FEA Analysis of TSI™ Neck Stabilization Stem

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Objectives

- Compare stresses generated in conventional stem compared to neck stabilization stem when restoring same head centre.
- Compare strain in bone.
- Consider the effect of varus / valgus tilting both stem designs.

Model Setup

FEA Model

784N Abductor & Tensor fascia

Original Femoral head centre restored for each implant.

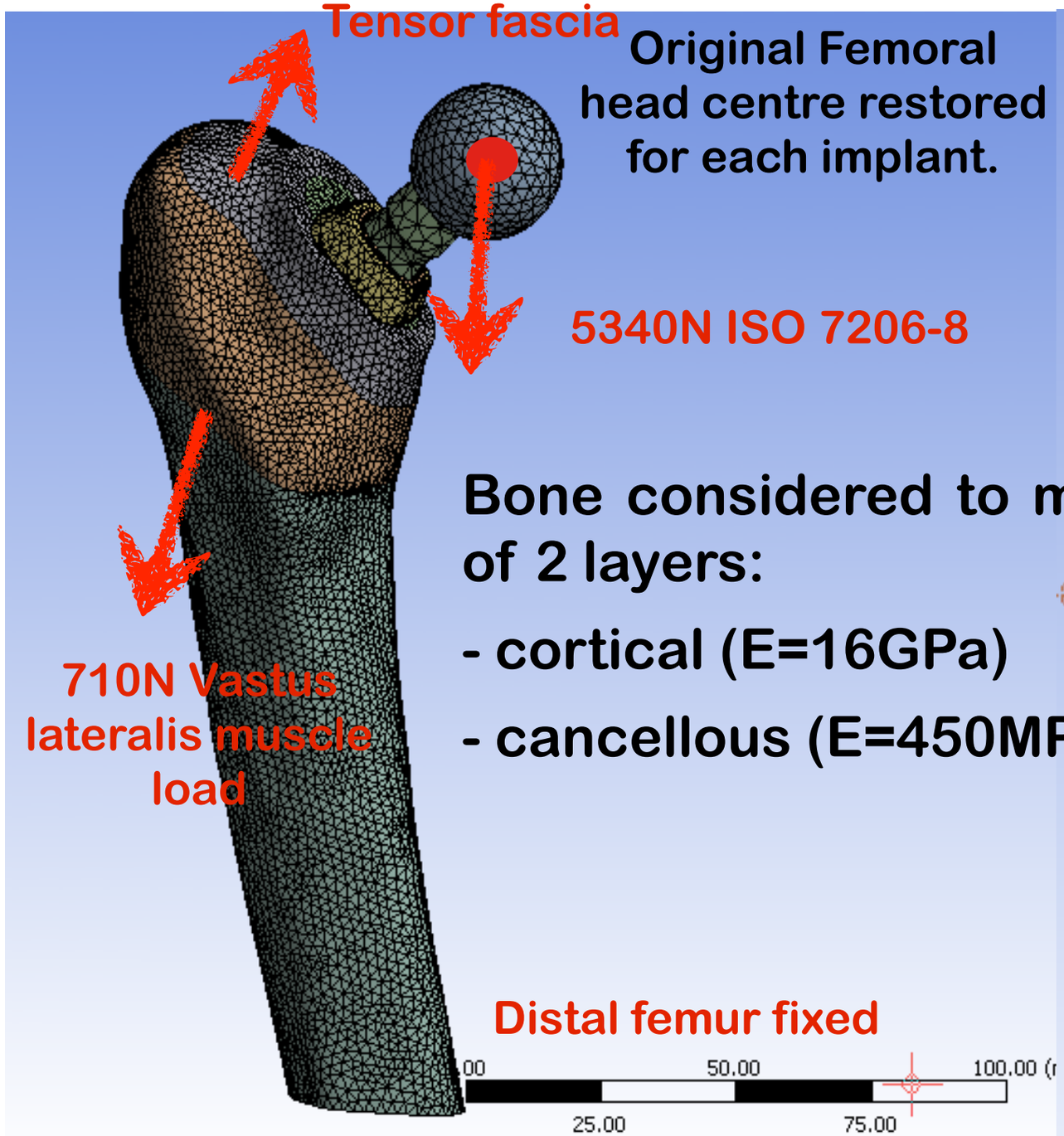
5340N ISO 7206-8

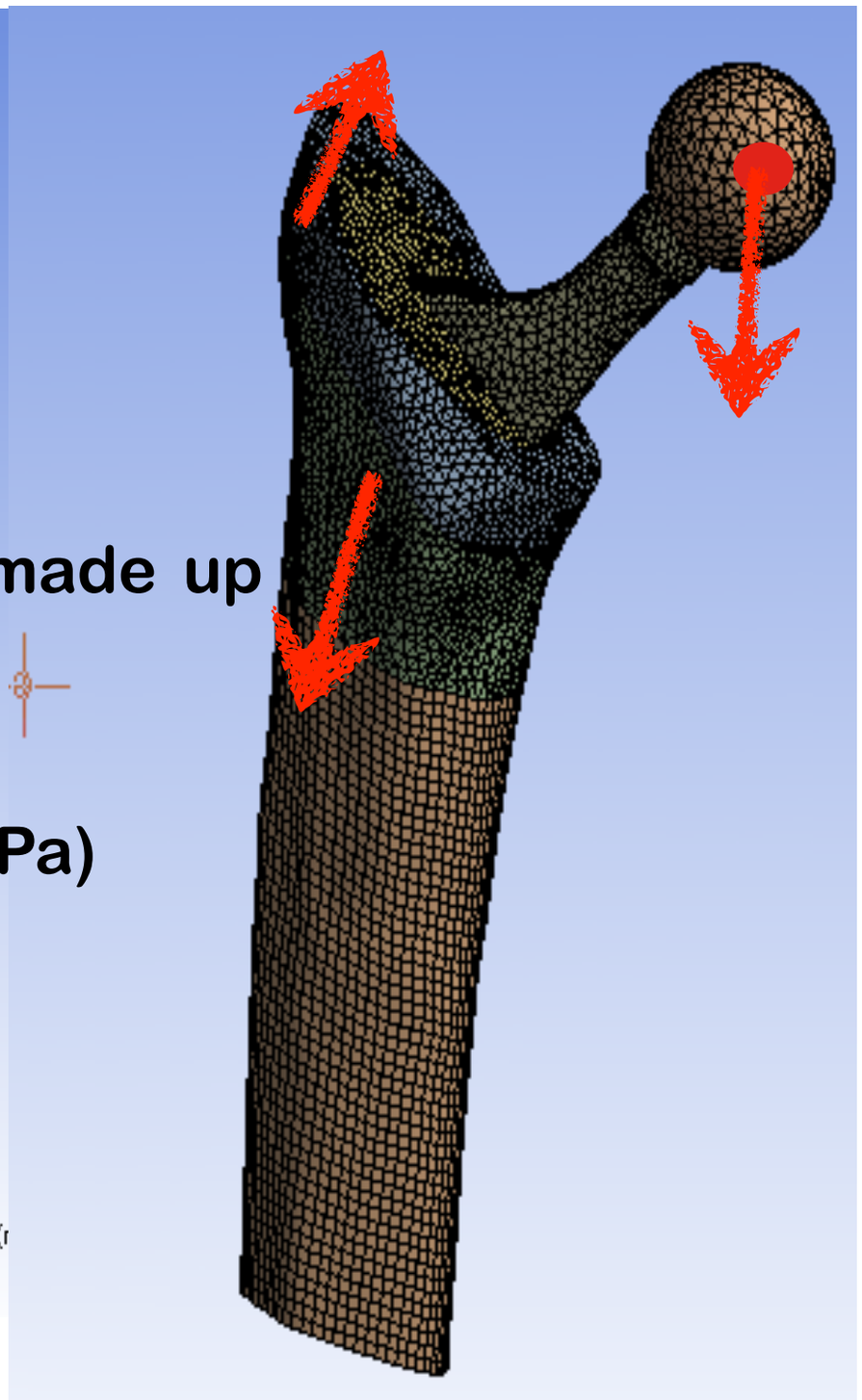
Bone considered to made up of 2 layers:

- cortical (E=16GPa)
- cancellous (E=450MPa)

710N Vastus lateralis muscle load

Distal femur fixed





Components

Components used to restore head centre

- TSI implant size 1 (range supplied is 1 through to 5), 22mm neck with +8mm head.
- Taperloc Stem Size 3, high offset with +8mm head.

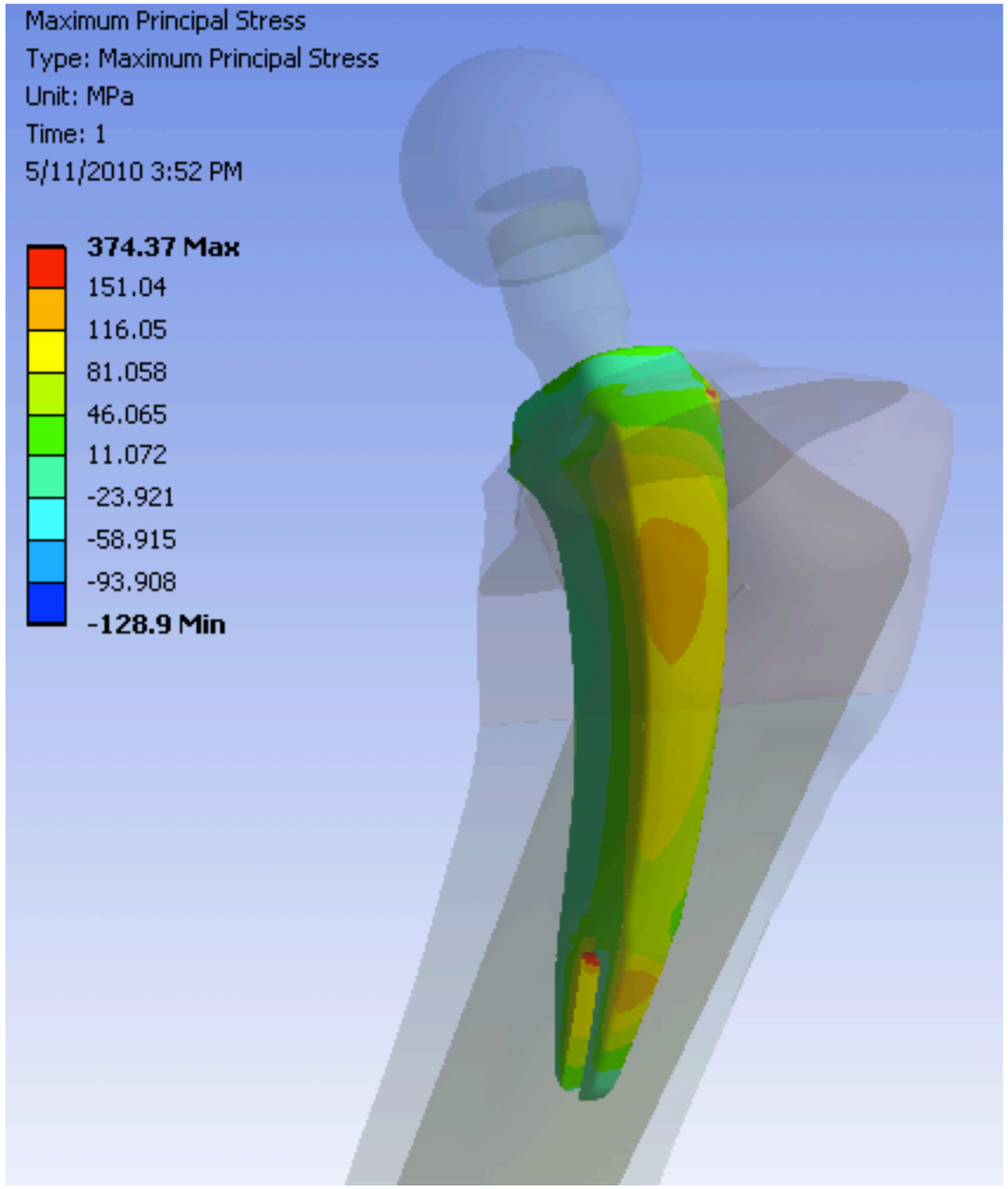
Both Stems have Plasma coated proximal bodies and uncoated distally. Both implants were bonded to bone in coated region and frictionless conditions of remaining part of stem.

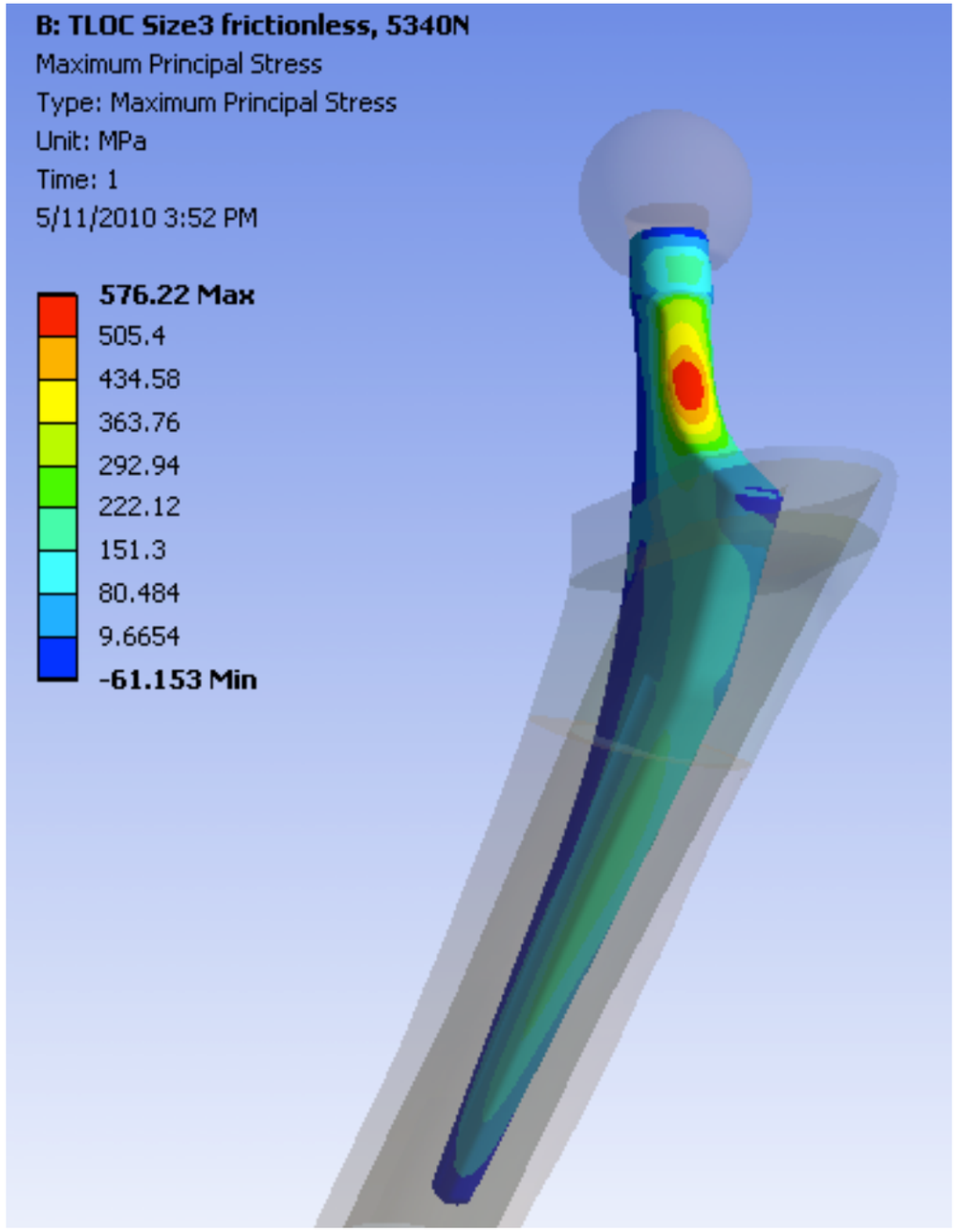
Implant Materials:

- Neck Stabilization implant Titanium Stem, CoCr Neck.
- Conventional Stem, Monoblock Titanium

Stress in Stem

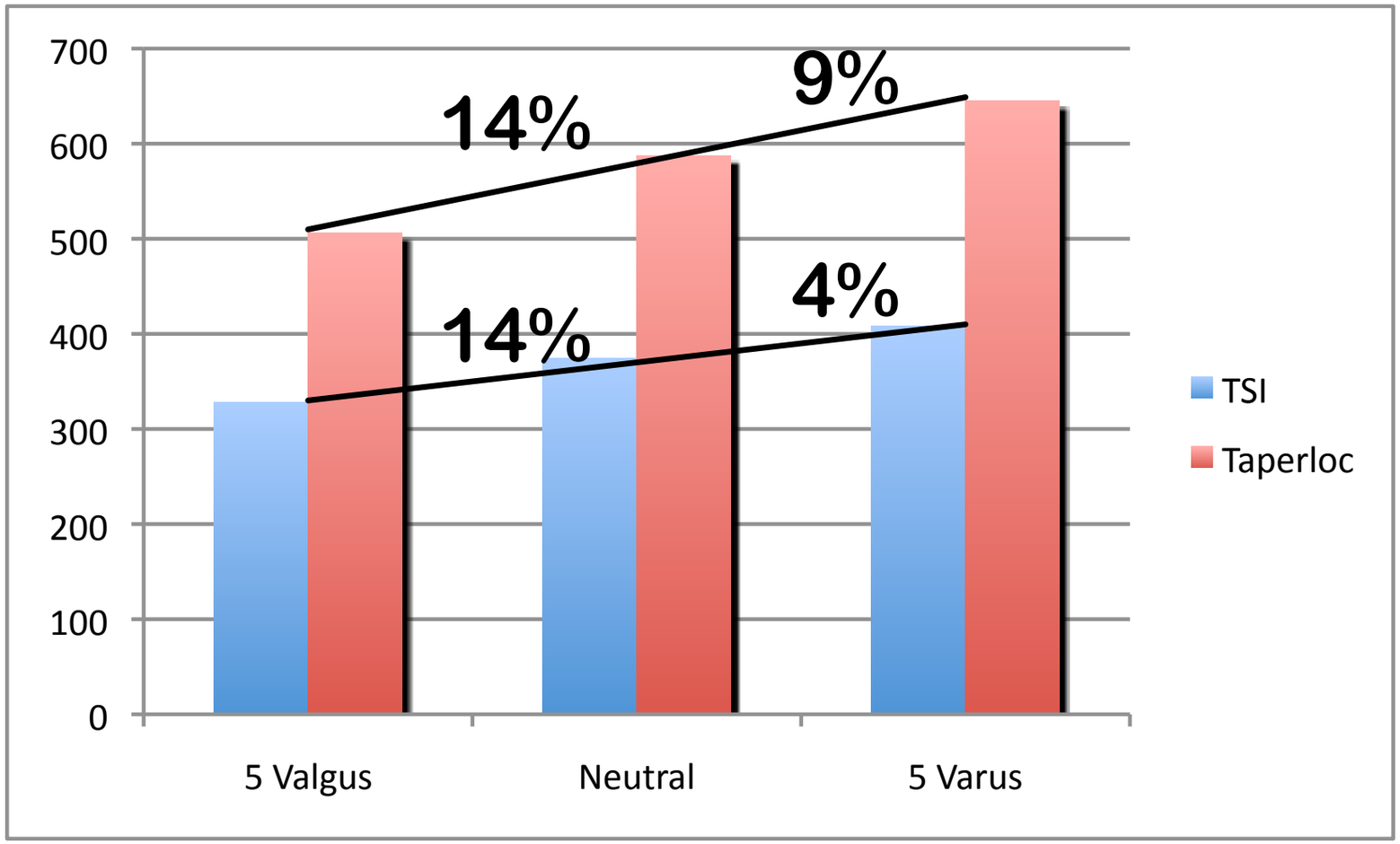
- The maximum principal tensile stress in the neck stabilization stem was 35% less than that of the monoblock design.





Stress in Stem

- The effect of Varus tilting Stem was much less for the neck stabilization stem compared to the monoblock design.



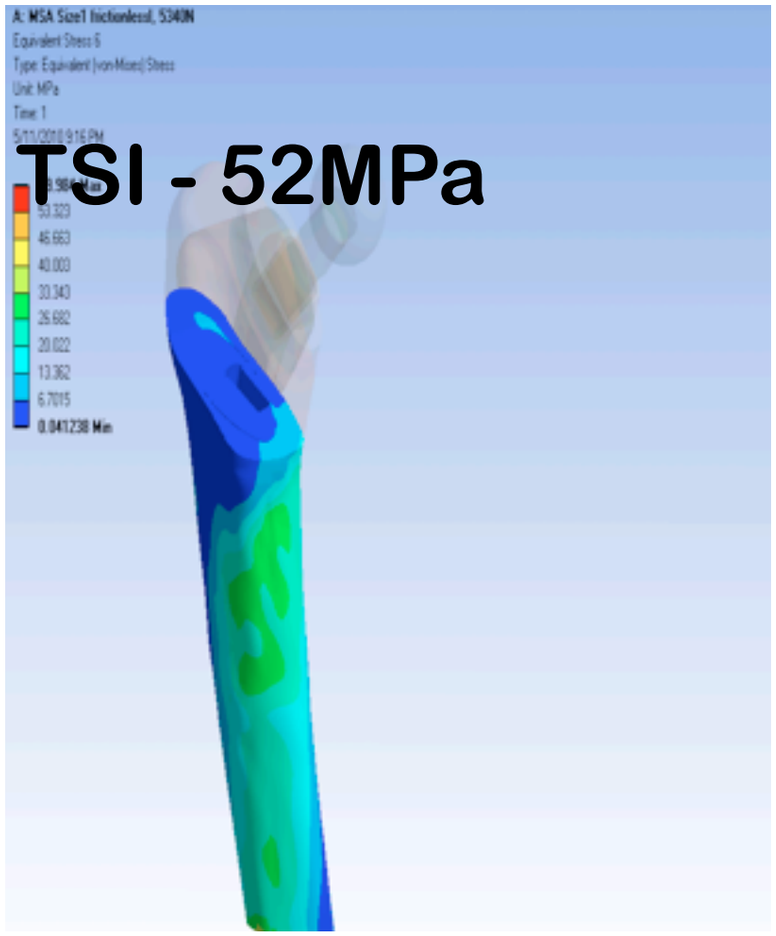
Head Centre

5 tilt shifts head centre 1.8mm

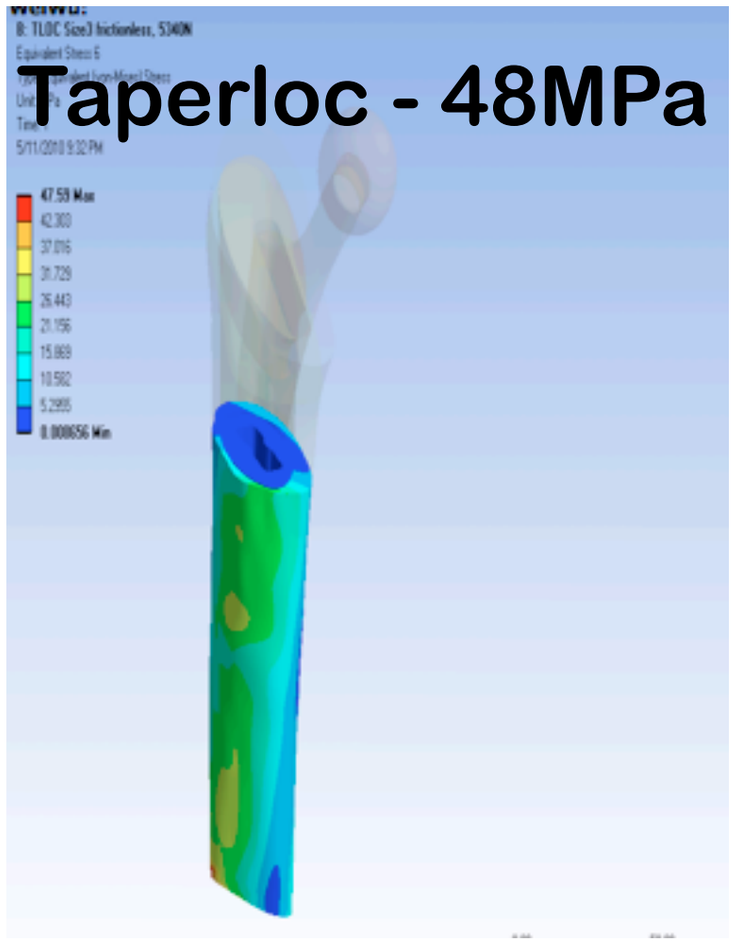
5 tilt shifts head centre 2.8mm

Stress in Femur

- The equivalent stress in the distal femur was similar for both the neck stabilization and the monoblock stem.



TSI - 52MPa



Taperloc - 48MPa

Stiffening effect of long stem in femoral canal is equivalent to additional structural support achieved by neck stabilization.

Conclusions

- Biomechanical advantage of neck stabilization stem produces lower stress in stem compared to monoblock equivalent.
- Stress in bone is comparable for both neck stabilization and monoblock design.
- Effect of varus tilting on monoblock design has more than double effect on stem stress.