A 3-D NUMERICAL ANALYSIS OF OF THE MECHANICAL RESPONSE OF AN INTERSPINUS IMPLANT

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Introduction

The Wallis device is an interspinous implant that is used for dynamic lumbar stabilization. The implant is intended to improve the stability of the treated intervertebral lumbar segment while preserving its mobility and local lordosis [Senegas, 2006]. From the mechanical point of view, the Wallis device is studied in order to provide rigidy and support loading from human body and action [Cristie, 2005].

Figure 1. a) The non-rigid fixation Wallis implant, b) Placement and securing of the Wallis implant in the human spine [Senegas, 2006].

From mechanical point of view the overall implant constitutes a "floating" system, with no permanent fixation in the vertebral bone, to avoid the risk of loosening. (Fig. 1). It achieves an increase in the rigidity of destabilized segments beyond normal values As a final purpose Wallis must be capable of supporting mechanical loading imposed on the lumbar spine by different physical activities.

Methods

An experimental program was set up and performed in order to investigate the mechanical response as well as the failure mode of the specific implant. 20 specimens of UHMW-PE were cut in the desired dimensions and tabbed according to EN-ISO 527 and EN-ISO 604 standards [4, 5]. For the determination of the mechanical properties of the materials under study, a series of mechanical static tests both in tension and compression were executed in an INSTRON 3382. universal testing machine with a load capacity of 100 KN following the ASTM D639 standards. Moreover numerical modelling using FEA was applied in the implant in order to determine its mechanical response (Fig. 2).

Results and Discussion

The methodology that was used included mechanical characterisation of the materials under study.

The numerical analysis verified the experimental results concerning the mechanical behaviour of the implant.

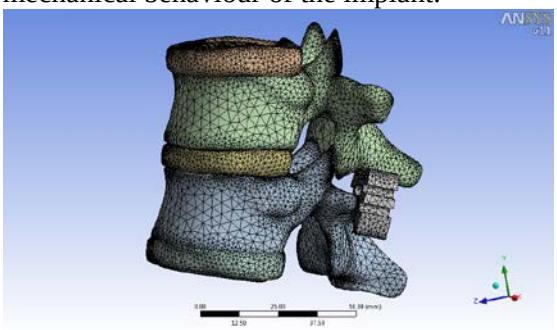

Figure 2 FEM meshing for the vertebra-implant coupling system.

It can be concluded that the mechanical response of the vertebra-implant coupling system can be predicted through numerical modelling. Moreover stress relief is observed through the insert of the implant in the intervertebral lumbar segment denoting a variation in the stress field of the region under study of the implant.

References

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