NEW INSTRUMENTS FOR INTERNAL FIXATION OF FRACTURES USING MINIMALLY INVASIVE TECHNIQUES

Dr. eng. Comşa Stanca, sing. Gheorghiu Doina, eng. Ciobota Dan
National Institute of Research & Development for fine Mechanics Bucharest, Romania

Abstract - The main concern in medical field is in our days is protection and increase of life quality. The complexity of the surgery technique, competition with time, minimalization of the risks, are the elements which characterizes the modern medicine. The aim is to obtain quickly the maximum comfort of the patient with minimal risk. The ascended trend to improve the medical act is sustained by new surgery techniques and performing instruments. In this category is included conception of an instrumentation which diminish the area of injury and allowed the fastening of the fracture minimal invasive.

Keywords – instruments, fractures, techniques

Introduction
Traditional bone screws in plates have relied on two forces to create stable fixation: compression between opposing cortices and friction between the plate and bone caused by the screw. A tensile force is generated along the axis of the screw. This tensile force relies on the shear strength of the bone at the screw-thread interface. In particularly hard bone, higher forces can be generated, whereas in softer, osteopenic bone, the shear strength is lower and more susceptible to stripping.

As the screw is tightened, its increasing tensile force creates increasing compressive force between the plate and bone. This compression generates a friction force between the bone and plate. Applied load is transferred from the bone to the plate, across the fracture, and back to the bone. A tight frictional interface is key to the load transmission. As long as the applied (patient) load is less than the frictional force, the construct will remain stable.

Although a bicortical screw has inherent angular stability, when the patient load exceeds the maximum friction available, some collapse across the fracture gap results. This collapse is due to the lack of angular stability between the plate and the screw.

Unicortical bone screws have lower load carrying capability than bicortical screws. However, if a unicortical screw is locked to the plate, its load carrying capacity increases due to the angular stability. This locked screw-plate connection provides the path for load transmission to the plate. When comparing the load applied to a locked screw with a conventional screw, both screws are subjected to the same patient load. However, load on the bicortical, non-locked screw is always higher due to the initial tightening required to generate friction between the plate and the bone, which ensures stability of the construct.

The particularity of the stabilization and fastening system
The screws are in a special construction, (fig.1), and have a thread head for lock in the plate. The next thread will be fixed in the bone. The tip of the screw can drill the bone, to allow an easy penetration. Unicortical locking screws offer angular stability for optimal purchase and reduced stress on the bone. Locking screws perform drilling, tapping and locking to the plate.

Another feature is that the distal screw lengths and angles ensure that screws do not penetrate the far cortex or the intercondylar notch when the plate is placed properly. The screw lengths may be adjusted as necessary based on plate position and patient anatomy. (Fig.2)
Instruments for guide and insertion

The guide and insertion device for implant plate have a main component and a radiolucent extension, which allow the positioning of the existing holes on implant plate. The alignment of the three points of the insertion guide with corresponding points from the implant plate is shown in figure 3.

Insertion guide allow the introduction of a stabilization bolt in the insertion slave. The dimension of the insertion sleeve allows the use of 5mm screws for more stability of the plate to the insertion guide. (fig.4)

Fig. 3. Align the three points of the Insertion Guide with the corresponding three points on the plate.

Fig. 4. Stable attachment of plate to Insertion Guide.

Steps for insertion the implant plate:

1. The implant plate will be inserted between vastus lateralis muscle and periosteum. During insertion the proximal end of plate must be kept in contact with bone. The distal end of the plate will be placed against lateral condyle.

2. The properly position of the Insertion Guide on the lateral condyle is when the guide will be at approximately 10° from the femoral shaft. (Fig.5)

Fig. 5

3. The position of plate can be adjusted if necessary. (Fig.6)
4. Insert a Kirschner Wire through the cannula of the Fixation Bolt to provide preliminary fixation of plate. (Fig. 7)

5. Confirm proper position of the proximal end of plate with a lateral X-ray. The diaphyseal screws must be positioned through the center of the intramedullary canal. Therefore the proximal end of the plate should be centered on the shaft in a lateral view.

6. Make incision at most proximal hole. This location is marked using an Insertion Sleeve after the reduction is reconfirmed. (Fig. 8)

7. Through this stab incision, replace the Insertion Sleeve and trocar. Ensure that the Insertion Sleeve is fully seated in guide to avoid interposed soft tissue, which can keep the bolt from engaging with the plate. Secure the sleeve by tightening the nut on side of guide.

8. Remove trocar and close plate insertion frame by threading the Stabilization Bolt into the proximal plate hole.

9. Insert K-wire through Stabilization Bolt. (Fig. 9)

10. Place the insertion sleeve and trocar in insertion guide. Mark on the skin the place of incision. Remove the insertion sleeve and make the incision.

11. Reinsert the sleeve with trocar until it is fully seated to ensure that no soft tissue is interposed. Remove the trocar. Insert Pull Reduction
New Instruments for internal fixation of fractures using minimally invasive techniques

Instrument through sleeve. (Fig. 10)

**Fig. 10 The drilling instrument**

12. Take out the drilling instrument and tighten the screw to reduce the fracture. (Fig. 11).

13. Place diaphyseal screws so that the drill tip passes through the center of intramedullary canal. (Fig. 12). Tightening is make until the head screw is thread in plate, distance marked on the screw sleeve. (Fig. 13)

**Fig. 12**

**Fig. 13**

14. Screw insertion proceeds as planned preoperatively. (Fig. 14)

**Fig. 14**
15. If it is necessary a Direct Measuring Device can be used. (Fig. 15)

Conclusion

For the less invasive technique is necessary to have adequate instruments to be able to reduce bone fracture. For this reason, a new set of instruments is developing to help the surgeon to perform good fixation.

All instruments are design to support multiple sterilizations and insertion strength. They are made from biocompatible materials.

The design instruments for less invasive technique

The instruments allow tightening implant plate to the fractured bones to reduce fracture with less invasive technique. They allow positioning the plate holes, alignment of the implant plate, drilling of the holes in bone and screwing up the screws. Also are design instruments to measure the angle of implant plate position and the depth of the holes in bone.

The main advantage of using these instruments is a minimal trauma of the soft tissues, no tendency to fracture of the bone after implant removal, reduction of the hospitalization period and medical care and also of the costs, reduction of the incapacitating period, no additional anesthetic risk and psychological impact for the patient.

References:

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