Case Report

Esmarch technique for maintaining reduction during intramedullary nailing of tibial shaft fractures

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SUMMARY

Given the frequency of tibial shaft fractures that undergo intramedullary fixation, the aim of this case report is to demonstrate an easily reproducible technique for fracture reduction maintenance intra-operatively using a non-invasive technique. Our technique utilizes an Esmarch bandage applied in specific fashion particularly as a means of maintaining fracture reduction during reaming and insertion of the intramedullary device. When compared to other well-described techniques of tibial shaft fracture reduction and preservation, this method is of minimal insult to soft tissues and without need for additional incisions or implantation of additional devices. Furthermore, this technique is of little cost or increased equipment utilization in the operative environment.

Introduction

Intramedullary (IM) nailing of tibia fractures has become the standard of care for treating extra-articular tibia shaft fractures [1]. IM nail fixation offers advantages over other treatment methods such as plate fixation, as patients can weight bear earlier and the procedure can be performed without large skin incision over a potentially compromised soft tissue envelope. Furthermore, improvements with techniques and implants have resulted in malalignment rates of less than 8% [2]. Achieving and maintaining reduction of the fracture is vital during this procedure, as proper placement of the IM nail is reliant upon a reduction that is sustained throughout the process of reaming, nail insertion, and placement of interlocking screws.

Well described reduction techniques

There are a number of previously described reduction devices and techniques that range widely in nature, all involving methods of maintaining fracture reduction throughout the procedure. One method involves placement of a pointed reduction forceps to maintain the tibia in alignment. This technique is often described as highly conducive for open tibia fractures, as in the case of closed fractures, incisions are needed to aid placement of the clamp. A drawback of this technique is that clamps are at risk of loosening due to manipulation of the extremity while reaming and insertion of the IM nail [3].

Another technique previously described involves the placement of Poller or blocking screws in order to guide the passage of the IM nail. The screws are ideally placed prior to reaming and nail placement, however screws can be placed later to correct deformity with nail removal and subsequent repeated reaming or to enhance construct stability in a metaphyseal fracture with poor bone quality or comminution. Screws are placed to prevent deformity of the fracture by narrowing the IM canal and can help mitigate

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Fig. 1. Initial AP and lateral radiograph of the tibial midshaft fracture demonstrating complete displacement, approximately two centimeters of shortening and 30° of apex posterior angulation.

potential malalignment. However, the use of blocking screws can generate significant forces and the operative surgeon must be aware of possible fracture propagation [4].

Plate-assisted reduction uses a 3.5-mm dynamic compression plate (DCP) or limited contact dynamic compression plate (LC-DCP) with a minimum of two unicortical screws on both sides of the fracture. This technique is also helpful in an open fracture, as reduction can be achieved by placing the plate directly over the tibia. It has been described in closed fractures when alignment cannot be obtained or maintained with other techniques, however it does necessitate additional incisions or soft tissue dissection. In certain cases, the plate can be retained to add additional stability [5].

A universal distractor can be placed medially to achieve reduction and prevent valgus deformity. The Schanz pins, as a secondary function, can also serve as blocking devices to provide guidance for the IM nail during placement.

Esmarch reduction technique

In this demonstrative case, a midshaft tibial shaft fracture occurred in an 18 year-old female. Initial radiographs demonstrated a tibial midshaft fracture with complete displacement, two centimeters of shortening and 30 degrees of apex posterior angulation (Fig. 1A, B). Although the Esmarch bandage is most commonly used for the purpose of exsanguination prior to placement of a tourniquet, in this case the Esmarch bandage can be utilized as an aid particularly to help maintain alignment during guidewire placement, reaming, and nail insertion [6]. Care must be taken to not apply the bandage too tightly as significant pressure can be created with multiple wraps of the Esmarch bandage, found to be above 600 mm-Hg after the third wrap when stretching of the bandage is performed with each wrap as opposed to over the total length initially [7]. The fractured tibia is held in a reduced position

Fig. 2. Operative photograph demonstrating the placement of the Esmarch bandage to the lower extremity to maintain reduction of the tibial shaft fracture.

Fig. 3. Intra-operative AP and lateral fluoroscopic images demonstrating reduction of the tibial shaft fracture with use of the Esmarch bandage.

after manipulation of the leg, confirmed on biplanar intra-operative fluoroscopy. Starting distal to the fracture near the level of the ankle, the Esmarch bandage is wrapped from distal to proximal, bypassing the fracture by approximately 10 cm. The Esmarch is then wrapped in a distal direction and wrapped over the fracture site an additional time, tucking the remainder of the Esmarch over the area of initial apex angulation to serve as a strut (Fig. 2). With this method, the surgeon can continue with the procedure with minimal effort utilized to maintain the reduction and stabilization (Fig. 3A, B). Final fluoroscopic images are shown confirming reduction and intramedullary nail placement of the tibial shaft fracture (Fig. 4A, B, C, D).

The advantages to the Esmarch technique include minimizing the amount of soft tissue damage compared to other techniques. Pointed reduction forceps necessitate two additional incisions, as does the plate-assisted reduction, with the possibility of a large incision for direct plate placement. Blocking screws can cause fracture propagation during placement. It should be noted that there is a possibility of Esmarch loosening during manipulation of the extremity while reaming and insertion of the intramedullary nail, however the force of friction is increased due to total contact surface area as compared to the pointed reduction clamps which only have two points of fixation and increased potential for loosening.

Summary

When compared with other reduction techniques in IM nail of tibia shaft fractures, we feel that this Esmarch technique of reduction maintenance offers significant ease of reduction without a significant increase in cost, equipment utilization or intra-operative morbidity. Utilizing this technique does not preclude any of the other reduction techniques described, and it does not involve additional incisions or placement of additional devices.

Fig. 4. Post-operative images confirming reduction and intramedullary nail placement of the tibial shaft fracture.

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