Technical Note

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Uses of Wooden Angle Frame in Orthopaedics !

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Abstract

An appropriate positioning is crucial for a successful surgery and good outcome. Many methods of supporting lower extremity are used in operating room. The authors describe a wooden device, which is made of wood, to facilitate lower extremity surgery. The wooden angle frame is radiolucent and facilitate various surgical procedures. This can reduce assistant dependence, reduce radiation exposure and it is cost effective.

Keywords: *angle frame, radiolucent support, lower limb surgery , wooden frame*

Introduction

Lower limb fractures are complex to treat because of muscle pull and fracture pattern. An appropriate positioning is essential for good surgical outcome. A simple wooden angle frame can be used in variety of fractures as well as post- surgery rehabilitation. Produced from local available material, it can be manufactured at local place and simple design are few benefits. Along with that as it is made up of radiolucent wooden material and radiolucent bolts so it can be used without hinderance in surgeries. The advantages are less manpower, easy imaging access but less radiation exposure, and more cost-effectiveness. It is made from three radiolucent wooden plates. The adjustable plate and base plate are connected by hinge which is secured by radiolucent plastic bolts. The two plates can move freely between a folded or unfolded position from a range of 0 to 180 degrees. The locking mechanism is created by making slots in base plate. Angle frame can be repeatedly used after folding, packaging and autoclaving. (figure 1)

Various uses can be enumerated as

1. Distal femur fractures
2. Proximal tibia fractures
3. Floating knee
4. Tibia shaft fractures

1. Distal femur fractures

Distal femur fractures are difficult to reduce due to muscle forces acting on fracture fragment. The shortening is caused by the pull of the quadriceps and hamstrings, while a varus, extension deformity results from the unopposed pull of the adductors and the gastrocnemius, respectively. Intraarticular involvement most commonly presents as a single fracture in the sagittal plane and occurs in the intercondylar area without direct extension into the femoro-tibia1 articulation but obvious involvement of the patellofemoral articulation. There can be fragmentation of the anterior femoral notch from a direct force applied through the patella. Displacement of this sagittal plane fracture is associated with rotational malalignment between the two condyles. Less commonly, one or more sagittal plane fractures or fractures occurring in the coronal plane (Hoffa fractures) may have direct extension to the articular surface[4]. If displaced, these fractures can have a direct impact on the function of the femoro-tibia articulation from the secondary effects of lost congruency. Knee flexion is required for fracture reduction, easy access for intraarticular fracture also to avoid overlapping of another leg while taking c-arm views.

Conventional method consists of flexing knee with bolster but it doesn't give steady support, angle frame gives stable support compared to that and also it can be adjusted according to requirement.[1][2] To nullify deforming gastrocnemius muscle force knee has to flex up to 30 degree while to correct hyperextension deformity at fracture site bolster underneath knee or Homan's retractor helps in fracture reduction. Failure to achieve this lead to malreduction[3] With angle frame this can be achieved, angle frame gives control over knee flexion in term of amount of degree which bolster fails to do .

2. Proximal tibia fractures

Intraarticular variation of fracture anatomy and various plane involvement makes it a challenging task to fix proximal tibia fractures. The relative lack of a periosteal sleeve in the proximal tibia of the skeletally mature adult makes accurate reduction difficult to achieve and harder yet to maintain. Few other forces also act to displace fractures of the proximal tibia. The intact extensor mechanism tends to cause apex anterior angulation. To minimize the effect of the patellar tendon, it has been suggested that the appropriate position for the knee to facilitate reduction is 20 degrees of flexion [6] The forces acting on the proximal tibia can create a propensity to malalignment. Different degree of knee flexion may be needed to visualize and reduce such fracture fragments. Angle frame helps in such scenario, as after flexion opposite leg comes out of vision and c arm zone, surgeon can visualize medial and lateral aspect without much difficulty. Intraarticular

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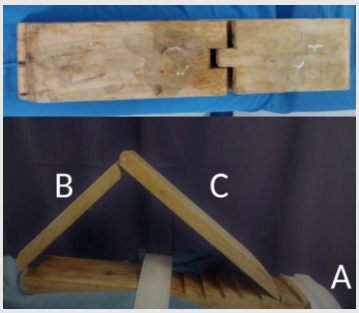

Figure 1: A- angle frame base plate, B & C - adjustable plates

visualization is also improved with knee flexion ultimately aiding for knee arthrotomy to visualize intraarticular reduction and if needed fixation of ACL/PCL avulsion.(figure 4)

3. Floating knee

By definition floating knee comprises of fracture of distal femur and proximal tibia making knee joint unstable.[7] The floating knee injury will always have two different fractures. These fractures range from simple diaphyseal to complex articular types. Retrograde Nailing femur first allows for quick stabilization of femoral fracture and permits positioning of the limb to provides sufficient knee flexion for tibial nailing. If plating is planned for distal femur fracture, angle frame helps in stabilizing unstable distal part and aids in reduction. In the existing literature, a sterile towel or bolster are used to maintain knee flexion, at the same time one or more assistants are needed to help stabilize the injured limb in a flexed position. It is difficult to achieve a strong support with the soft supports such as sterile towels, folded pillow, etc, so that the operation is performed while the injured knee is still in "floating" or "swing" state.[9] Angle frame is placed beneath popliteal fossa of the injured extremity. After adjusting appropriate angle, such device exhibits a much stronger supportive effects than others, thereby reducing the physical exertion of the surgeonsand also needs a minimum number of assistants.Advantage angle frame is no need to change bolsters in between fixation of femur and tibia and secondly proximal tibia fracture reduction also becomes easy due to controlled knee flexion.[8]

4. Tibia shaft fracture

With the development of intramedullary nail (IMN), tibial

Figure 2: Pre-operative and post-operative radiograph of tibia shaft fracture. Good reduction achieved with angle frame support

fractures became amenable to treatment with IMN. Although theoretically advantageous, IMN insertion for these fractures remains technically challenging. This is most notable with proximal third tibial fractures where the quadriceps and extensor mechanism complex attempts to extend the proximal fracture fragment, whereas the distal fragment remains flexed, resulting in a procurvatum deformity of the tibia.[10]Equally problematic is the fact that the metaphysis is conical in shape, making even a slightly angulated entry, result in a coronal plane (valgus/varus) deformity. IMN of the tibia is appropriate for proximal one-third, midshaft, and distal one-third tibial shaft fractures. IM nailing may be combined with open reduction and internal fixation of tibial plateau fractures and tibial plafond fractures. As the fracture becomes more proximal or distal, involving the metadiaphysis or metaphysis, control of alignment and reduction becomes more challenging and the use of adjunct reduction techniques and tools may be necessary. [11] There are many different ways of positioning the patient for tibial IMN - the use of a traction table with the knee flexed over a bolster in the popliteal fossa; hanging the leg over the end of the table. However, all of these techniques have limitations and difficulties, especially with regards to repeated repositioning of the fluoroscopic C-arm when trying to obtain AP and lateral views when checking the entry point, or for distal locking. In order to overcome these difficulties aangle frame is which aims to simplify the procedure for both surgeon and radiographer .The patient is positioned supine with angle of angle frame below popliteal fossa (figure 3); lateral images can be obtained with flexing angle frame and rotating C-arm and AP images with frame extended, whilst the C-arm in the AP position. Nailing in the semiextended position has recently gained significant attention in the orthopaedic literature , it is done in semiextended position using a medial parapatellar approach has been suggested by Tornetta and Collins as a method to avoid apex anterior deformities [11]. Over the last years, surgical instrumentation has been

Figure 3: Guide wire insertion on angle frame. C-arm positioning and surgeon's position

Figure 4: Proximal tibia fracture, position is assisted by angle frame. knee flexion achieved with angle frame, facilitating intra-articular fracture elevation and reduction

developed for this technique in order to allow the procedure to be performed in a safe fashion and with minimal damage to the adjacent intraarticular structures. The procedure is performed with the knee flexed approximately 15–20 degrees. (figure 3)

Conclusion

Wooden angle frame is a simple device which can be effectively used for lower extremity surgeries ranging from distal femur to distal tibia. This angle frame is radiolucent thus helps in reducing exposure of radiation, time for surgery and reduction difficulty. Being produced locally with available material, its uses can be explored more with further research.

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