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**FEATURES OF CALCULATIONS OF ENDOPROSTHETIC**  
**JOINTS USING FEM**

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Joint endoprosthesis is an effective means of restoration of function in the case of incurable lesions or traumas. Currently there are about one million endoprosthetic operations performed annually in the world. It is reported in that for every 3–4 primary endoprosthetic operations, at least one follow up operation is performed, caused by phenomena relating to poor biocompatibility of the used materials with body tissues, loosening of the prosthesis from the leg bone, wear of swivel joints [1].

The problem of studying the contact pressure distribution in an endoprosthetic swivel joint is an elastic contact nonlinear and static problem. The most promising method available to solve these problems is the finite element method (FEM). One of the most powerful packages for solving elastic contact problems is ANSYS, which is selected for further study. The advantage of the ANSYS method is that it makes it possible to directly tabulate the contact pressure epures by post processing.

As the base, the design is taken as a tricomponental titanium endoprosthetic ball and chirulen cup (trademark UHMWPE fabricated by Hoechst, Germany); the liner insert is a titanium race. The mean dimensions of the finite elements are 0.15 mm for the chirulen insert (with account of workmanship accuracy), and 0.2 mm for the titanium components. The final friction coefficient was set as  $f = 0.1$ . The spherical ball diameter was varied within the range 28–58 mm taking into account the experience of designing such articles. The forces effective in the joint were set within the range 500–4500 N. The clearance in the tribocouple was varied within the range 0–0.2 mm. The load was directed towards the ball in the vertical axial direction. It was assumed that the titanium race over the outer surface was fixed rigidly. All these parameters were varied at 5 levels, yielding 125 calculations. Figure 1 shows the contact pressure epure in the joint at zero clearance, load 4500 N, and ball diameter 28 mm. It is apparent that the maximum contact pressure area is at the symmetry axis, which contradicts the assumed interaction mechanics.

Statistical processing of the findings yielded the equation for determination of the maximum contact pressure at zero clearance:

$$\sigma_{\max}(D, P) = 1.72 \frac{P}{D^2}, \quad (1)$$

here  $\sigma_{\max}(D, P)$  is the maximum contact pressure;  
 $P$  is force (N);  
 $D$  is the sphere diameter (mm); and 1.72 is the coefficient yielded by the statistical processing of the data determined by the calculation [1].

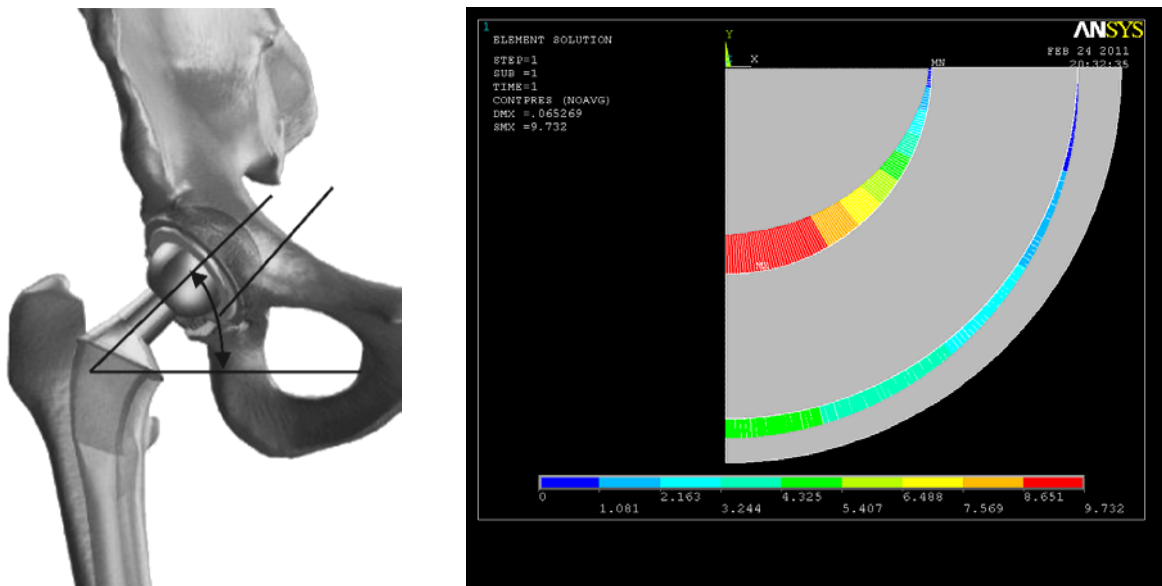


Figure 1 – Epures of contact pressure between endoprosthesis components (spherical ball; acetabular cup; race)

Thus, the dependence of the maximum contact pressure  $\sigma_{\max}$  in the tri-componental endoprosthetic on the sphere diameter, force, and clearance is non-linear. The ball size and design of the prosthetic should be selected for a particular patient with account of his weight to prevent intensive wear of the acetabular component.

#### REFERENCES

1. Contact Pressure in Hip Endoprosthetic Swivel Joints / A. V. Grushko, S. E. Sheykin, I. Yu. Rostotskiy // *Journal of Friction and Wear*. – 2012. – Vol. 33, N 2. – P. 124–129. – ISSN 1068-3666.

## СУЧАСНИЙ ЗАСІБ ВИКОРИСТАННЯ ІНФОРМАЦІЙНИХ ТЕХНОЛОГІЙ ДЛЯ НАКІСТКОВОГО ОСТЕОСИНТЕЗУ ОПОРНО-РУХОВОГО АПАРАТУ ЛЮДИНИ

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Сучасні інформаційні технології все більше використовуються в галузі охорони здоров'я, що буває зручним, а часом просто необхідним. Завдяки цьому медицина, в тому числі і нетрадиційна, набуває сьогодні абсолютно нових рис. У багатьох медичних дослідженнях просто не можливо обійтися без комп'ютера і спеціального програмного забезпечення