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Research article

Is it possible a rehabilitation protocol for the treatment of diaphyseal humeral fractures treated by external modular fixation? Our Preliminary experience.

Michele Bisaccia [(1)], Luigi Meccariello[(2)], Giuseppe Rinonapoli[(1)], Gabriele Falzarano[(2)], Giovanni Colleluori[(1)], Luigi Piscitelli[(1)], Andrea Schiavone[(1)], Cristina Ibáñez Vicente[(1)], Olga Bisaccia[(3)], Emma Cistaro[(4)], Mauro Ungaro[(1)], Paolo Ceccarini[(1)], Marco Scrivano[(5)], Umberto Mercurio[(5)], Auro Caraffa[(1)]

[1)]Division of Orthopedics and Trauma Surgery, University of Perugia, S. Maria dellaMisericordia Hospital, Perugia, Italy

2)U.O.C.Orthopedics and Traumatology, Azienda Ospedaliera "Gaetano Rummo", Benevento, Italy

3)Department of Diagnostic Imaging, "Niguarda Ca' Granda" Hospital, Milano Italy

4) M.D.Hospital of Cosenza, Cosenza, Italy

5) M.D.University of Perugia, Perugia, Italy

Corresponding Author:

Luigi Meccariello, MD

U.O.C.Orthopedics and Traumatology, Department of Emergency Azienda Ospedaliera "Gaetano Rummo",

Via dell'Angelo 1, Benevento, Italy

E-mail: drlordmec@gmail.com

Phone: +393299419574

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ABSTRACT

Humeral shaft fractures make up approximately 1% to 3% of all fractures. They have a bimodal distribution with the highest incidence observed in young male patients and women between 60 and 80 years. About 2% of these fractures are open. Surgery can be performed with intramedullary nailing, plates and screws and with external fixation. None of these techniques are universally accepted and each method has its own advantages and its disadvantages.In this study, we explain our rehabilitation protocol in patients treated with E.F. for humeral shaft fracture. Our rehabilitation protocol aims to restore the arc movement and the strength of the shoulder. To this regard, specific attention is paid to increasing the dynamic stability and restoring both the motility and strength of the shoulder and elbow.

Key Words: Humeral Fractures, Thirty Diaphyseal Fractures, External Fixation, Physiotherapy Protocol.

Introduction

We annually treat around thirty diaphyseal fractures with external fixation(EF) at our department and in this review here we report on the protocol and post-surgical rehabilitation we carry out for these patients . The main indications for the use of external fixation in humeral shaft fractures are open fractures, poly-traumatized patients, patients with severe skin problems and those with gunshots wounds [1,2,3,4,5].

We have extended these indications in our practice given the ease and rapidity of application, both ease of reduction and good stabilization of the fracture, the possibility of maintaining the reduction during the healing time and the possibility to correct any loss of reduction during the treatment. Furthermore, it is considered a less invasive technique, compared to others, and does not cause injuries to the rotator cuff or elbow joint level. A key feature that differentiates E.F. from other treatments is its ability to ensure adequate stability without excessive stiffness; which is crucial for a good healing of the fracture.

External fixation has been shown to enable a fast and safe reduction, stable fixation and early mobilization with minimal complications [6]. Moreover, good or excellent results accompanied with minimum complications have been reported, compared to open reduction and internal fixation [7,8].

MATERIAL AND METHODS

We analyzed the diaphyseal fractures of the humerus treated at our department utilizing external fixation between 2011 and 2016.We have classified these fractures according to the AO classification: 56% type A, 29% type B and 15% type C. For all cases we used the Hoffman II fixator by Stryker®, positioning pins in the following manner:2 or 3 proximal, 3 distal and 1 intermediate for stabilization .We removed the fixator, on average, after about 12 weeks.

General concepts in post –traumatic rehabilitation of the shoulder

Whenever a rehabilitation program of the shoulder is elaborated the whole kinetic chain needs to be evaluated, considering the importance of the proximal stability for the distal mobility [9].Muscle strengthening exercises specific for the shoulder, especially for the rotator cuff, have been the subject of many scientific papers to date.Jobe and Moynes[10]have affirmed that the supraspinatus is better exercised, with the arm flexed at 90°, and completely intra-rotated. The infraspinatus and the teres minor are exercised in lateral decubitus with the arm held at the side and the elbow bent 90° . The subscapular in a supine position with the arm at the side and the elbow flexed at a 90°. Kelly reports that the best position for isolating the supraspinous, with minimum activation of the subspinous, is with the arm elevated at 90° in the scapular plane and at 45° external rotation of the humerus. Moreover, physical methods can be employed after surgery. Among these, cryotherapy is useful both pre and post exercise and is recommended for the initial phases to reduce the inflammatory process as well as for preventive measures following the resolution of the acute phase.

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It is also possible to utilize various machines to achieve specific objectives. Among these, an ergometer can be used in the initial phases of rehabilitation to restore arc movement and in the final phases so to increase muscle resistance. Whereas the inertial machine fosters coordination and expediency along with favoring eccentric strengthening particularly those muscles involved in the decelerating of the shoulder. Isokinetic device can be utilized at a high speed for increasing muscular resistance as well as allowing to exercise eccentric contraction of the posterior muscles and the concentric contraction of the anterior cuff muscles. Manual counter resistance exercises are useful for promoting both agonistic contraction and facilitating muscle synergy. Elastic bands are versatile instruments for strengthening the musculature according to diagonal schemes.

Another issue to consider following a humeral fracture is the so called "pain arc", which is characterized by specific points where pain intensifies along the entire arc movement; along the arc of movement there can be up to 3 or 4 points of arrest with the most commonly reported points when the arm is elevated 70° to 120°.

Our Protocol

Our rehabilitation protocol aims to restore the arc movement and the strength of the shoulder. To this regard, specific attention is paid to increasing the dynamic stability and restoring both the motility and strength of the shoulder and elbow. All patients are discharged from hospital between the 2nd and 4th post-operative days (average 2.9 days). We perform clinical follow-up every week for the first month and then every two weeks until the removal of the fixator. Rx are performed every 4 weeks to evaluate fracture consolidation. Patients are asked to medicate daily the pins with Amukine ® until the fixator is removed and at every follow-up visit the pins are checked and the presence of infection is excluded [12].

At two-weeks post surgery, surgical stitches and bandages are removed. Therein patients are instructed to wash their hands and use a fresh swab for each pin, remove any crust, and then dry the pins with a fresh swab. At this time, with the fixator in place, patients can take a shower as long as it is followed by complete drying. Immersing in a tub or swimming pool, however, is forbidden.

Up until the third post-surgery day while in hospital, patients are encouraged to perform active and passive mobilization of their elbow, wrist and hand.

From hospital discharge, patients are instructed to perform elbow, wrist and hand active ROM, pendulum exercises (clockwise and counterclockwise) for a full week ; beginning with supine external rotation with a cane at not more than 20° . Patients are told to perform 30min sessions of this exercise 3-5 times daily and carry out 10 min sessions of cryotherapy 3-4 times daily.

In the case of pain, patients are advised they can take up to 3 gr of paracetamol daily.

At one week post-surgery the first in-hospital check is performed and the second cycle of exercises is initiated up until week VI: assisted and active forward elevation, pulley exercises, isometric exercises for internal rotation (IR), external rotation (ER), extension and abduction and the beginning of supine active extension-flexion (EF).

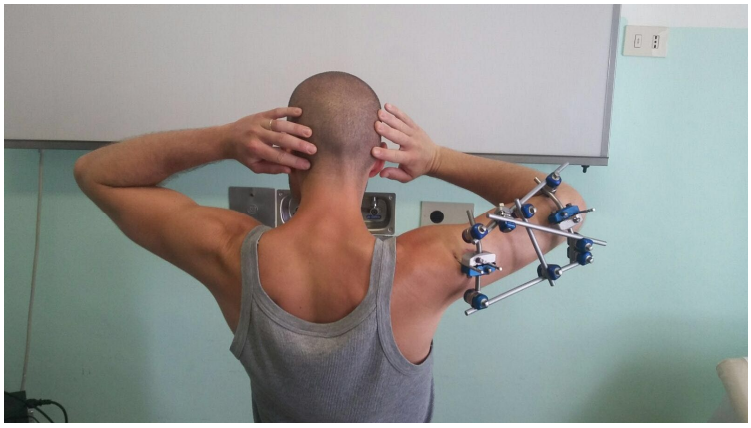
Following an ulterior follow up, the third phase is started which runs from week VII to the removal of the fixator (by week XII).

In this phase the exercises consist of positioning the patient erect during EF, the utilization of therabands to progressively strengthen the IR, ER, flexion, abduction and extension with the aim of progressively reinforcing the deltoid and rotator cuff; initiating stretching exercises in order to progressively increase ROM in all directions and the start of light lifting.

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Upon the removal of the external fixator, the final phase of rehabilitation is initiated which consists of muscle strengthening exercises , a complete restoring of ROM and the strengthening of bicep, triceps, deltoid and rotator cuff muscles.

If the patient is employed in a sedentary profession, a return to work is allowed. While if the patient is occupied in manual work, a recommendation on returning to work is decided by the surgeon. Finally, patients can drive an automobile at around 15 days from the fixator removal.



Example of the rehabilitation phase.

PROTOCOL SCHEME

While in hospital

- Active and passive mobilization of the elbow, wrist and hand

Week I

- Elbow, wrist and hand active ROM and pendulum exercises both clockwise and counterclockwise
- Begin supine external rotation with a cane until 20° abduction: 30 min sessions 3-5 times daily
- Cryotherapy 10min, 3-4 times daily.
- In the case of pain: up to 3gr of paracetamol daily

WeeksII to VI

- Assisted and active forward elevation
- Pulley exercises
- Isometric exercises for IR, ER, extension and abduction
- Begin supine active EF.

Week VII up until the removal of EF (within 12 weeks).

- Position the patient erect during EF,
- Utilizetherabands to reinforce progressively IR, ER, flexion, abduction and extension,

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- Initiate stretching exercises to progressively increase ROM in all directions.
- Start lightweightlifting.

Upon removal of the external fixation:

- Initiatemusclestrengtheningexercises
- Initiate exercises to completely recover ROM in all directions
- Begin exercises to reinforce bicep, tricep,deltoid and rototary cuff muscles.
- Sedentary work: allowed after removal of EF
- Manual job: at the discretion of the surgeon.
- Swimming: allowed after the pintracks have closed
- Golf: one month after EF removal
- Automobile driving: around 15 days after fixator removal

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HUMAN AND ANIMAL RIGHT: For this type of study is not required any statement relating to studies on humans and animals.

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