

## Document details

1 of 1

[Export](#) [Download](#) [Print](#) [E-mail](#) [Save to PDF](#) [Add to List](#) [More...](#)
[Full Text](#) [View at Publisher](#)

BMC Musculoskeletal Disorders  
Volume 15, Issue 1, 3 February 2014, Article number 30

Open Access

## Design process of cementless femoral stem using a nonlinear three dimensional finite element analysis (Article)

Baharuddin, M.Y.<sup>ab</sup> [✉](#), Salleh, S.-H.<sup>b</sup> [✉](#), Zulkify, A.H.<sup>c</sup> [✉](#), Lee, M.H.<sup>d</sup> [✉](#), Noor, A.M.<sup>b</sup> [✉](#), A Harris, A.R.<sup>b</sup> [✉](#), Majid, N.A.<sup>b</sup> [✉](#), Abd Kader, A.S.<sup>e</sup> [✉](#) [🔍](#)

<sup>a</sup>Department of Biomedical Engineering, Faculty of Engineering, University of Malaya, Kuala Lumpur, Malaysia

<sup>b</sup>Centre for Biomedical Engineering Transportation Research Alliance, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia

<sup>c</sup>Department of Orthopaedic, Traumatology and Rehabilitation, Kuliyyah of Medicine, International Islamic University Malaysia, Kuantan, Pahang, Malaysia

[View additional affiliations](#) [v](#)

### Abstract

[View references \(55\)](#)

**Background:** Minimal available information concerning hip morphology is the motivation for several researchers to study the difference between Asian and Western populations. Current use of a universal hip stem of variable size is not the best option for all femur types. This present study proposed a new design process of the cementless femoral stem using a three dimensional model which provided more information and accurate analysis compared to conventional methods. **Methods:** This complete design cycle began with morphological analysis, followed by femoral stem design, fit and fill analysis, and nonlinear finite element analysis (FEA). Various femur parameters for periosteal and endosteal canal diameters are measured from the osteotomy level to 150 mm below to determine the isthmus position. **Results:** The results showed better total fit (53.7%) and fill (76.7%) canal, with more load distributed proximally to prevent stress shielding at calcar region. The stem demonstrated lower displacement and micromotion (less than 40  $\mu\text{m}$ ) promoting osseointegration between the stem-bone and providing primary fixation stability. **Conclusion:** This new design process could be used as a preclinical assessment tool and will shorten the design cycle by identifying the major steps which must be taken while designing the femoral stem. © 2014 Baharuddin et al.; licensee BioMed Central Ltd.

### Author keywords

Cementless hip Femur Finite element analysis Hip replacement Morphology

### Indexed keywords

MeSH:

Adult Arthroplasty, Replacement, Hip Computer Simulation Computer-Aided Design Female  
Femur Finite Element Analysis Hip Prosthesis Humans Imaging, Three-Dimensional Male  
Multidetector Computed Tomography Nonlinear Dynamics Prosthesis Design Prosthesis Failure  
Radiographic Image Interpretation, Computer-Assisted Stress, Mechanical Young Adult

ISSN: 14712474  
Source Type: Journal  
Original language: English

DOI: 10.1186/1471-2474-15-30  
PubMed ID: 24484753  
Document Type: Article

[Metrics](#) [View all metrics](#)

9 [Citations in Scopus](#)  
75th Percentile

1.35 [Field-Weighted  
Citation Impact](#)

[PlumX Metrics](#) [v](#)  
Usage, Captures, Mentions,  
Social Media and Citations  
beyond Scopus.

[Cited by 9 documents](#)

[The effect of boundary constraints on finite element modelling of the human pelvis](#)

Watson, P.J. , Dostanpor, A. , Fagan, M.J.  
(2017) *Medical Engineering and Physics*

[Comparative analysis of the biomechanical behaviour of two cementless short stems for hip replacement: Linea Anatomic and Minihip](#)

Gabarre, S. , Herrera, A. , Ibarz, E.  
(2016) *PLoS ONE*

[The influence of contact ratio and its location on the primary stability of cementless total hip arthroplasty: A finite element analysis](#)

Reimeringer, M. , Nuñez, N.  
(2016) *Journal of Biomechanics*

[View all 9 citing documents](#)

Inform me when this document is cited in Scopus:

[Set citation alert](#)
[Set citation feed](#)
[Related documents](#)

Morphological study of the newly