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PROSTHESIS FOR FEMORAL HEADS

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12 Claims. (Cl. 128—92)

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This invention relates to prostheses for arthroplasty and more specifically to prostheses made from synthetic materials suitable for injection molding, and to processes for the production of said prostheses.

At this time, the most commonly used prosthesis of a joint is the one of the head of the femur which may consist of a cap or of a round or polygonal shaft attached to a cap so as to form a mushroom-shaped piece. The cap may consist of a hemispherical solid portion with a protruding rim of generally cylindrical shape which will surround the neck of the femur while the shaft is anchored inside the neck.

It is known to make prostheses of this kind from methyl methacrylate and from polyurethane. The known prostheses, however, have the disadvantage of not offering adequate fixation inside the bone. Due to their method of production by turning, arthroplastic prostheses made from methyl methacrylate have been of circular cross section and only the point of the shaft is of angular section. Prostheses made from polyurethane have been made with other than round shafts, particularly with shafts of quadrangular section. According to the present invention, such prostheses are provided with special means for preventing rotation and longitudinal displacement along the axis of the shaft. This results in excellent fixation of the prosthesis to the bone which satisfies all requirements.

According to the method of the invention, such arthroplastic prostheses are produced by injection molding. Only by this method is it possible to produce in an economical way the shapes described by this invention. It has furthermore been shown that certain synthetic materials which are suitable for injection molding cannot be worked by machining since their best mechanical properties can be obtained only when the materials are used in thin sections. The size and the special shapes of prostheses according to the invention have presented difficult problems to the art of injection molding and have necessitated the use of novel methods of molding which therefore also are essential parts of the invention.

The specification is accompanied by a drawing in which:

Fig. 1 is a longitudinal section through a prosthesis according to my invention for a femoral head, this view being explanatory of the manufacture of the prosthesis;

Fig. 2 is a longitudinal section through the completed prosthesis;

Fig. 3 is a longitudinal section through a modified prosthesis; and

Fig. 3B is a cross section taken in the plane of the line 3B—3B of Fig. 3.

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Referring to the drawing, and more particularly to Figs. 1 and 2, the prosthesis consists of a cap *a* and a shaft *b*.

To secure the prosthesis against longitudinal displacement, transversal ridges are provided at the lower end of the shaft. Once the prosthesis is properly positioned, applied stresses will be detrimental only when applied as tensile stresses. The transversal ridges are, therefore, given a saw tooth profile in such a way as not to offer much resistance to further penetration of the shaft into the bone, but to lock it firmly when tensile stresses are applied. In Fig. 2 a prosthesis according to the invention is shown in longitudinal section with the profile of the ridges indicated at (*d*).

Means for preventing rotation of the prosthesis are provided not only at the shaft but ribs are located in the concave portion of the cap (Figs. 1 and 2, *i*) and pins protrude over the rim of the cap as shown in the sectional drawings of Figs. 1, 2 and 3, *h*, and may form extensions of the ribs *i*. Further means for preventing rotation of the prosthesis may be provided by not giving a smooth surface to the peripheral wall *k* of the cap, but by using e. g. a knurled surface. It is possible to secure the rim *l* of the cap against rotation by serrations instead of protruding pins *h*. It is essential to locate obstacles against rotation at the peripheral part of the cap so as to gain a mechanical advantage as compared to location on the shaft of the prosthesis only.

In the example of the invention shown in Fig. 3, the cap of the prosthesis is formed by a shell of relatively thin section reinforced by ribs *i'* which run without major change in cross sectional area along both the cap and the shaft. This shaft may have a star-shaped cross section. The number of points of this "star" is determined by the number of reinforcing ribs. I prefer to use four ribs which in the center of the cap merge into a shaft of cross-shaped section such as shown in Fig. 3B. When using a cross section of this type, one avoids development of shrinkage tension which normally builds up where the cap is joined to a shaft of circular section. In a cylindrical shaft, the material on solidification shrinks radially towards the axis of the cylinder, in the cap however shrinkage is directed towards the center of inertia of the section a space which is located towards the periphery of the cap. A shear stress therefore develops in the region of transition from the cap of the prosthesis to the shaft and mechanical shock may cause the cap to break from the shaft. According to the invention increasing diameter of the shaft or its ribs approximating to the cap extends this region and reduces the stress.

If the material is not sufficiently plastic to take such shrinkage stresses without damage, an axial