ARTIFICIAL LIMB FOR THE KNEE JOINT

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ABSTRACT

An artificial limb particularly suitable for the knee joint of a human being consisting of at least two coating inserts or implants, which are anchored to the end of the thigh bone and the shin bone. The insert on the thigh bone is a cup-shaped surface and the insert on the shin bone is formed like a block to provide a free supporting face for contact by the surface of the cup-shaped insert.

3 Claims, 4 Drawing Figures
ARTIFICIAL LIMB FOR THE KNEE JOINT

The present invention relates to a prosthesis and in particular to a partial prosthesis or artificial limb for the knee joint of a human being.

Different sicknesses in the region of the knee joint, like osteoarthritis, polyarthritis, and sickness which usually follows single or double fractures of the shin bone (tibia), or fractures of the condyles, may cause chronic changes and destruction, or partial destruction of the bone tissue, thus requiring the usage of a prosthesis or artificial limb. When complicated fractures occur, for instance, when the medial and/or the lateral tibia plateau is substantially destroyed, that is, the inner or outer bearing face of the shin bone is damaged, the knee joint is usually amputated and replaced by an artificial knee joint. This total amputation of the knee joint is used also in cases of arthritis or polyarthritis, that is, in cases where a total amputation of the knee joint is not usually required, but is carried out nonetheless, because of lack of a better solution. It should be noted that in such cases the shape of the joint heads are substantially or completely intact. When there is a total replacement of the human knee joint, the artificial joint has a lot of disadvantages. An artificial replacement of the natural knee joint constitutes a rather large implant with respect to the surrounding natural soft tissue which encompass the implant, and may cause injuries after the healing process. Furthermore, experience has shown that wound infections easily occur. Moreover, conventional artificial knee joints do not accommodate the normal anatomic structure of a natural knee joint. It should be noted that the known artificial knee joints are constructed like hinges and do not permit a lateral movement of the knee joint.

Thin intermediary metal bodies between the joint faces of the bones have been implanted to permit better freedom of movement in cases of arthritis. However, these implants of metal bodies or plates in the bones cannot be secured satisfactorily. On the one hand, it is preferable to implant such intermediary bodies, due to the minor operation required, opposite to a total replacement of the natural knee joint. However, the degree of success in these types of operations is rather low.

Accordingly, the subject invention provides a prosthesis or artificial limb for the natural knee joint in a human being wherein the aforementioned disadvantages do not occur. The prosthesis to be implanted should be as small as possible in its measurements, so that only a comparatively low amount of bone tissue substance has to be removed, so as to prevent the above mentioned disadvantages associated with a larger implant. It should be noted that the smaller implant of the artificial knee joint should be designed so that it does not cause a loss in stability and function. Moreover, the stability and function of the knee joint is improved so that the natural construction of a knee joint is substantially maintained.

In the invention, the subject prosthesis consists of at least two cooperating inserts or implants. One of the inserts or implants is mounted on the head of one of the shin bones in the form of a cup which assumes the curve of the head of the joint. The other insert or implant is mounted on the head of the other shin bone having a freely exposed support face to receive the first mentioned cup shaped insert or implant. It is to be understood that if one of the inserts or implants is referred to as cup shaped, it does not necessarily mean that this insert must be completely curved on its outside surface, which is directed towards and engages the supporting face of the other insert. However, such a cup shaped form is preferable, because it permits a point or linear engagement with the other insert to provide a favorable rolling action corresponding to the formation of the natural shin bone condyles. In contrast to the conventional artificial knee joints, wherein the artificial joint heads are linked together by means of hinges, the two opposite inserts or implants of the subject invention are not positively locked, but are independent of each other.

In order to obtain satisfactory walking conditions and favorable friction conditions, the inserts or implants are produced of alloplastic material, in accordance with the invention. In practice, it has been shown that it is rather advantageous if one of the inserts consists of a suitable metal, and the other insert is made of a suitable plastic. Such a combination has a favorable effect on the natural surrounding tissue and a minimum of abrasion. A further advantage is that the plastic material insert is relatively elastic which enables it to conserve the kinetic or pressure energy which acts on the joint as potential energy.

In a preferred embodiment of the invention, the cup shaped insert consists of metal, and the block-like insert consists of an elastic, plastic material. A suitable metal material is a refined steel with, for example, a chrome or nickel on a molybdenium base. A suitable plastic material is, for example, a high molecular polyethylene material. However, it is to be understood that other equivalent suitable materials may be used. In order to obtain a favorable friction and abrasion factor, it is recommended that one of the insert surfaces be highly polished. In order to freely anchor the insert in the bones, protrusions are provided on the inside of these inserts. The securing of the inserts is carried out by using a suitable bone cement. A number of certain acrylic resins are commercially available for use as bone cement.

It is therefore an object of the present invention to provide an artificial limb having two cooperating inserts secured to the thigh bone and the shin bone which permit greater freedom of movement than conventional devices.

It is another object of the invention to provide an artificial limb which is simple in design, easy to manufacture, and reliable in operation.

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawing which discloses the embodiments of the invention. It is to be understood, however, that the drawing is designed for the purpose of illustration only, and not as a definition of the limits of the invention.

In the drawing, wherein similar reference characters denote similar elements throughout the several views.

FIG. 1 is a perspective view of a cup shaped insert or implant for the thigh bone according to the invention.

FIG. 2 is a perspective view of a block-like insert made of plastic material for a shin bone.

FIG. 3 is a schematic side view of the joint heads of the thigh bone and the shin bone with the implanted artificial inserts; and,
FIG. 4 shows a schematic front view of the arrangement shown in FIG. 3. Referring to the drawings, there is shown a thigh bone (femur) 1, and a shin bone (tibia) 2, and the associated condyles 3 and 4 and the condyles 5 and 6 of the thigh bone (femur) and shin bone (tibia), respectively. As can be seen in FIG. 1, an insert or implant 7 is anchored in the joint head of thigh bone (femur) 1 in the medial condyl 3, as well as in the lateral condyl 4. Accordingly, as can be seen from FIG. 2, an insert or implant 8 is anchored in the joint head of the shin bone (tibia) in the medial condyl 5 and the lateral condyl 6. The cast cup shaped insert or implant 7 consist of high austenic refined steel which is highly polished on its outside surface. The cup is about 20-mm wide and 3-mm thick. The curve of the cup shaped insert or implant conforms to the natural curve of condyles 3 and 4. While the outside 9 of cup shaped implant 7 is curved at all sides, forming almost an arc, because the cup is bent in a right angle with respect to the aforementioned curve, the inside 11 of the cup shaped implant has only a curve corresponding to the natural bone. Protruding shoulders 12, 13, and 13' are provided on inside 11 for fixedly anchoring implant 7 to the natural bone. Grooves 14 are provided on the rod like shoulders 12 facilitating the anchoring of the shoulders to the natural bone, whereby the grooves are arranged laterally with respect to the longitudinal axis of the rod-like shoulders. The low shoulders are formed as either ribs 13 or cams 13'.

The implant 8 shown in FIG. 2 consists of high polymer polyethylene. The supporting face 16 is flat and coats with the outer surface 9 of implant 7. The supporting face is about 4 cm long and 2 cm wide, and corresponds to about the half of the load face of a shin bone condyl of a large knee joint. If these dimensions are too big for a smaller knee joint, the block may be reduced, intraoperative, without any difficulties. The side faces 17 of the implant 8 are in an acute angle with respect to supporting face 16. An anchoring bar 18 is mounted on the inside of implant 8, which is directed toward the shin bone (tibia) 2. To facilitate the anchoring, anchoring bar 18 is provided with grooves 19. A groove 21 is provided between anchoring bar 18 and the supporting face 16 which guarantees a secure mechanical anchoring.

Implants 7 and 8 are cemented into the natural bones with acrylic resin bone cement, after the knee joint is opened and the cartilage is removed, and the anchoring holes are milled into the natural bones for shoulders 12, 13, 13' and 18. This operation should be carried out in the extreme bending position of the knee joint. Before the bone cement hardens, the knee should be brought into its extreme horizontal position, in order to take care of eventual corrections, and to check the relative position of implants 7 and 8, with respect to each other.

It should be understood that if there is a lesser degree of damage to the knee joint, only one implant 7 or 8 may be implanted together with its associated condyl 3, 5, or 4, 6, respectively. The inventive prosthesis may also be used in so called crushed fractures of the knee joint, as long as the ligaments are still intact. The particular advantage of subject invention resides in the fact that the implant is rather small and light, and that the implant is not surrounded by soft tissue, but is maintained in the bone tissue.

In accordance with the invention, the prosthesis permits not only a bending and stretching movement of the knee joint, but also permits the slight turning and lateral movements which are possible with a natural knee joint. It should be noted that different materials may be used, however the above described embodiment is the preferred embodiment of subject invention.

While only a few embodiments of the present invention have been shown and described, it will be obvious that many changes and modifications may be made thereunto without departing from the spirit and scope of the invention.

What is claimed is:

1. An artificial limb for the knee joint of a human being, comprising:

a first rigid member, including a curved strip of material, having a plurality of radially inwardly extending fastening members integrally formed therewith disposed on the inside surface of said strip of material, at least two of said fastening members having a tapered rectangular shape and a plurality of parallel peripheral grooves spaced apart along the length thereof; and

a second rigid member, comprising a tapered block of material having a planar upper surface engaging the outer surface of said curved strip of material, and a peripheral groove disposed between the upper and lower surfaces thereof,

whereby at least one first rigid member is adapted to be fastened to the condyl of the thigh bone, and at least one second rigid member is adapted to be fastened to the tibia of the shin bone, so that said curved strip of material of said first rigid member engages the top planar surface of said second rigid member in point contact therewith.

2. The artificial limb as recited in claim 1, wherein said fastening members disposed on the inside surface of said strip of material include a plurality of elongated parallel rib members, integrally formed with said strip of material.

3. The artificial limb as recited in claim 2, wherein said curved strip of material is constructed of metal, and said second rigid member is constructed of plastic material.