

Design and Strain Analysis of Artificial Femoral Head & Stem

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Introduction

- ❑ Dislocation of bone, mechanical failure and infection - Hip bone replacement
- ❑ To avoid revision of hip replacement
- ❑ Study is performed with artificial bone with different materials

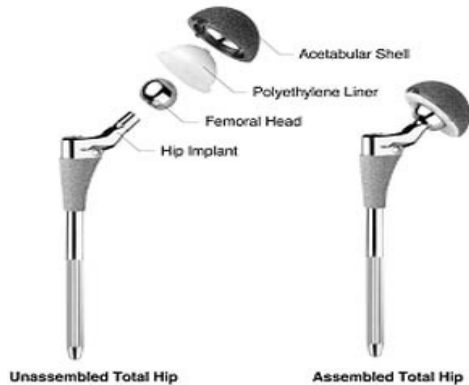


Figure 1. Hip bone

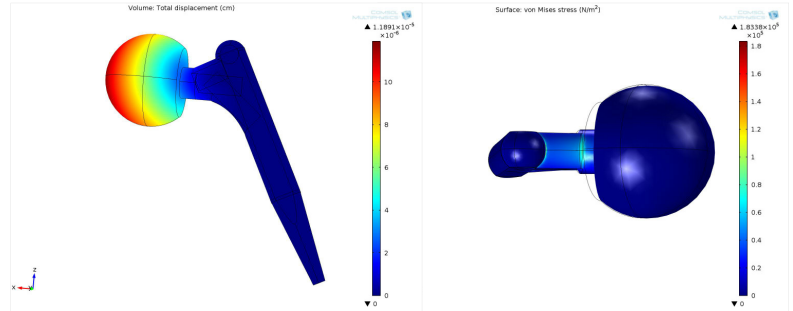


Figure 3. Displacement

Figure 4. Induced Stress

Table 1. Displacement and Stress of Biomaterials

Material	Pressure 490 Pa		Pressure 980 Pa		Pressure 1470 Pa	
	Stress (N/m ²)	Displacement (cm)	Stress (N/m ²)	Displacement (Cm)	Stress (N/m ²)	Displacement (cm)
Calcium HAP	9.17*10 ⁰⁸	5.95*10 ⁻¹³	1.83*10 ¹⁰	1.19*10 ⁻¹¹	2.75*10 ¹⁰	1.78*10 ⁻¹¹
Stainless Steel	1.06*10 ⁰³	9.10*10 ¹⁰	2.12*10 ⁰³	1.82*10 ¹⁰	3.18*10 ⁰³	2.73*10 ¹⁰
Titanium	1.96*10 ⁻¹³	8.65*10 ¹⁰	3.91*10 ⁻¹³	1.73*10 ¹⁰	5.87*10 ⁻¹³	2.59*10 ¹⁰
PMMA	6.74*10 ⁻¹¹	8.01*10 ⁰⁸	1.35*10 ⁻⁰⁹	1.60*10 ¹⁰	2.02*10 ⁻⁰⁹	2.40*10 ¹⁰

Computational Methods:

- ❑ A artificial hip bone with head and stem is designed similar to acetabular head and thigh bone in human bone
- ❑ Structural study was performed on various biocompatible bone implant
- ❑ Various range of applied pressure

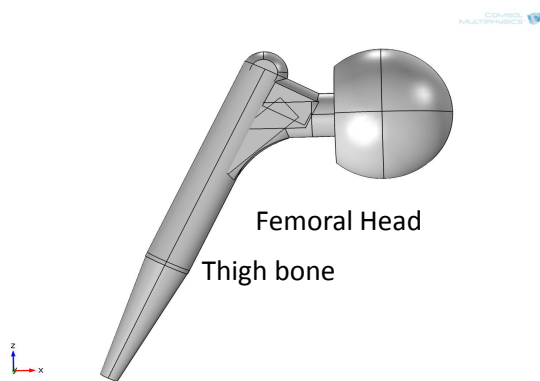


Figure 2. Model of hip bone implant

Results:

- ❑ The simulated result of hip bone with different material is listed in the table 1
- ❑ A model for the simulated result is shown in figure 3 and 4

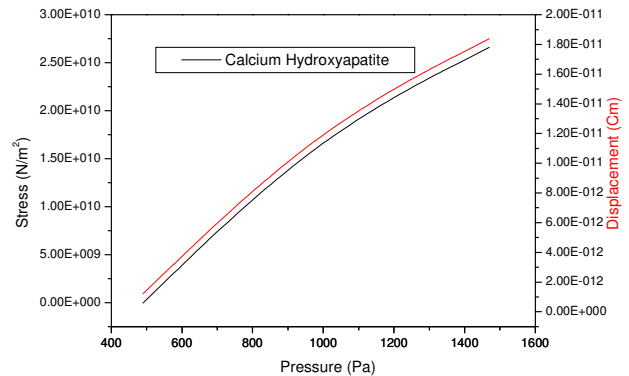


Figure 5. Stress and displacement of HAp

Conclusion: This simulation study shows that hydroxyapatite ceramic exhibits better mechanical stability among selected biocompatible materials

References:

1. Makarand G Joshi et al , Analysis of a femoral hip prosthesis designed to reduce stress shielding, Journal of Biomechanics Vol.33,2000,1655–1662
2. Tomas Navrat et al, Strain — Stress Analysis of Artificial Hip Joint, Influence of Bearing Material on Contact Pressure, World Congress on Medical Physics and Biomedical Engineering 2006, IFMBE Proceedings, Volume 14, 2007, pp 2945-2948