

Finite element analysis for the treatment of proximal femur fracture

Summary

The gamma nail and dynamic hip screw have been widely used for the treatment of proximal femur fracture. From the clinical point of view, the implants may fail and caused loss of fracture fixation in the impairment of fracture healing. The purposes of this study were to evaluate the performance of those two commercial available fracture fixators and newly design implant (double screw nail).

The whole modeling process was using SolidWork 2006 and then Finite element method was applied to simulate the real situation during the proximal femur treatment. Three types of implants (DHS, TGN, and DSN) were analyzed in treating three types of proximal femoral fractures (neck fracture, subtrochanteric fracture, and subtrochanteric fracture with gap). The Von Mises stress and strain energy density criteria were assigned to predict implants failure, while the total displacement criterion was assigned to investigate the fixation rigidity.

The Von Mises stress and the strain energy density results showed the same tendency. The stress occurred during the treatment of proximal neck fracture is the lowest while subtrochanteric fracture with gap is the highest. In treating neck fracture, DHS produced the highest stress and occurred at the junction between the screw cap and shaft of the lowest distal screw. Besides, high Von Mises stress also appeared at the lag screw around the intersection between lag screw and DHS plate, while DSN produces the lowest stress compare with another types of implants. In case subtrochanteric fracture with gap, DHS implant also produced the highest stress and DSN produced the lowest but for subtrochanteric fracture, TGN produced the highest stress and DHS is the lowest.

The stresses mostly occurred around the hole and neck region of the implant and the double screw nail has the lowest stress. The failure mode of fracture fixation is due to the stress concentration. In addition, the stresses occurred at double screw nail were the lowest. It meant that the double screw nail has the lowest risk of implant failure during the fixation because it can minimize the effect of stress concentration.

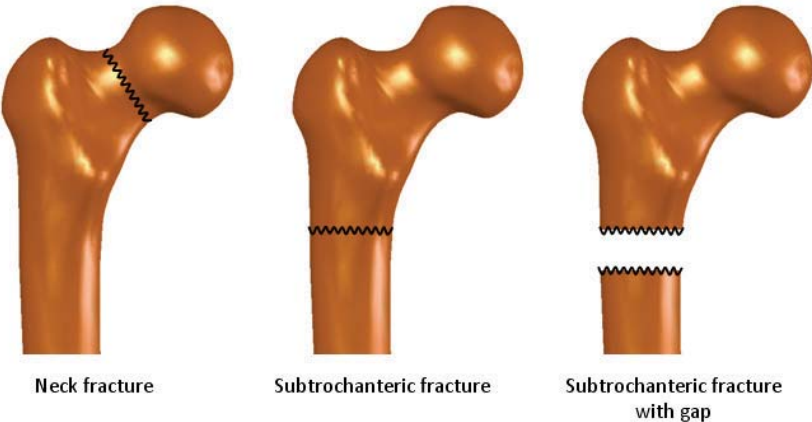


Figure 1: Three types of proximal femoral fractures

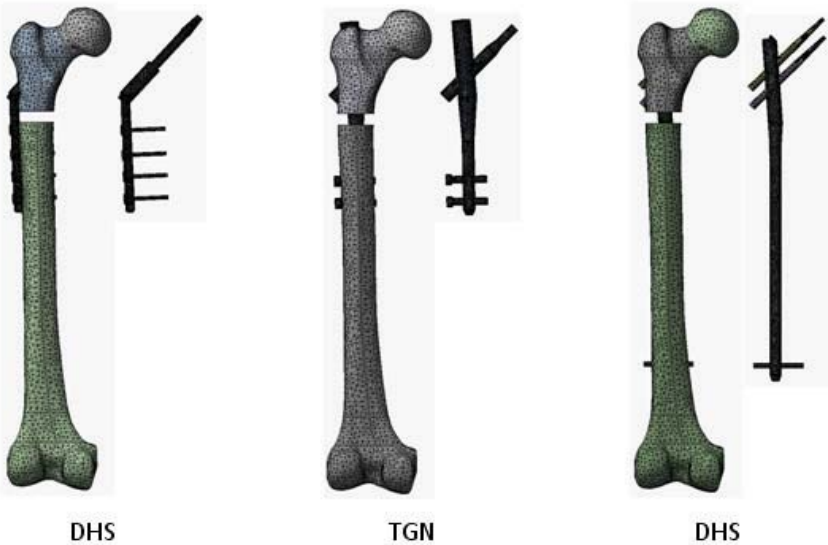


Figure 2: Three types of implants (DHS, TGN, and DSN)

