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PROSTHETIC PARTS AND METHODS OF MAKING THE SAME

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The present invention relates to improved prosthetic parts and to improved materials useful in forming prosthetic parts and to the method of making the same.

The present invention is particularly useful when applied to prosthetic parts to be used as substitutes for bone in the skeletal structure of an animal or to reinforce the skeletal structure of an animal and will be so described but it is not intended to limit the scope of the invention to such prosthetic parts, as will be described more fully hereinafter, those parts being presented only for purposes of illustration.

Materials of construction utilized heretofore in forming internal prosthetic parts of the type set forth have included metals and plastics, the preferred metal being "Vitallium" and the plastics most generally utilized having been the polyamide or nylon resins and the acrylic resins. The "Vitallium" metal is an alloy comprising 65% cobalt and 30% chromium and 5% molybdenum and is selected for its inertness toward the fluids found in an animal body; however, "Vitallium" has certain serious disadvantages for use as an internal prosthetic part. First of all, the "Vitallium" metal is heavy and has a specific gravity several times that of the bone which it replaces and in addition the metal is relatively brittle and can be shaped only with difficulty. There also have been instances of failure due to stress-corrosion and/or fatigue.

The internal prosthetic parts formed of plastic resins, such as nylon, used heretofore have certain advantages over "Vitallium" in that they are lighter in weight, have a specific gravity more nearly that of the bone which they replace, and when strained more nearly conform to the flexural movements of bone. The structural strength of the plastic resin parts, however, is not as great as the bone which they replace and disastrous results have been encountered in the use of these materials as a result of mechanical failure. There also have been substantial problems preesnted in the use of prosthetic parts formed of plastic resins in that the resins become brittle upon aging and are not sufficiently abrasion resistant; as a result crumbs of the resin sometimes are broken away from the prosthetic part and cause serious damage in the body tissue into which the crumbs come in contact.

All of the internal prosthetic parts available heretofore have had a common deficiency in that no workable structure has been provided which permits incorporation of the internal prosthetic part as an integral portion of the muscular-skeletal system of the associated animal in which the prosthetic part is inserted. Various attempts have been used to provide anchorage means for the growth of bone and muscle on prior prosthetic parts, but such efforts to promote the attachment of bone and muscle have met with failure.

Accordingly, it is an important object of the present invention to provide an improved prosthetic part and particularly an improved prosthetic part for internal use which readily accepts growth of body tissue against the surface thereof.

Another object of the invention is to provide an improved prosthetic part of the type set forth which has at least a portion of the surface thereof porous to facilitate and to enable the growth of bone, muscle and fibrous tissue thereinto so as to incorporate the prosthetic part into the muscular-skeletal system of the body in which the prosthetic part is implanted.

Yet another object of the invention is to provide an improved internal prosthetic part of the type set forth which is highly resistant to chemical attack by animal body fluids and which causes no adverse tissue reaction in the animal.

Still another object of the invention is to provide an improved internal prosthetic part made from an improved structural material which is lightweight and has a density substantially equal to that of bone, yet possesses good structural strength equal to or even exceeding that of bone.

In connection with the foregoing object, it is another object of the invention to provide an improved internal prosthetic part that is formed of a porous ceramic which is highly inert to animal body fluids and which possesses the desired structural characteristics.

Still another object of the invention is to provide an improved prosthetic part of the type set forth which more nearly resembles natural bone in surface color and texture and whcih possesses a dull surface finish which reduces glare at the operative site.

Yet another object of the invention is to provide an improved internal prosthetic part which is formed from an improved composite material comprising a porous ceramic having a synthetic organic plastic resin disposed in the pores thereof and adhering to the walls of the pores to impart to the composite material increased toughness anud flexibility and flexural strength of an order at least equal to and preferably greater than bone.

Still another object of the invention is to provide an improved internal prosthetic part of the type set forth which is readily reproducible so that the characteristics of the parts are predictable, the prosthetic parts being formed of a material of the type set forth which further possesses a hardness such that it can be readily shaped by ordinary tools.

A still further object of the invention is to provide improved methods of making internal prosthetic parts of the type set forth.

Still further features of the invention pertain to the particular arrangement of the elements of the improved prosthetic parts and of the composition of the construction materials thereof, and the steps of the methods of making the prosthetic parts, whereby the above-outlined features and advantages are attained.

The invention, both as to its organization and method, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a plan view on an enlarged scale of an internal prosthetic part in the form of a bone implant made in accordance with and embodying the principles of the present invention;

FIG. 2 is a perspective view on a reduced scale of an internal prosthetic part in the form of a femoral prosthesis made in accordance with and embodying the principles of the present invention;

FIG. 3 is a fragmentary view in cross section on an enlarged scale through the femoral head of the prosthesis of FIG. 2 substantially as seen in the direction of the arrows along the line 3—3 thereof and illustrating the disposition of the synthetic organic plastic resin in the pores of the ceramic material;

FIG. 4 is a fragementary view in section on an enlarged scale along the line 4—4 of FIG. 2 illustrating that the portions of the pores adjacent to the surface are free of resin to permit growth of bone, muscle and fibrous tissue thereinto;