Management of the Terrible Triad Injury of the Elbow: A Case Series Retrospective Review

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Abstract: *Objectives:* To expose our experience in the multidisciplinary management of patients with terrible triad injury of the elbow (TTIE) treated in our hospital.

Material and methods: A descriptive-retrospective study including all patients with TTIE treated surgically between January/2008-December/2014.

The analyzed variables were demographic, etiologic, type of fracture (Mason, Reagan and Morrey Scale), type of surgery/approaching technique, time between injury-surgery, immobilization period, range-of-movement (ROM) before/after treatment, and complications.

An assessment before/after the treatment using analogical visual scale (AVS), goniometry and Mayo Elbow Performance Index (MEPI) was carried out.

Results: A total of 12 patients were included. The most common cause was accidental fall (75%). All fractures were surgically treated (mean 4.6 days after injury) with subsequent detention (29 days average). The surgical approach was lateral (n=8), posterior (n=2), and both lateral and medial (n=2).

The increase in the flexion/extension ROM was 27.27º/24.09º, in pronation/supination was 23.65º/23.9º. The initial/final AVS was 4.46/2.16. In MEPI scale, 9 patients had excellent-good results, 2 regular, and one underwent bad response. Only one patient had complications during the follow up period.

All patients were treated surgically promptly and immobilized for a month. As the MEPI states, the results of our series are acceptable. This is in accordance with present day reports.

Conclusions: The clinical results of the series are consistent in relation to the literature. The results suggest that an integral, multidisciplinary approach (surgical and rehabilitation) for the TTIE must be achieved. Despite the small series and the infrequent appearance of the pathology, no cases were lost during the study.

Keywords: Dislocation, elbow, fracture, terrible triad, rehabilitation.

1. INTRODUCTION

Terrible triad injury of the elbow (TTIE) is characterized by the presence of elbow dislocation, radial head fracture and fracture of the coronoid apophysis. However, it can also include a wide spectrum of lesions. It is a complex lesion with uncertain prognosis [1].

The typical mechanism of production of TTIE has been postulated to occur during a fall on an outstretched arm, causing a valgus posterolateral force to the elbow that results in a sequential lateral to medial disruption of the surrounding capsuloligamentous structures [2]. The supination of the forearm over the humerus leads to dislocation. The bone lesions are associated with lesions of the soft tissue, which spread from the lateral region to the medial one, which means that the anterior band of the medial collateral ligament is the last part to be damaged [3]. In its diagnosis it is essential to have high clinical suspicion as well as a series of emergency imaging studies ranging from conventional radiography to CT scan (see Figures **1** and **2**) [4]. Chemama *et al*. considers Ct scan assessment should be systematically perfomed after dislocation reduction for proper investigations of bony lesion [2, 5].

The loss of mobility may affect activities of daily living (ADLs) [6], such as feeding, bathing or grooming [7, 8].

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Figure 1: CT image showing a fracture of less than 50% of the coronoid. Fracture of the head of the radio with minimum displacement of the fragments.

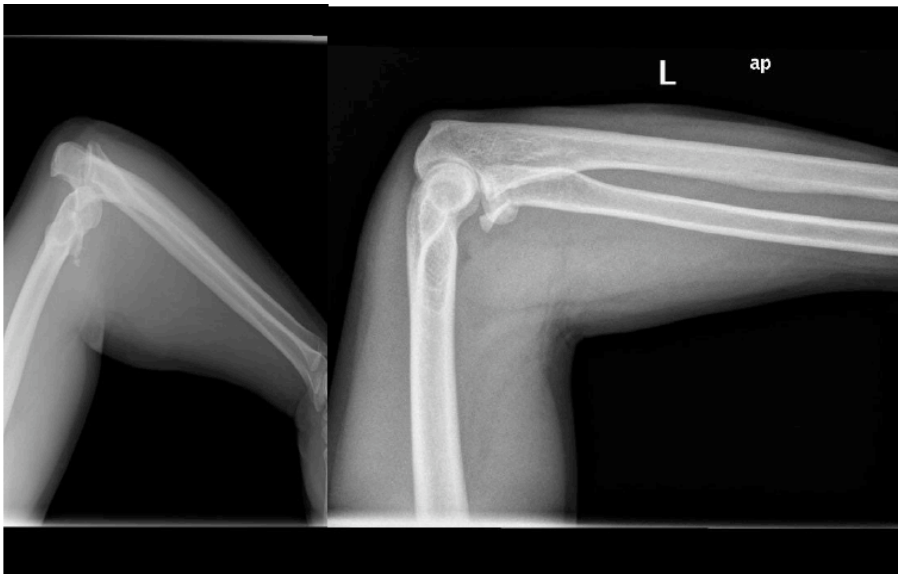

Figure 2a: Shows an example of a series malignant triad collection our study. It is a lateral radiograph of a posterior dislocation radio head fracture of the radial head and the coronoid. **b:** This is another example of TTC. It can be appreciated fracture coronoid process more than 50%.

TTIE can often lead to rigidity subsequent to the lesion, with the consequent loss of functionality [7-10]. In its management and treatment it is essential to achieve a recovery of mobility and functionality [9].

The treatment of this lesion is generally surgical because a conservative treatment does not allow an early mobility of the joint, which can lead to subsequent rigidity [11, 12]. The first objective of the surgical treatment is to achieve a stable reduction which makes it possible to move the joint at an early stage [2, 13, 14].

The reviewed literature does not show a unanimous agreement on the implementation of a routine rehabilitation program after an elbow fracture [9, 10] Nevertheless, we observe that a rehabilitation program after TTIE intervention may represent the difference between a functional and a non-functional extremity [9],

not only through the treatment of the potential rigidity, but also by preventing it.

The objective of this case review is to assess and present our experience with regard to the treatment protocol implemented by our service and the functional results in the multidisciplinary management of patients with terrible triad injury of the elbow treated in our center.

2. MATERIALS AND METHODS

We carried out a retrospective study which included all patients with a diagnosis of TTIE in the period between January 2008 and December 2014, who were surgically treated in our hospital.

The selection of the sample was carried out through a search in the registry of the University Hospital of Salamanca of all the cases recorded in the period of our study under the terms of elbow fracture or dislocation, radial head fracture, fracture of coronoid apophysis and elbow instability, classified under the corresponding CIE9 codes (Code 813.02 and 813.12 for fracture of the coronoid apophysis, 813.5 and 813.05 for fracture of the radial head, 718.82 for elbow instability and 832.02 for elbow dislocation). Finally, only those patients who met the criteria for TTIE were selected. The study included a total of 12 patients.

Among the variables of the study, we registered demographic data (age and sex) etiology of the lesion (falls from height, indirect trauma, traffic accident…), type of fracture, type of approach and surgical intervention, period between trauma and surgical intervention, time of immobilization after surgical intervention, range of movement before and after rehabilitation treatment, number of sessions of re-habilitation treatment and postoperative complications.

To classify the type of fracture for the radial head and the coronoid apophysis, were used the scales of Mason [15] and Regan and Morrey [16], respectively.

The Mason classification categorizes radial head fractures into 4 types: type I: non-displaced or minimally displaced fracture (less than 2mm); type II: fracture with displacement; type III: comminuted fracture; and type IV: fracture with dislocation of the elbow joint (Johnston) [15].

Through the Regan and Morrey scale, fractures of coronoid apophysis are classified into three types. Type I corresponds to a fracture involving the coronoid process tip (less than 10% of the apophysis), type II are fractures of 50% of less of the height of the coronoid apophysis, and type III are fractures of more than 50% of the height of the apophysis [16].

For the functional assessment we carried out an evaluation after the surgical intervention and after the rehabilitation treatment through physical examination, in order to assess the range of motion of the joint through goniometry. The measurement was carried out with the elbow flexed to 90º, close to the body, and starting from a neutral position, for an assessment of pronation and supination, and with the extremity in anatomical position for an assessment of flexion and extension.

The radiological follow-up used simple postero-anterior and lateral X-rays to control the correct evolution of the process and the appearance of possible complications (arthritic changes, maintained reduction and heterotopic ossification).

With regard to pain, its levels were assessed at the beginning and end of the rehabilitation therapy through the visual analogue scale (VAS), a classical method to measure the intensity of pain and quantify the subjective perception of pain by the patient.

In order to assess the functional results of our study we used the Mayo Elbow Performance Index (MEPI) at the end of the treatment [17], because it is easy to use and interpret, and it takes into account the factors which may be relevant for recovery in this type of lesion (pain, mobility, stability and functionality).

2.1. Action Protocol

All the patients underwent surgery to stabilize the elbow joint and to make it possible to obtain early mobilization in order to prevent joint rigidity.

2.2. Postoperative Period

2.2.1. Immobilization

All the patients were immobilized after the operation with a static orthosis at 90 degrees in order to reduce edema and inflammation, after which a hinged orthosis was placed, during an average period of 3-4 weeks, and they were subject to frequent clinical-radiological controls to prevent a potential postoperative subdislocation of the joint.

In the cases of isolated suture of the radial collateral ligament, the forearm was placed in pronation to protect the lateral ligament and prevent dislocation. In

PROTOCOL OF REHABILITATION TREATMENT

INITIAL STAGE

1. Paraffin (to relax the muscles and reduce pain)
2. Postural treatment; correction of wrong elevation of shoulder joint and homolateral leaning.
3. Mobilization of the gleno-humeral joint
4. Massage techniques:
    a. Treatment of the scar ("Z-shaped" massage)
    b. Mild massotherapy techniques to improve the qualities of the tissue and vascularization.
    c. Evacuation techniques for edema drainage.
5. Myofascial release techniques (alternate days)
6. Manual treatment of the muscle-tendon insertion points of brachialis and biceps.
7. Treatment of trigger points (twice a week)
8. Elongation of flexors and extensors
9. Passive motion of joint arc, without pain
10. Active-assisted motion until encountering pain
    a. 1 serie of 10 repetitions of flexion-extension.
    b. 3 series of 10 repetitions of pronation-supination
    c. 2 series of 10 repetitions of flexion-extension combined with pronation-supination.
11. Cryotherapy (reduces pain, spasms, tone)

INTERMEDIATE STAGE

1. Active-assisted motion:
    a. 2 series of 10 repetitions of flexion-extension of the elbow combined with pronation-supination
    b. Flexion-extension of wrist and diagonal motion in all axes of the shoulder
2. Manual therapy (Mulligan, Maitland,...)
3. Muscle energy techniques
4. Isometric contractions
5. Eccentric training (to increase fibroblastin in the tendon)
6. Progressive resistive motion
7. Work with elastic band: color bands for progressive resistance, exercises of elbow flexion and extension
8. Rhythmic stabilization
9. Progressive introduction of DLAs

FINAL STAGE

When the joint range of motion is over 75% of the total and there is no effusion, edema or pain at rest, we will continue with the training and increase proprioception through the following measures:

1. Work with ball
2. Multidirectional motion
3. Weight unloading exercises:
    a. The palm of the hand is over the medicine ball with stretched elbow.
    b. 3 series of 10 weight unloading with different directions and positions of the hand.
4. Coordination.

Figure 3: Protocol of rehabilitation treatment.

the cases in which the medial ligament was affected, immobilization was carried out with the forearm in full supination. In the cases in which both ligaments were unstable, the forearm was immobilized in the neutral position [2, 5].

After remove the static orthosis, a hinged orthosis was applied allowing a flexion-extension and prono-supination rehabilitation protocol to be initiated with maximum extension limited to 30º.

2.2.2. Rehabilitation Treatment

At day 5-7 after the intervention, a joint assessment of the Service of Traumatology and the Service of Rehabilitation was carried out to consider the possibility of starting rehabilitation treatment, in the cases in which, after reaching joint stability and integrity of the capsular ligamentous complex, the patients presented with decreased joint range which led to loss of functionality in ADLs.

The rehabilitation program was divided into three stages, Figure **3**, which can be globally defined as assisted active kinesiotherapy to recover the joint range of motion and resisted active kinesiotherapy to activate the affected muscles, thermotherapy for muscle relaxation and pain relief and cryotherapy to reduce edema and inflammation after the treatment.

	Sex	Age	Cause of accident	Mason	Morrey	Time from trauma to surgery	Treatment of radial head	Treatment of coronoid apophysis	Ligament repair	External fixation	Surgical approach
1	F	63	Fall from normal height	1	2	4 days	DECAPITATION	ANCHOR	YES (LCL)	NO	Lateral
2	F	88	Fall from normal height	1	1	2 days	NO	NONE	NO	NO	Lateral
3	M	46	Fall from normal height	3	1	1 day	SCREWS	NONE	YES (MCL)	NO	Lateral
4	M	31	Indirect trauma	1	3	4	PLATE	SCREW	NO	NO	Lateral
5	M	52	Fall from normal height	3	1	Same day	DECAPITATION	NONE	YES (LCL)	NO	Posterior
6	M	65	Fall from normal height	2	3	7 days	SCREWS	SCREW	YES (LCL AND MCL)	YES	Lateral and Medial
7	M	79	Fall from normal height	3	1	Same day	PARTIAL DECAPITATION	NONE	NO	NO	Posterior
8	M	44	Fall from height	1	3	9 days	PROSTHESIS	ANCHOR	YES (LCL)	NO	Lateral
9	M	36	Traffic accident	3	1	2 days	DECAPITATION	NONE	NO	NO	Lateral
10	F	16	Traffic accident	3	3	2 dias	PLATE	SCREW	YES (MCL)	NO	Lateral
11	M	34	Fall from normal height	3	1	4 days	DECAPITATION	NONE	NO	NO	Lateral
12	M	39	Fall from normal height	3	2	10 days	PROSTHESIS	ANCHOR	YES (LCL)	YES	Medial and Lateral

Figure 4: Patient data according to demographic characteristics, type of fracture and treatment.

3. RESULTS

In total, 12 patients were included in the period between January 2008 and December 2014. All the patients included in the study had terrible triad injury of the elbow. We may highlight that no patients were lost during the follow-up period. The average age of the patients was 50 years, with a range between 16 and 88 years. 25% were women (n=3) and 75% were men (n=9), Figure **4**. The average follow-up period for the patients was 12 months.

With regard to fractures of the radial head, in our series all the patients presented with type IV fracture in Mason's classification, with a combination of fracture and dislocation. However, if we only take into account the fracture lines in the radial head, 4 patients were type I, 1 patient was type II and 7 patients were type III, Figure **4**.

With regard to the fracture of the coronoid apophysis, according to the Regan and Morrey scale, 6 cases in our series (50%) were type I, 2 cases (16.6%) were type II and 4 cases (33.3%) were type III, Figure **4**. If we focus on the mechanism of the lesion, the most common etiology was an accidental fall (from normal height) in 75% of cases (n=9). In 2 other cases (16.6%), the cause of trauma was a traffic accident, one of which took place with a bicycle (8.3%) and the last one was a fall from a height of two metres. Most of the patients in our study underwent surgery within the first week, and more specifically between day 1 and 4 after the lesion had taken place, with an average of 4.6 days. Two patients only underwent surgery 7 and 9 days after the lesion, respectively.

All the fractures were treated with surgery and subsequent immobilization with brachiopalmar splint or cast for an average of 29 days. The minimum

	Flexo-extension Pre-RHB	Flexo-extension Post-RHB	Gain in range of motion FE	Prono-Supination Pre-RHB	Prono-Supination post RHB	Gain in ROM Pro-sup	Eval Pre-RHB	Eval post-RHB	Mayo final	Time of immobilization after surgery	No. of RHB sessions	Complications
1	100 /-60	150/-15	50/45	75/90	90/90	15/0	5	2	Good	34 days	51	Arthralgia
2	80/-50	110/-20	30/30	45/65	85/90	30/25	6	3	Good	28 days	90	Intolerance to osteosynthesis material
3	110 /-30	150/-15	40/15	(80/80)	90/90	10/10	4	0	Excellent	**14 days**	64	None
4	110/-20	no rhb	No Rhb	No rhb	No rhb	No rhb	5	2	Average	35 days	None	None
5	90/-40	100/-25	10/15	45/45	75/80	30/35	7	3	Good	28 days	90	None
6	100/-50	130/-30	30/20	60/90	80/90	20/0	4	0	Average	Fijadorext	100	Intolerance to external fixation pins
7	80/-50	110/-20	30/30	85/45	85/90	0/5	2	0	Good	54 days	0.5	None
8	80/-65	90/-30	10/35	80/40	90/90	10/50	9	6	Bad	28 days	61	Subdislocation of radial head
9	100/-15	110/-5	10/10	75/85	85/90	10/5	2	0	Good	28 days	Did not attend	None
10	100/- 40	150/-10	50/30	45/45	85/90	40/45	2	8	Excellent	35 days	64	None
11	110/-30	130/-10	20/20	45/80	85/90	35/10	2	0	Excellent	21 days	16	None
12	90/-40	110/-25	20/15	45/60	90/90	45/30	6	2	Excellent	14 days	64	None
	95.8/-40.8	121.8/-17.08	27.27/24.09	61.8/65.9	85.45/89.09	23.65/23.19	4.41	2.16	Good/ Excellent	29 days	66.6	None

Figure 5: Summary of functional results in our study.

immobilization time was 14 days, and the maximum was 54 days. Before the rehabilitation program started, the average flexion was 95.8 (range: 80/110) and average flexion was -40.8 (range: -65/-15), with an average pronation of 61.8 (range: 45/85) and an average supination of 65.9 (range: 40/90). The average flexion-extension arc of motion before the rehabilitation treatment was 55 (range: 110/40).

After the end of the rehabilitation treatment, the average flexion was 121.8 (range: 90/150) and the average extension was -17.8 (range: -30/-5), with an average pronation of 85.45 (range: 90/75) and a supination of 89.08 (range: 90/80). The average flexion-extension arc of motion after the treatment was 104 (range: 150/72.2).

The average duration of the rehabilitation treatment was one to three months, with an average of 66 sessions Figure **5**.

With regard to pain, the average score according to the VAS before the rehabilitation treatment was 4.46, and after the rehabilitation treatment it was 2.16 Figure **3**.

Most of the patients showed good to excellent results, according to the Mayo scale, both globally and when considering the items individually, Figure **6**. The results in the 12 recorded cases of terrible triad injury of the elbow were good or excellent in 9 cases, average in 2 of them and bad in only 1 case.

	Pain	Motion	Stability	Function	Score	Results
1	30	20	10	25	85	Good
2	0	15	10	20	45	Bad
3	45	20	10	25	100	Excellent
4	15	20	10	25	70	Average
5	30	20	10	20	80	Good
6	15	20	10	20	65	Average
7	30	20	10	20	80	Good
8	15	5	0	15	35	Bad
9	30	20	10	25	85	Good
10	45	15	10	25	95	Excellent
11	45	20	10	25	100	Excellent
12	40	20	10	25	95	Excellent

Figure 6: Results from the Mayo Scale in our study.

With regard to the potential complications, during the follow-up period in our case series only one case of intolerance to external pin fixation was observed, together with a subdislocation of the radial head which did not require operation. No complications were registered in any of the other patients in the study.

4. DISCUSSION

Terrible triad injury of the elbow is a complex lesion with an uncertain prognosis [1]. The initial treatment of the lesion is surgical, and it attempts to obtain a stable reduction which makes it possible to move the joint at an early stage in order to prevent joint rigidity [2, 5, 13, 14, 18, 19]. This is a relevant fact, since instability is considered a factor for poor prognosis after an elbow fracture [6, 9, 20]. Similarly, the time from fracture to the intervention is a relevant prognostic factor after an elbow fracture, as is the severity of the lesion or the age of the patient [9, 20].

For these reasons, it is worth highlighting that most of the cases reviewed in the literature were treated within the first week after TTIE [19], as well as in our series, in which the average time from trauma to surgical operation was 4.6 days, an optimal time when compared with other studies [19].

4.1. Post-Operative Management

Currently, and from a rehabilitation perspective, there are several aspects in the management of terrible triad injury of the elbow which are subject to debate and which we will now analyze.

There are no doubts with regard to the aim of the rehabilitation treatment, which is to reach the highest possible degree of functional independence to carry out activities of daily living through the highest possible mobility or arc of motion of the elbow [6, 8, 9, 21] and to try to meet the expectations of the patient, as long as they are realistic [21]. If these expectations are not realistic, and in order to obtain higher therapeutic adherence, prevent complications and reach better functional results, it is necessary to properly educate the patient [9, 21], a factor which is considered essential in the rehabilitation of elbow fractures [9].

However, there are limited references in the literature to the postoperative management, and the sources do not show a unanimous consensus on the implementation of a rehabilitation program [9,10], because there is a debate on whether early or delayed rehabilitation is a better approach for greater functional recovery [22].

In this type of lesion, there are no established protocols regarding the beginning of rehabilitation [9, 10, 23]. However, we report that a rehabilitation program after an operation for TTIE may represent the difference between a functional and a non-functional extremity [7, 9]. Also, we consider that good communication is essential between the surgeon and the person or team responsible for the rehabilitation [18] for the implementation of a systematic rehabilitation protocol [21]. Moreover, the treatment must be individualized and adapted to each of the stages of the evolution of the patient [7].

With regard to the onset of the treatment, although some authors are in favor of immediate mobilization [23] (after the surgical intervention), most of them recommend mobilization within 10 to 20 days after the operation [8, 10, 20], in order to allow the soft tissue to scar during that period.

Other authors support the idea that an active movement of the elbow after surgery promotes the stability of the elbow through the recruitment of motor units which help to achieve a dynamic stabilization of the elbow [9]. The active motion of the joint stimulates arterial flow and venous and lymphatic fluid return [18].

As we pointed out before, the immobilization time and the subsequent onset of the rehabilitation treatment is still subject to debate, although it is widely accepted that a long immobilization may contribute to higher rigidity and functional loss, and to poorer results [9, 10, 21] caused by a higher adherence of the joint capsule and the surrounding soft tissue [21].

Nevertheless we consider that the immobilization period should vary depending on the lesion of the patient and an individual assessment of each case must be carried out with regard to the immobilization period and the rehabilitation treatment. In our series, the average immobilization time was 29 days (considering that this time period comprises a static orthosis after which a dynamic orthosis placed).

4.2. Rehabilitation Treatment

With regard to the different modalities of rehabilitation treatment or treatment techniques in cases of TTIE, we may highlight that there is no established consensus either [9, 10, 23]. There are some recommendations or treatment approaches which are used more frequently and which may be found in the literature, but with weak evidence which will now be analyzed. In view of this situation, we want to highlight

the fact that our study offers in detail the rehabilitation treatment program implemented (based on the results and findings found in the literature), in order to guarantee its reproducibility in future studies with which comparisons may be established.

The recommendations and findings that show in the literature may be summarized as follows:

The initial objective of the treatment is the control of pain and edema, as well as joint release [9]. Once that the edema and the pain have subsided, the active mobility program can be started at an early stage [21]. Afterwards, and already in the subacute stage, the joint release program will be accompanied by a therapy for muscle promotion and strengthening, generally after 8 to 12 weeks in complex fractures and after week 6 in simple fractures [9].

Active and active-assisted kinesiotherapy is more commonly used and recommended than passive kinesiotherapy for joint improvement and release, with better results [7, 9, 10, 21, 20]. The muscles which surround the elbow lose the ability to generate enough tension after the trauma, and the training plan includes exercises for muscle improvement in order to strengthen the joint [18]. These exercises may be implemented in the fibroblastic stage of scarring, approximately at week 6 after the surgical intervention [18].

The use of superficial thermotherapy is recommended [18], although there is no scientific evidence in this regard [9, 10], in order to add elasticity to the capsule and the soft tissue, and to improve tissue extensibility [7, 9].

Cryotherapy is commonly used after the treatment session with an analgesic and anti-inflammatory objective [7, 9].

Ultrasounds, magnetotherapy, acupuncture, laser, arthromotor units or pressotherapy are not indicated in this pathology [7, 9].

Massages should be applied very selectively, and never routinely, due to the risk of formation of calcifications derived from the increased vascularization they induce [7, 9]. It should only be used in the treatment of wounds and scars, around 3-4 weeks after surgery, in order to desensitize the area, assist with the compression in order to reduce scar hypertrophy and add traction tension to assist in the remodeling of the scar tissue [21].

It is essential to educate the patients and to teach them a program of in-house exercises, both in the immobilization stage, in order to prevent the rigidity of the associated joints (wrist and shoulder) and during the rehabilitation treatment [8, 21].

With regard to the duration of the treatment, the optimum time of rehabilitation and the number of sessions which will be required is an unknown factor which varies according to the type of patient [10]. In our series the average time was three months, and the average number of sessions was 66, although it may take up to 6-12 months to recover the strength [9].

4.3. Functional Results

With regard to the recovery of arc of motion, the final arc was 104 (range: 150/72.2), with an average pronation of 85.45 (range: 90/75) and a supination of 89.09 (range: 90/80). This is considered to be good mobility in comparison with similar studies [13].

In the cases in which the flexion and extension arc was not within acceptable limits, we assessed the possibility of a new operation to increase the arc of motion. A flexion and extension arc close to 120/-30 degrees with approximately 50/50 degrees of pronation and supination was considered acceptable for most DLAs [7, 8, 10]. For their part, some authors claim that a range of 120/-60 degrees would be enough to carry out most DLAs with minimum difficulty [8].

With regard to the results assessed through the Mayo index, a good result was obtained in most cases (Figure **5**), like studies of Pugh and McKee and Mullati [13, 24].

Finally, we want to mention that the number of patients included in our study was low and that a larger sample may alter the results. However, the combination of a surgical treatment protocol and an individualized rehabilitation protocol may partially account for the good results. This study has some limitations, like the absence of a follow up period, the assessment was retrospective and the number of patients was low. Also, the surgical treatment was not uniform in all cases. However, the fact that the study deals with a rare pathology and it sets out a comprehensive approach and a follow-up stage in which no patients were lost adds relevance to the results of our clinical findings.

We also point out the fact that the study includes a detailed description of the treatment protocol implemented by our service which guarantees its

reproducibility by other authors, so that the results can be compared and the data may be extrapolated to another population, different from the one treated in our service.

REFERENCES

[1] Morrey BF. Current concepts in the management of complex elbowtrauma. Surgeon 2009; 7(3): 151-61. http://dx.doi.org/10.1016/S1479-666X(09)80039-5

[2] Chan K, Graham Kingi J, Kenneth W and Faberi J. Treatment of complex elbow fracture-dislocations. Curr Rev Musculoskelet Med 2016; 9: 185-189. http://dx.doi.org/10.1007/s12178-016-9337-8

[3] Pike JM, Athwal GS, Faber KJ and King GJ. Radial head fractures-an update. JH and Surg Am 2009; 34(3): 557-65. http://dx.doi.org/10.1016/j.jhsa.2008.12.024

[4] Kuschner SH, Sharpe F and Elbow Dislocations. In: Baker CL, Plancher KD, editors. Operative Treatment of Elbow Injuries. New York: Springer Verlag 2002; 253-8. http://dx.doi.org/10.1007/b97243

[5] Chemama B, Bonnevialle N, Peter O, Mansat P and Bonnevialle P. Terrible triad injury of the elbow: How to improve outcomes? Orthop Traumatol Surg Res 2010; 96: 147-154. http://dx.doi.org/10.1016/j.otsr.2009.11.009

[6] Rommens PM, Küchle R, Schneider RU and Reuter M. Olecranon fractures in adults: factors influencing outcome. Injury 2004; 35(11): 1149-57. http://dx.doi.org/10.1016/j.injury.2003.12.002

[7] Barcelona Aparición, Gomá Alonso M, Miralles Rull I and MontullMorer S. Tratamiento fisioterapéutico de la rigidez de codo. Fisioterapia1999; 21: 2-9.

[8] Rivera-Garcia VE, Geanini-Yagüez A, Martin-Fraile ME, Idoate-Gil A and Díaz-González P. Valoración functional de la fractura-luxación de codo. Rehabilitación (Madr) 2000; 34(5): 354-358.

[9] Macdermid JC, Vicent JI, Kieffer L, Kieffer A, Demaiter J and Macintosh S. A survey of practice patterns for rehabilitation post elbow fracture. Open Orthop J 2012; 6: 429-39. http://dx.doi.org/10.2174/1874325001206010429

[10] Wang YL, Chang WN, Hsu CJ, SUN SF, Wang JL and Wong CY. The recovery of elbow range of motion after treatment of supracondylar and lateral condylar fractures of the distal humerus in children. J OrthopTrauma 2009; 23(2): 120-5. http://dx.doi.org/10.1097/BOT.0b013e318193c2f3

[11] Uresh S. Type 4 Capitellum fractures: Diagnosis and treatment strategies. Indian J Orthop 2009; 43(3): 286-91. http://dx.doi.org/10.4103/0019-5413.53460

[12] Morrey BF and O'Driscoll SW. Fractures of the coronoid and complex Instability of the Elbow. In: Morrey BF, editor. Master Techniques in Orthopaedic Surgery: The Elbow. 2nd ed. Philadelphia: Lippincott Williamsand Wilkins 2002; 128-38.

[13] Brigato RM, Mouraria GG, Kikuta FK, Coelho SP, Cruz MA and Zoppi Filho A. Functional evaluation of patients with surgically treated terrible triad of the elbow. Acta Ortop Bras. [online] 2015; 23(3): 138-41. http://dx.doi.org/10.1590/1413-78522015230301008

[14] Ozel O and Demircay E. Review of management of unstable elbow fractures. World J Orthop 2016; 7(1): 50-54 http://dx.doi.org/10.5312/wjo.v7.i1.50

[15] Johnston GW. A follow–up of one hundred cases of fractures of the head of the radius with a review of the literature. Ulster Med J 1962; 31: 51-6.

[16] Regan W and Morey B. Fractures of the coronoid process of the ulna. J Bone Joint Surg Am 1989; 71: 1348-54.

[17] Gill DR and Morrey BF. The Conrad-Morey total elbow arthroplasty in patients who have rheumatoid arthritis. A ten to fifteen-year follow–up study. J Bone Joint Surg Am 1998; 80: 1327-35.

[18] Pipicelli JG, Chinchalkar SJ, Grewal R and Athwal GS. Rehabilitation considerations in the management of terrible Triad Injury to the Elbow. Tech Hand Surg 2011; 15: 198-208. http://dx.doi.org/10.1097/BTH.0b013e31822911fd

[19] Rodriguez-Martin J, Pretell-Mazzini J, Andres-Esteban EM and Larrainzar-Garijo R. Outcomes after terrible triads of the elbow treated with the current surgical protocols. Int Orthop 2011; 35: 851-860. http://dx.doi.org/10.1007/s00264-010-1024-6

[20] Lee S, Park MS, Chung CY, Kwon DG, Sung KH, Kim TW, et al. Consensus and different perspectives on treatment of supracondylar fractures in children. Clin Orthop Surg 2012; 4(1): 91-7. http://dx.doi.org/10.4055/cios.2012.4.1.91

[21] Bano KY and Kahlon RS. Radial head fractures—advanced techniques in surgical management and rehabilitation. J Hand Ther 2006; 19(2): 114-35. http://dx.doi.org/10.1197/j.jht.2006.02.011

[22] Armstrong A. The terrible triad injury of elbow. CurrOpinOrthop 2005; 16: 267-70. http://dx.doi.org/10.1097/01.bco.0000169387.61611.28

[23] Pugh DM, Wild LM, Schemitsch EH, King GJ and McKee MD. Standard surgical protocol to treat elbow dislocations with radial head and coronoid fractures. J Bone Joint Surg Am 2004; 86A: 1122-1130.

[24] Pugh D and McKee M. The Terrible triad injury. Tech hand up extreme Surg 2002; 6: 21-29.

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