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Role of ligamentotaxis in management of comminuted intra/juxta articular fractures

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Background: Comminuted intra/juxta-articular fractures are the most difficult one's to treat in orthopaedics as far as functional & cosmetic results are concerned. The basic aim of our study was to analyse the efficacy of distractors / external fixator in various forms using principle of ligamentotaxis to achieve a high degree of functional & cosmetic results in these fractures.

Methods: This consecutive prospective study comprised of thirty cases of comminuted intra/juxta-articular fractures, varying from grade 0 to grade III B Gustilo & Anderson classification, treated by the principle of ligamentotaxis using distracter / ex fix in its various forms.

Results: Average time of union varied from 3 weeks to 20 weeks depending upon the bone involved. Commonest complication was pin tract infection (13), while delayed union (3) and mal-union (one) was also observed. Good range of motion at the involved joint was observed in majority of the cases. As per modified clinical scoring system of Green and O'Brien (1978) excellent to good results were seen in 73.34% cases and fair to poor results in 26.66%.

Conclusion: Thus we conclude that ligamentotaxis is an excellent method for the management of comminuted intra/juxta articular fractures. It not only obviates the need of ORIF and/or POP cast but also gives better functional results. It is very useful in compound comminuted fractures around joints where other methods are contraindicated.

Key-words: Comminuted, Intra/juxta-articular fractures, Ligamentotaxis, Distracter.

Introduction

With increasing mechanization and high speed vehicular traffic the incidence of orthopaedic trauma including comminuted intra/juxta articular fractures is on rise. Management of comminuted intra/juxta-articular fractures continue to be a therapeutic problem & challenge for the orthopedic surgeon. The treatment problem includes not only achieving union in right anatomical position but also good functional results as far as joint mobility is concerned. There are various methods of reducing and maintaining the reduction of the fracture published in the literature, which include the pins and cast, per-cutaneous pinning, P.O.P. cast, open reduction with internal fixation and external fixator or distractor using the principles of ligamentotaxis.

Ligamentotaxis is the term used to emphasize that, for traction to be effective it must be balanced by counter traction provided by ligaments and soft tissue surrounding the bone[1]. The pull and the counter pull restore the length and guides alignment of the fracture fragments, which are otherwise difficult to control[2]. This tissue tension can be maintained by external fixator or by a distracter.

The most important and demanding part of operative fracture treatment concerns the reduction and correct alignment of the fracture fragments, which must be gentle to the bone and surrounding soft parts to preserve the essential blood supply to all tissues[3]. The present consecutive prospective study comprises of 30 cases of comminuted intra/juxta articular fractures admitted in our institution, managed by the principle of ligamentotaxis.

Material and methods

Thirty cases of either sex with comminuted intra/juxta-articular fractures, admitted in our institution were taken up for the present study. The patient was operated under appropriate anesthesia. If there was any wound, swab for culture sensitivity was sent, thorough debridement was done and the wound was properly cleaned. Then the fracture was stabilized by trans-articular device. Traction on the ligaments and soft tissue around the fracture was applied to reduce the fracture according to the principle of ligamentotaxis and reduction was maintained using the same implant. Different implants were used depending upon the bone involved.

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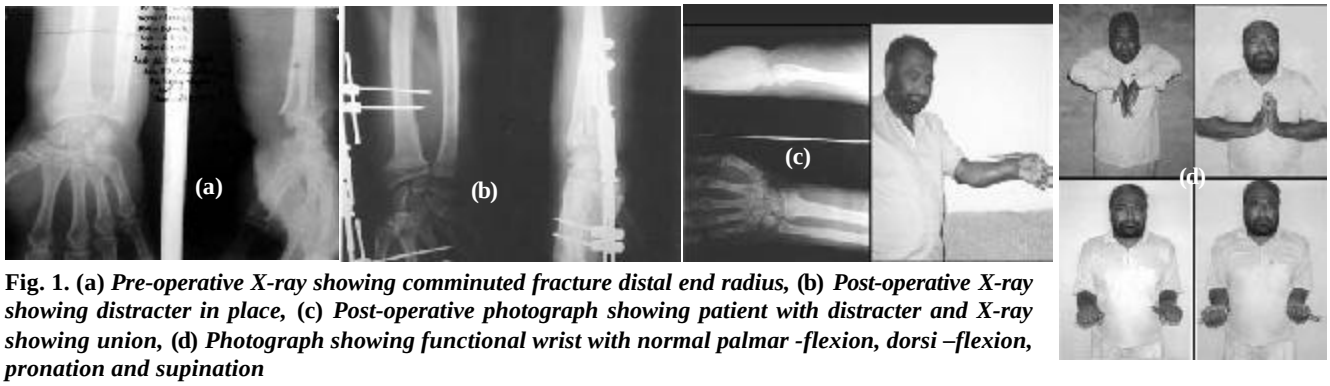

Fig. 1. (a) ***Pre-operative X-ray showing comminuted fracture distal end radius,*** **(b)** ***Post-operative X-ray showing distracter in place,*** **(c)** ***Post-operative photograph showing patient with distracter and X-ray showing union,*** **(d)** ***Photograph showing functional wrist with normal palmar -flexion, dorsi –flexion, pronation and supination***

For fractures around wrist JESS turn buckle distraction/ compression device, simple distracter for wrist, external fixator with Schanz pins or K-wires & link joints were used. For phalangeal & metacarpal fractures JESS distraction/ compression device, Pins and rubbers traction system and external fixator using K-wires & link joints were used. For metatarsal fracture JESS distraction/compression device was used. For distal end tibia we used external fixator using Schanz pins and tubular rods and Ilizarov's ring fixator depending upon the requirement of fracture anatomy. Distracter was preferred as it can help in future adjustment. In case there was extensive comminution / bone loss bone grafting was planned either at the same time or later, depending upon the soft tissue condition. Skin grafting when indicated was done at appropriate time. Entry points of wires/pins were covered with betadine soaked gauge for 24-48 hours. After that, patient was advised to clean the area with antiseptic lotion twice daily. Final functional results were evaluated according to modified clinical scoring system of Green and O'Brien[4] as shown in table no. I.

Results

In our study the commonest mode of injury was road traffic accident (17), followed by fall of heavy object (6), assault by direct blow (4) and machine injury (3). Distal end radius was the most commonly treated bone using ligamentotaxis principles (13), followed by metacarpals & phalanges (12), tibia (3) and metatarsals & toes (2). JESS distracter was the most commonly used implant (17), followed by external fixator (6), Pins & rubbers traction system (6) and Ilizarov's ring fixator (1). Duration of treatment varied from 8.38 weeks (range 5-20 weeks) for distal end radius to 4.67 months (range 3-7 months) for proximal tibia. Metacarpals, metatarsals, phalanges and toes generally united with in 4 weeks (range 3-8 weeks). Additional procedures such as split thickness skin grafting (2), minimal internal fixation with inter-fragmentary screw (2), bone grafting (1), readjustment (3) and tendon repair (2) were done where ever indicated.

Complications seen included pin tract infection (13), soft tissue infection (8), and compound fracture resulting in bone infection (6), delayed union (3) and mal-union (1). No non-union was observed in our study.

According to Green and O'Brien criteria pain, muscle strength, range of motion and functional status of the patient were recorded for evaluating the final functional results of our study. Pain at fracture site was absent in 19 patients but mild or occasional pain was complained by 11 patients. No patient had moderate but tolerable or severe pain at fracture site. Range of motion at the affected joint was recorded using gonio-meter and compared with that of normal side. It returned to 100% in only three patients, 19 patients had 75-99% range of motion, five patients had 50-75% range of motion and remaining three had 25-49% range of motion. Muscle strength at the involved joint was 100% in ten patients, 75-99% in ten patients, 50-74% in seven patients and 0-24% in three patients when compared with normal side. For functional status 27 of our patients returned to regular employment and three patients had restricted employment. No patient was unemployed or unable to work. Results were graded as per modified clinical scoring system of Green and O'Brien (Table I). Final functional results of our study were excellent in eight cases, good in 14, fair in two and poor in six patients.

Discussion

Management of comminuted intra/juxta articular fractures has always posed a challenge to the orthopedic surgeon in the terms of reduction of fracture, maintenance of reduction while the fracture unites and mobility of joint after the fracture union. Post union functioning of the joint is the most difficult part of the management of the comminuted intra/juxta fractures. Patient's expectations are very high and good results are not always possible due to severity of injury, soft

tissue damage and the periarticular fibrosis that result in the process of healing.

Commonest complication seen with external fixation is pin tract infection (10-13%)[5,6], probably due to poor patient compliance or angry looking inflammation around the pin tract without pus formation. Incidence of other infections can be high due to their being compound fractures and crush injuries of hand. Other complications are delayed union and malunion[7], and neurovascular injury[8].

Pain, an important criteria in the final functional outcome was absent in 19 cases of our series on follow-up after fracture union. About one third cases (36.67%) which included mainly compound fractures and crushed hand injuries had mild pain on activity at follow up. González et al demonstrated absence of pain in 65% of the cases at follow up[5].

Range of motion of the affected joint after fracture union was 100% in 3 patients and between 75-99% of the normal in 19 patients. This is comparable with Duteille et al[6] and Deshmukh et al[9].

Muscle strength around the affected joint was the third factor considered in final functional outcome and it was also assessed as percentage of normal limb muscle strength at the affected joint. One third patients had full recovery in muscle strength, poor recovery was seen in 3 cases of crush injury who had <25% of the normal muscle strength and the main factor responsible was associated soft tissue injury. Ten patients had 75-99% of normal muscle strength. Chan et al[8] reported significant loss of grip strength in 37.5% patients. Deshmukh et al[9] and Cannegieter and Juttmann[7] have shown average grip strength of 92-95% of normal in all the patients. This comparatively poor recovery of muscle strength is because our study included all type of injuries from simple fractures to compound fractures and crush injuries.

Functional status of the patient was assessed from whether he was able to return to his regular employment or employment was restricted. Majority of our patients (90%) were able to return to their regular employment, only three patients had restricted employment and this was due to significant loss of muscle strength in all the cases of crush injury hand. This is better than González et al[5] (60%) but comparable to Deshmukh et al[9] (92.3%).

Final outcome in our series is comparable with that of the other series[7,8,10,11]. We achieved 73.34% good or excellent results. From the above study it is clear that management of comminuted intra/juxta-articular fractures with distracters / ex fix in various forms using principle of ligamentotaxis is quite an effective method to achieve a high degree of functional and cosmetic results, especially when the fracture is associated with soft tissue injury the extent that it is not compatible with other methods of fracture treatment like ORIF and POP cast.

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