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Numerical analysis of hip implant surfaces

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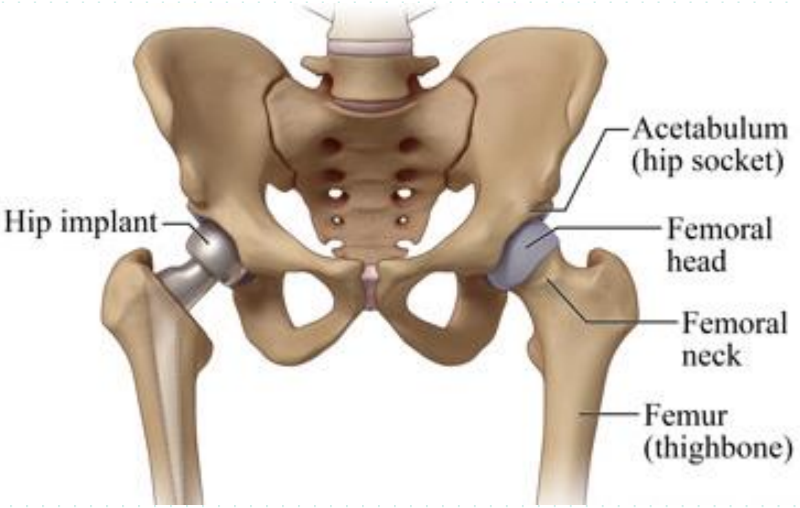
Introduction

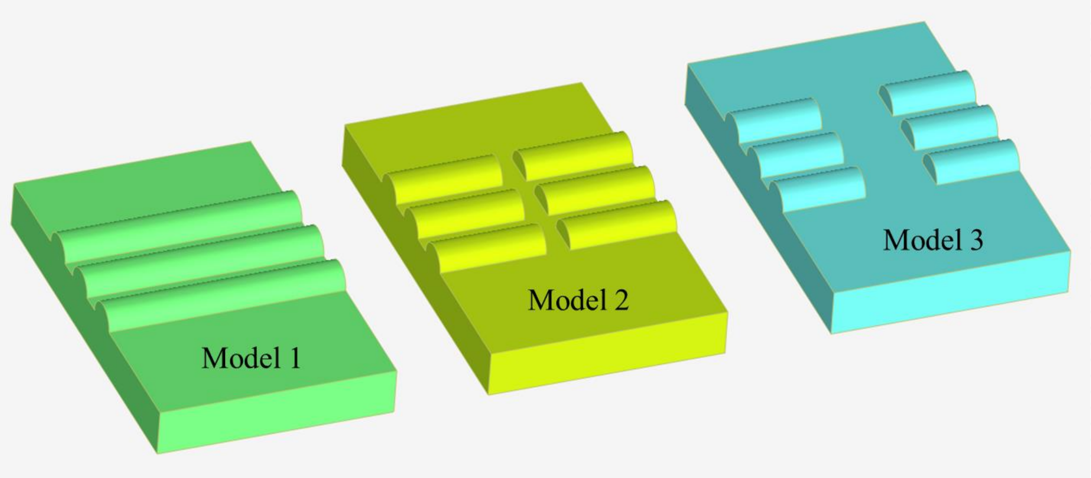
- Within 10 years of hip replacement procedure, about 10% of patients need to have revision surgery.
- Aseptic loosening is one of the major causes of revision surgeries.
- A possible way to reduce the number of revision surgeries as a result of aseptic loosening is to provide a better bone – implant fixation.



Hip joints

Possible solution: Rough implant surface

Materials & Methods

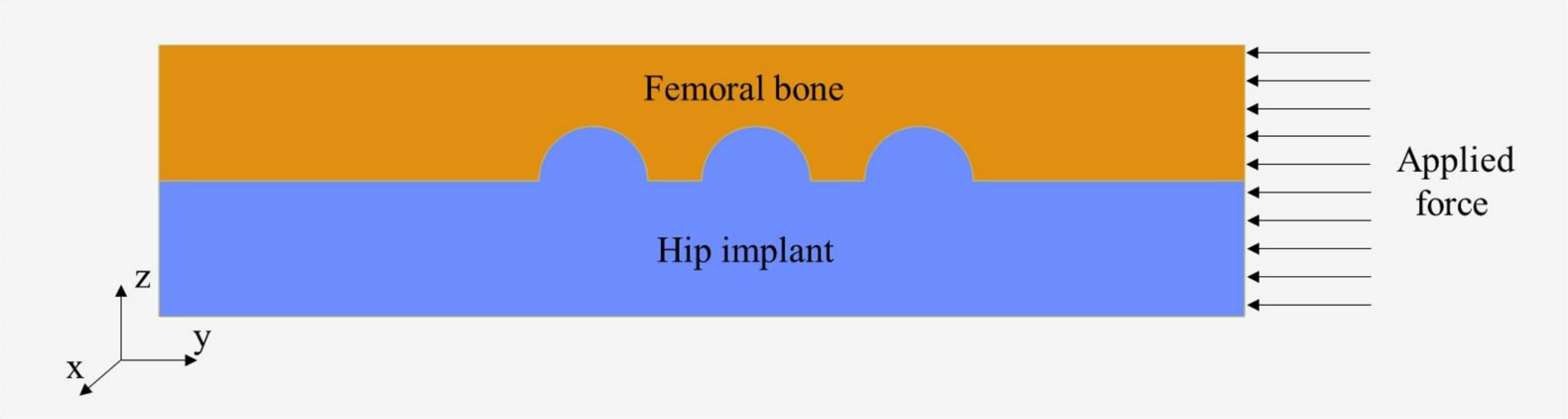


Implant surface topographies

Overview of femoral bone – hip implant model

- 2 material properties have been used:
  - Titanium alloy (Ti6Al4V) for hip implant and
  - cortical femoral bone were used
- Both materials were considered to be linear elastic, isotropic and homogeneous.

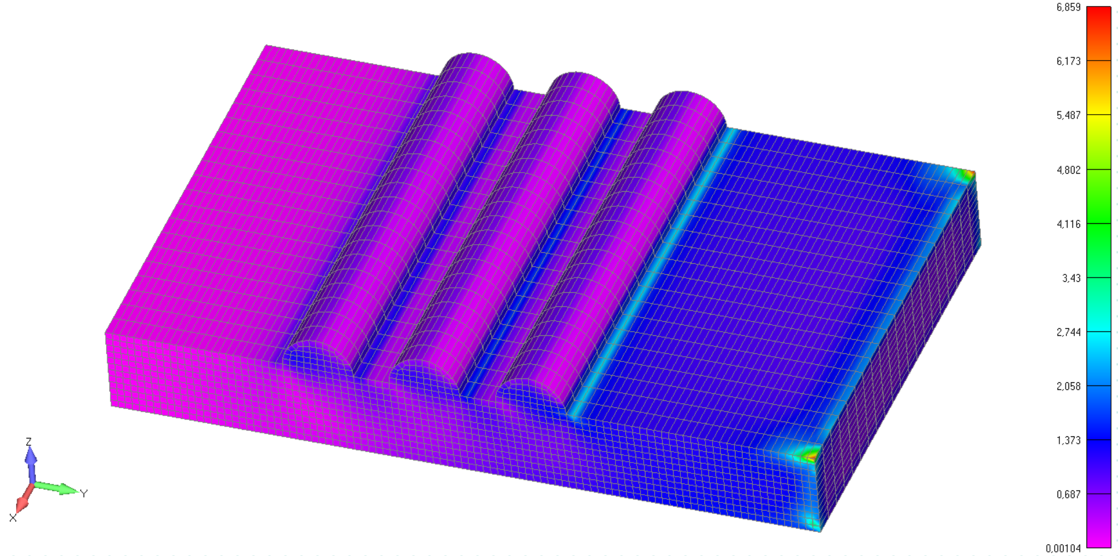
Materials & Methods



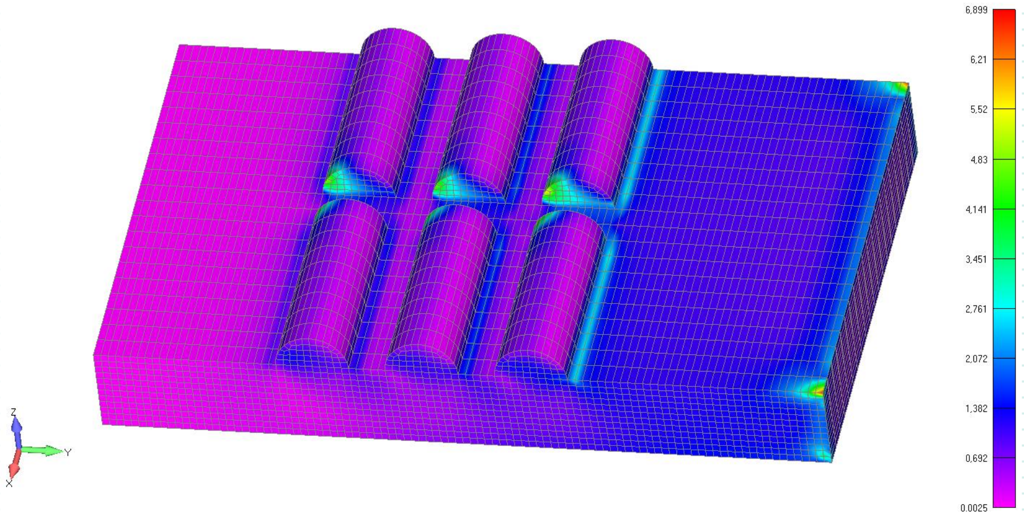
Loading Conditions

- The upper surface of the cortical bone was fixed.
- The sideways of the implant and bone were allowed to move in the y and z direction (locked in the x direction).
- The bottom surface of the implant was locked in the z direction.
- Coefficient of friction: 0.39

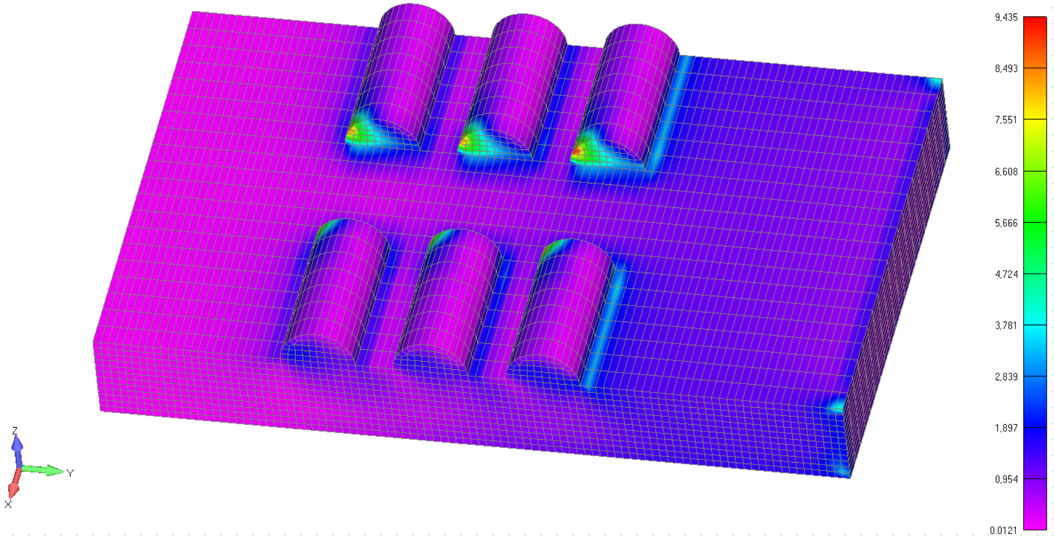
Results



Model 1 – Shear stress [MPa]



Model 2 – Shear stress [MPa]



Model 3 – Shear stress [MPa]

Comparison of the results

Results including corner nodes

	Model 1	Model 2	Model 3
Shear Stress [MPa]	**6.859**	**6.899**	**9.435**

Results without corner nodes

	Model 1	Model 2	Model 3
Shear Stress [MPa]	**2.75**	**6. 1**	**9.435**

Future Plans

- Thus far we have performed static analysis on more than 50 simple hip implant surface topographies.
- Based on the obtained shear stress distributions we will choose top 10% of models that will be further analyzed using complex loading conditions.

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Thank you for your time!

If you have any questions feel free to contact me

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