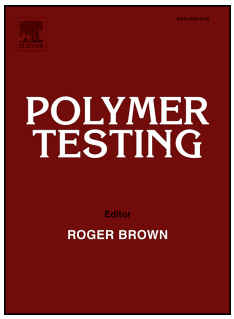
# Accepted Manuscript




Elliptic crack behavior emanating from the cement mantle of the total hip prosthesis

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ACCEPTED MANUSCRIPT

**Title:** *Elliptic crack behavior emanating from the cement mantle of the total hip prosthesis*

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**Abstract**

Damage accumulation and failure in the cement polymethylmethacrylate (PMMA) is the most prominent in a cemented total hip arthroplasty (THA) leading to eventual implant loosening. In this study, we used the three-dimensional finite element method (FEM) to analyze and calculate the three modes (I, II and III) of the stress intensity factor (SIF) of elliptic crack in the cement mantle for different sizes, orientation and location of crack according to different patient activities. From obtained results, we show that the opening crack mode is proportional to the stress applied on the damaged part (compression or traction). The risk of crack failure in the anterior region of the proximal part is more important and causes a danger of fracture of cement whose the value of SIF reached exceeds the intrinsic resistance of the material. The study of the daily patient activities shows us that the climbing stairs represents the maximum value of SIF.

**Specifications Table**

| | |
|---|---|
| Subject area | *physic* |
| More specific subject area | *biomechanical* |
| Type of data | *Table, image, text file, graph, figure* |
| How data was acquired | *Analyze with FEM, abaqus 6.11, 3D model crack ,model CMK3 prothesis* |
| Data format | *Raw, filtered, analyzed.* |
| Experimental factors | *Analyze of* stress intensity factor (SIF) *intensity* |
| Experimental features | *3D crack elliptic with abaqus* |
| Data source location | *aMechanics and Physics of Materials Laboratory, Djillali Liabes University of Sidi Bel-Abbes- BP89 cité Larbi Ben M'hidi, Sidi Bel-Abbes, Algeria* |
| Data accessibility | / |

*Keywords*; 3D crack; elliptic; bone cement; dynamic; PTH.

## 1. Introduction

In the hip particularly, the mechanism of stress is very complex: it is a combination of forces of compression, shear, torsion and tension. The mechanical strength of the total hip prosthesis (PTH) depends mainly on the nature of the cement used. Figure 1 show a schematic of a cemented THR where the acetabular cup is fixed by the cement to the pelvic bone. The stability of the fixation critically depends on the integrity of the bone cement under typical physiological loading conditions, Loosing of cemented implants usually caused by a mechanical failure of the PMMA under cyclic loading [20-21.], due to its brittle nature and low mechanical properties. Cement is the weak

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