11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20 - 25, 2014, Barcelona, Spain

ORIENTATION OF SURGICAL MESHES IN CONTEXT OF VARIABILITY OF HUMAN ABDOMINAL WALL PROPERTIES

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Key Words: *Finite Element simulations, biomechanics, hernia repair, implants*

Hernia repair is nowadays quite common medical problem. Junge et al. [1] conclude that properties of surgical meshes should fit mechanical properties of the abdominal wall. The influence of orientation of orthotropic meshes on forces in tissue-implant joints, which high value usually causes hernia relapse, has been investigated by Finite Element simulations in [2]. Moreover, the optimal orientation of implant due to minimisation of junction forces has been indicated. These studies were done for the mean strains of human abdominal wall described in [3]. The mechanical behaviour of abdominal wall is characterised by big variability. Hence, there is a need to investigate how the optimal orientation of different implants changes with variation of the human abdominal wall strains.

A FE membrane model of surgical mesh [2] with bilinear elastic material model [4] has been used. Kinematic extortions have been applied to the model supports (10 point joints), that simulate displacements of the fasteners during human movements. Kinematic extortions have been calculated analougsly to [2] by taking the strain values in external surface of abdominal wall caused by daily human activities obtained by Szymczak et al. [3]. Then the values were reduced respectively to values in internal surface accroding to Podwojewski et al. [5]. In this study, particular cases of data for different people have been taken into analysis instead of avarage values. Calculations have been performed for three types of implants and two cases of hernia placement. For each case and orientation, a maximum reaction in model supports is found. Then an orientation (direction of elastic modulus E_1 with respect to midline), for which the smallest maximum reaction force has been found, is chosen as the optimal orientation due to minimasation of junction forces. Exemplary results for two implants, one case and kinematic extortions refferening to properties of 2 people and avarege properties are presented in Fig. 1.

To sum up, the optimal orientation in upper lateral part of abdominal wall depends on the range of strains which may occur in patients abdominal wall. For considered cases of kinematic extortions referening to properties of different people, optimal orientation of DynaMesh and Proceed is from 45 deg to 75 deg. Elastic modulus E_1 of Parietex is bigger than E_1 only in initial range of strains. Parietex should be postioned in orientation 75 deg when acting under small strains, whereas for big strains the orientation 135 deg is optimal.

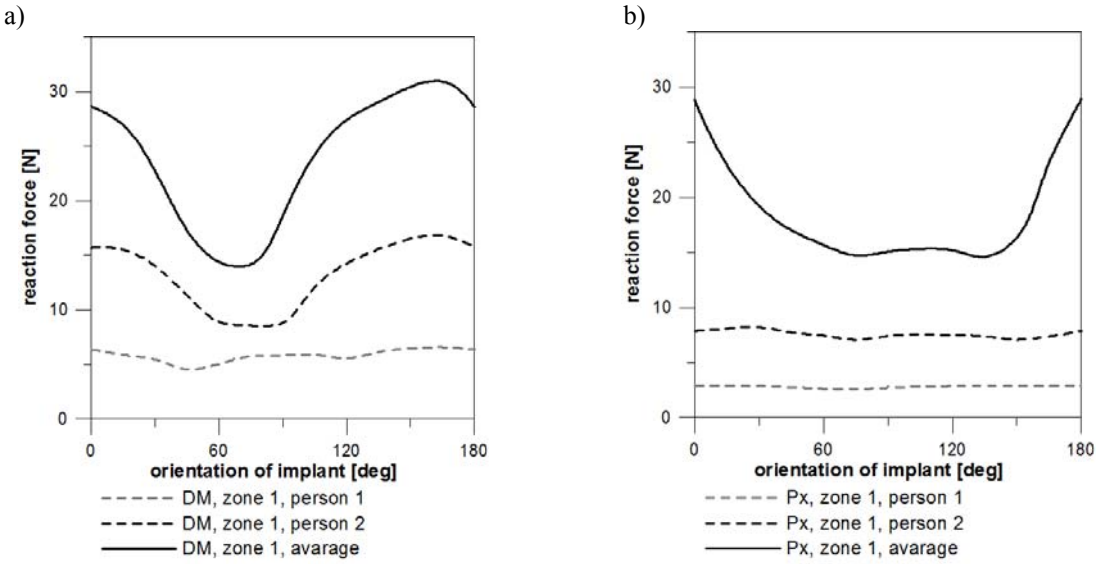

Fig. 1 Orientation of implant vs reaction forces a) DynaMesh, b) Parietex

Acknowledgemnts

This study is partially supported by the EU, as part of the Innovative Economy Operational Programme (contract No UDA-POIG.01.03.01-22-086/08-00) and by the subsidy for the development of young scientists given by the Faculty of Civil and Environmental Engineering, Gdansk University of Technology. Computations were done in TASK Computer Science Centre, Gdańsk, Poland.

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