performance Score (MEPS), Quick-Disability of the Arm Shoulder and Hand-score (Q-DASH) and the modified-American Shoulder and Elbow Surgeons score (m-Ases). A radiographic evaluation was also performed.
Results: Mean follow-up was 31 months. At final evaluation, mean flexion, extension, supination and pronation were 137°, 10°, 77° and 79°, respectively; mean MEPS, m-ASES and Q-DASH scores were respectively 96, 91 and 8 points. Complications observed after first surgery were: elbow stiffness in 5 cases, mild posterolateral instability in 3 cases, chronic subluxation in 1 case. Radiographic evaluation showed secondary arthritis in 9 cases, symptomatic HO in 3 cases and late hardware displacement in 2 cases. Six out of 26 patient underwent reoperation with final satisfactory results.
Conclusion: The current diagnostic and therapeutic protocols allow obtaining satisfactory clinical outcomes in majority of cases but a high number of major and minor unpredictable complications persist yet. In this series, low compliance, obesity, and extensive soft elbow tissue damage caused by high-energy trauma represented negative prognostic factors unrelated to surgery. On the other hand, the strict application of current algorithms by an expert elbow surgeon appears to improve clinical results by reducing the influence of other avoidable negative prognostic factors well known in current literature, such as the incomplete recognition of injuries, delayed treatment, inadequate treatment of bony and ligamentous injuries, prolonged immobilization and, last but not least, the surgeon's inexperience.
Level of evidence: Level IV, Case series, Treatment study.

Introduction

Elbow dislocation associated with both radial head and coronoid fractures has been referred to as the "terrible triad injury" (TTI); it represents a pattern of complex elbow instability that has historically been associated with a poor prognosis [1-6]. TTI is a severe injury that is difficult to treat. It may result in chronic instability, elbow stiffness and post-traumatic arthritis, and consequently loss of function and chronic pain [2,6-20]. The aim of TTI treatment is to restore the primary and secondary stabilizers of the elbow so as to obtain a stable joint and allow early rehabilitation; therefore, anatomical and stable osteosynthesis of coronoid process, together with the repair or replacement of radial fractures followed by ligament reconstruction, currently represents the main goals of surgery [21-26]. Although this standardized treatment appears to have yielded more favorable and reproducible clinical outcomes in recent studies [9,11,12,17,19,20,26-29], a high rate of complications and re-interventions has been documented in the literature [6,8-11,15,19,20,29,30]. In a recent systematic review [31], Chen observed that all but one of the 16 studies examined were retrospective, and concluded that "evidence from additional prospective studies would be welcome" to understand which refinements in surgical and post-operative management are needed to reduce complications. We have therefore investigated whether the application of a standardized protocol applied by our team on a series of consecutive patients with TTI followed prospectively yields satisfactory outcomes and a low complication rate. We hypothesized that the application of current guidelines improves clinical results, but on the other hand a significant number of complications that are unrelated to surgery persist and continue to affect the prognosis of TTI.

Materials and methods

Between 2008 and 2013, twenty-six consecutive patients who underwent surgery for TTI were included in this study. The same elbow surgeon (G.G.) treated all the patients. The series comprised 13 men and 13 women, with a mean age of 52 years (range: 28-81).

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The right side involved 13 patients. The type of injury was classified using standard radiographs (anteroposterior and lateral view), CT scans with 2D and 3D reconstructions and intra-operative fluoroscopy in all patients. Eight patients had suffered high energy trauma (defined according to van Laarhoven: fall of height 5 m, car accident >65 km/h, motor accident >32 km/h, car–pedestrian or car–bicycle impact >8 km/h, vehicle deformity >50 cm, vehicle intrusion passenger compartment >30 cm, vehicle rollover, passenger ejection from vehicle, fatality in same vehicle) [32].

Coronoid fractures, which were categorized according to the Regan and Morrey classification [3], comprised 17 type 1, 7 type 2 and 2 type 3 injuries. Coronoid fractures were also categorized according to the O'Driscoll classification [33]: they comprised 3 type 1 sub 1, 15 type 1 sub 2, 6 type 2 sub 2 and 2 type 3 basal 1 fractures. Radial head fractures, which were classified according to the Mason classification, comprised 8 type 2 and 18 type 3 radial head fractures [34]. The classification of soft tissue constraint injuries was performed using the Giannicola classification system [35]. Table 1 provides details of all the osseous and ligament lesions observed in each patient.

Surgical treatment

Surgical treatment was performed according to the current therapeutic algorithms, as summarized in Fig. 1 [23,24.30]. All but one patient underwent surgery on average 3 days after trauma (range: 2-6 days). The remaining patient received delayed treatment 40 days after sustaining the injury because initial conservative treatment which was initiated in another hospital failed and recurrence of the elbow dislocation was observed. A posterior skin incision was performed in all cases. Radial head fractures were exposed through the elbow Kocher approach. In

Table 1
Detail of osseous and soft tissue lesions and their treatment in each patient.

Case	Radial head (Mason)	Radial head tratment	Coronoid (Regan-Morrey/ O'Driscoll)	Coronoid treatment	Soft tissue lesions (Giannicola)	Soft tissue lesions treatment	HEF
1	III	RHA	2/ anteromedial Sub 2	2 FFS + trans-osseous suture	LCL: type PM PLC: Large LCM*: tear CEO: tear	3 suture anchors + Cross-suture	no
2	III	RHA	1/ anteromedial sub 2	2 FFS	LCL: type PMD PLC: Large LCM:PMD CEO: tear FPO:tear	1 suture anchor + Cross-suture	yes
3	II	2 HS	2/ anteromedial sub 2	Trans-osseous suture	LCL: type PMD PLC: Large LCM*: tear CEO: tear	Cross-suture	yes
4	II	2 HS	1/ anteromedial Sub 2	2 FFS + trans-osseous suture	LCL: type M LCM:type PM PLC: Small	3 suture anchors + Cross-suture	no
5	III	RHA	2/ anteromedial Sub 2	Trans-osseous suture	LCL: type PM LCM: type PM	2 suture anchors + Cross-suture	no
6	III	RHA	1/ Tip Sub 2	Trans-osseous suture	LCL: type PMD LCM*: tear PLC: Large	4 suture anchors + Cross-suture	no
7	II	2 HS	1/ Tip Sub 2	Trans-osseous suture	LCL: type P PLC: Large LCM*: tear CEO: tear	3 suture anchors	no
8	II	3 HS	2/ anteromedial Sub 2	2 FFS + trans-osseous suture	LCL: type PM PLC: Small LCM*: tear	1 suture anchor + Cross-suture	no
9	III	RHA	1/ Tip Sub 1	No suture, no ostheosynthesis	LCL: type PM PLC: Small CEO: tear	2 suture anchors + Cross-suture	no
10	III	RHA	3/ Basal 1	3 FFS	LCL: type M	Cross-suture	no
11	II	2 HS	3/ Basal 1	2 FFS	LCL: type D-BF	2 suture anchors	no
12	II	1 HS	1/ tip sub 2	Trans-osseous suture	LCL: type PM PLC: Large LCM: type PM	3 suture anchors + Cross-suture	no
13	III	RHA	1/ tip sub 2	Trans-osseous suture	LCL: type PM PLC: Small LCM*: tear	1 suture anchor + Cross-suture	no
14	II	Bone fragment excision	2/ Tip Sub 2	3 FFS	LCL: type PM PLC: Large	3 suture anchors + Cross-suture	no
15	II	1 HS + bone graft	1/ tip sub 2	Trans-osseous suture	LCL: type P PLC: Large-BF LCM: type P	3 suture anchors	no
16	III	2 HS + mini plate + bone graft	2/ Tip Sub 2	2 FFS	LCL: type PM PLC: Small	1 suture anchor + Cross-suture	no
17	III	RHA	1/ Tip Sub 2	1 FFS + Trans-osseous suture	LCL: type PM PLC: Large	2 suture anchor + Cross-suture	no
18	III	RHA	1/ Tip Sub 2	1 FFS + Trans-osseous suture	LCL: type PM PLC: Large LCM*: tear	2 suture anchors + Cross-suture	no
19	III	RHA	1/ Tip Sub 2	Bone fragment excision	LCL: type PM PLC: Large LCM*: tear	2 suture anchors + Cross-suture	no

(continued)