IMPLANT USED IN HERNIA REPAIR UNDER PHYSIOLOGICAL MOVEMENTS OF HUMAN ABDOMEN

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Introduction

The study deals with the mechanical behaviour of implant used in repair of abdominal hernia. Due to anisotropy of the abdominal wall and anisotropy of the implants [e.g. Saberski et al, 2010], properties of the surgical meshes should fit to the mechanical properties of the abdomen [e.g. Junge et al., 2001]. During activities like bending of torso or breathing, the joints between implant and tissue can be displaced what increases the junction forces. The influence of orientation of the implant in two perpendicular directions was investigated experimentally in an animal models [e.g. Anurov et al, 2012]. Here seven possible orientations in different areas of the abdominal wall are studied.

Methods

Two types of the surgical meshes are considered: almost isotropic Dualmesh Gore and strongly anisotropic Dyna Mesh. Material properties are taken from previous research [Tomaszewska *et al*, 2012]. The implant is modelled as membrane structure [see e.g Lubowiecka et al., 2012, Tomaszewska et al., 2012]. The FEM analysis is geometrically nonlinear with assumption of large strains. The strains of abdominal wall during life excitation are identified by Szymczak et al, 2012. These outcomes are used here as kinematic extortions of the implant to check, how orientation of the mesh influences on the forces in the joints. The junction forces for different possible placements of hernia are analysed. In each area seven orientations of the mesh are checked.

Results

The orientation of the almost isotropic Dualmesh Gore in not so relevant. However, for the anisotropic Dyna Mesh relative difference between the biggest and the smallest maximal reaction depends strongly on the orientation. In the majority of cases the smallest maximal reaction was obtained for transversal orientation (stiffer direction perpendicular to the midline). The exception is in the area near a navel, where the smallest maximal reaction was found for 60 degrees (counted to the central vertical line). The biggest maximal reactions have been found for 15 degrees (near the direction of first support counting from midline of the abdominal wall).

Discussion

Junge et al. 2001 and Anurov et al 2012, among others, recommend to put stiffer direction of implant in transverse direction of the abdominal wall. Based on our results, we also conclude surgeons should avoid putting the implant in position, in which stiffer direction is parallel or close to parallel to the midline of the abdominal wall. Our analyses show, that inappropriate orientation of the anisotropic implant can highly increase forces in joints. That happens especially in lower, lateral part of the abdominal wall.

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