

[54] **PROSTHETIC DEVICE FOR THE TARSAL JOINT**

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[58] Field of Search..... 3/1; 128/92 C, 92 CA, 92 R

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[57] **ABSTRACT**

A partial prosthesis for the human tarsal joint has a first member of synthetic plastic material which is to be anchored in the head of the tibia and which has an exposed concavely curved first surface. A second member of metallic material is to be anchored in the talus and has an exposed second surface which is convexly curved on a radius different from that of the first surface, and which engages the first surface with at most line contact.

3 Claims, 5 Drawing Figures



Fig. 1

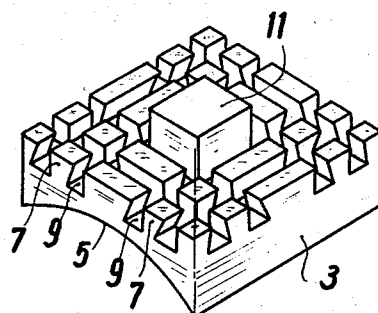
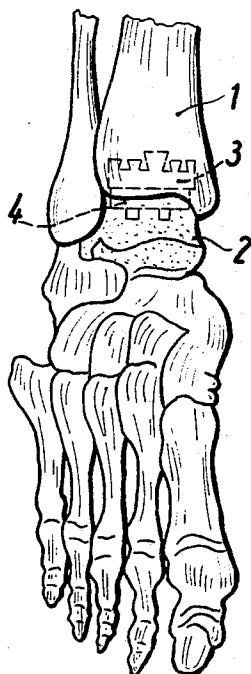


Fig. 2

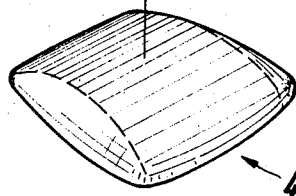


Fig. 3

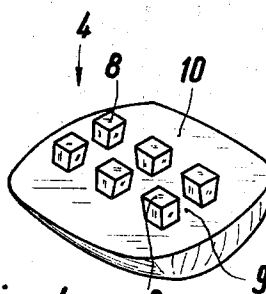


Fig. 4

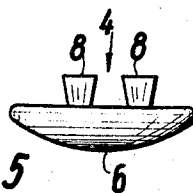


Fig. 5

PROSTHETIC DEVICE FOR THE TARSAL JOINT

BACKGROUND OF THE INVENTION

The present invention relates to a prosthetic device in general, and more particularly to a partial prosthesis for the human tarsal joint.

The use of prosthetic devices is becoming more and more widely accepted, as the variety and adaptability of such devices increases. One area where heretofore prosthetic devices have not been employed is the human tarsal joint, despite the fact that there are circumstances--such as arthritic problems or permanent mal-positioning of the joint with a resultant high-level of continuous pain--which make the employment of a tarsal joint prosthesis highly desirable. Heretofore it was always thought that it would be impossible to replace the tarsal joint by a prosthetic device of conventional type, because the approximately roller-shaped talus bone is relatively small and it is, for instance, impossible to anchor in it a prosthesis utilizing a long shaft which would have to be anchored in the talus bone in order to provide for a proper securement.

Because of the difficulties in employing a prosthesis, an alternative has been used, namely to stiffen the tarsal joint and make it thereby immovable, in order to reduce or eliminate the constant pain experienced under the aforementioned conditions. This, however, is also not fully satisfactory for the very reason that the stiffening operation involves making the tarsal joint immovable.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to overcome the disadvantages of the prior art.

More particularly, it is an object of the present invention to provide a partial prosthesis for the human tarsal joint.

An additional object of the invention is to provide such a partial prosthesis for the human tarsal joint which permits the surgeon to retain the form of the bones of the joint largely unchanged.

In keeping with these objects, and with others which will become apparent hereafter, one feature of the invention resides in a partial prosthesis for the human tarsal joint which, briefly stated, comprises a first member of synthetic plastic material which is adapted to be anchored in the head of the tibia, this first member having an exposed concavely curved first surface. A second member of the prosthesis is of metallic material and adapted to be anchored in the talus, and the second member has an exposed second surface which is convexly curved on a radius different from that of the first surface and which engages the latter with at most line contact.

With this construction, a simple arrangement is provided for permitting relative movement of the two members and the bones in which they are anchored, reducing frictional resistance to a minimum. Furthermore, because the surfaces are both configured of part-cylindrical outline, the prosthesis permits a slight lateral relative shifting of the two members and therefore of the bones with which they are connected. Despite the small size of the tibia, the construction according to the present invention permits the surgeon to anchor the members appropriately, retaining the bone

substance to a very significant extent, so that even if the operation during which the prosthesis is inserted should finally be found to have been unsuccessful, it is still possible subsequently to stiffen the tarsal joint in the previous manner, which would not be possible if during the anchoring of the first member in the tibia a large portion of the substance of the tibia bone were destroyed for anchoring purposes.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

Fig. 1 illustrates the skeleton of a human foot with the partial prosthesis according to the present invention being inserted;

FIG. 2 is a perspective view illustrating a first member of the partial prosthesis;

FIG. 3 is a top view of the second member of the partial prosthesis which cooperates with the first member shown in FIG. 2;

FIG. 4 is a bottom view of the member shown in FIG. 3; and

FIG. 5 is a side view of the member shown in FIGS. 3 and 4.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawing, and firstly to FIG. 1, it is emphasized that the skeleton of the human foot shown there has been provided to illustrate where the partial prosthesis according to the present invention is located. The upper tarsal joint, which is to be replaced by the partial prosthesis according to the present invention, is clearly visible in FIG. 1 and will be seen to be located between the head of the tibia bone 1 and the approximately roller-shaped relatively small talus bone 2. A comparison of FIGS. 1 and 2 will show that one of the members of the partial prosthesis is substantially block-shaped, being identified with reference numeral 3. It is anchored in the tibia bone and has a free surface (its underside) which is provided with an inwardly concavely curved part-cylindrical surface 5. FIGS. 3-5 show in different views the second member of the partial prosthesis which cooperates with the first member 3 and is identified with reference numeral 4. The second member 4 is a metallic plate having an exposed convexly curved part-cylindrical surface 6 whose radius of curvature is substantially smaller than the radius of curvature of the surface 5. Thus, when the surfaces 5 and 6 engage one another they are in line or point contact, but not in surface-to-surface area contact. The reduction of frictional resistance which results from this, is clearly evident and requires no detailed discussion. In the example, it is pointed out that the radius of curvature of the surface 5 may, for instance, be 31 mm., whereas the radius of curvature of the surface 6 may, for instance, be 25 mm., although both of these figures should be understood to be exemplary only.

The member 3 is of synthetic plastic material, and high-molecular polyethylene has been found to be particularly advantageous for this purpose. The member 4

is of metallic material and its surface 6 is polished to a high degree of smoothness.

The sides or surfaces of the members 3 and 4 which face away from surfaces 5 and 6, respectively, that is the support surfaces which contact the respective bones, are provided with anchoring projections 7 and 8, respectively, which extend outwardly and conically diverge outwardly, so that grooves or depressions 9 are formed between them which are particularly advantageous for anchoring in the respective bone, using a bone cement which is well known to those skilled in this field.

The talus bone 2 is so small that the member 4 which is to be anchored in it cannot be provided with an elongated shaft or projection to extend into the talus bone, that is to be driven into the bone 2. Because of this, the invention provides that the member 4 is produced in various different sizes of which the one to be used is so selected--depending upon the particular anatomical circumstances of a given case--that it is just large enough to be able to rest with its margins 10 on the hard portions of the bone and not to sink into the talus bone 2. In accordance with the invention, it is advantageous under these circumstances that the projections 8 of the second member 4 be provided only in the center portion thereof, as shown in FIG. 4.

The second member 4, which is plate-shaped as mentioned earlier, is approximately trapezoidal in outline as shown in FIG. 3. The purpose of this is to take into account the fact that usually the talus bone is slightly wider at the front side of the foot than at the rear side, so that the particular configuration chosen for the member 4 can fully utilize the supporting surface of the talus bone.

Bones have, generally speaking, a hard outer skin, the corticalis, and a soft inner spongy structure, the spongiosa. That being the case, the implantation of the projections of the second member 4 is advantageously carried out by forming a hole in the outer hard layer of the talus bone, removing (e.g., by drilling) all or most of the spongiosa, and filling the resulting cavity with a bone cement which, when hardened, will retain the projections of the member 4. The member 4 will then be supported on a relatively long hard outer surface layer of the talus.

When the prosthesis according to the present invention is used for adults, then a size of the first member 3 of approximately 34 x 40 mm. is usually sufficient, because if the member 3 should be found to be too large during the operation, material can be removed from it inasmuch as it is made of synthetic plastic. This is not possible with the second member 4 which is of hard metallic material. It is therefore advantageous if the second member 4 is made in several different sizes, as mentioned earlier, for instance four sizes on the order of approximately 28-29 mm. up to a largest width of approximately 35-36 mm., and with a length of the non-parallel edges of approximately 35 mm. The maximum dimension in direction normal to the general plane of the member 4 is advantageously between ap-

proximately 4 and 6 mm., and the length of the projections is approximately 4 mm. It will be understood that the similar maximum dimension of the first member 3 can be larger, because the tibia bone 1 permits greater material removal. For this reason it is also advantageous, in order to obtain an improved anchoring effect, if the various projections 7 on the first member 3 are of various different lengths, although that is, of course, not absolutely necessary.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the type described above.

While the invention has been illustrated and described as embodied in a prosthetic device, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A partial prosthesis for the human tarsal joint, comprising a first rigid member of synthetic plastic material, substantially block shaped, having an exposed concavely curved first surface of part-cylindrical shape, and a support surface facing away from said first surface and including a plurality of discrete trapezoidal-shaped projections of different sizes extending over the entire support surface, substantially diverging in a direction away from said support surface; a second rigid member of metallic material, substantially plate-shaped and of substantially trapezoidal outline, having an exposed convexly curved second surface of part cylindrical shape with a radius of curvature different from that of said first surface, and a support surface facing away from said second surface and including a plurality of discrete trapezoidal-shaped projections substantially diverging in a direction away from said support surface provided on only a center portion of said support surface; whereby said first rigid member is adapted to be fastened to the head of the tibia, and said second rigid member is adapted to be fastened to the talus so that said first and second members engage each other in line contact and have limited freedom of lateral displacement along the line of contact.

2. A prosthesis as defined in claim 1, wherein different ones of said projections of said first member are of different lengths.

3. A prosthesis as defined in claim 1, wherein said first member is of high-molecular polyethylene.

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