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(19)

(54) ENDOPROSTHETIC BONE JOINT DEVICES

(71) We, NATIONAL RESEARCH DEVELOPMENT CORPORATION, a British Corporation established by Statute, of Kingsgate House, 66 - 74 Victoria Street, London, S.W.1, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

This invention concerns endoprosthetic bone joint devices, and more particularly such devices for the knee joint.

Various devices have been proposed with a view to providing a knee joint endoprosthesis which simulates the natural joint function. However, it is well established that the knee joint is a complex mechanism and it is probably generally accepted that the devices proposed so far only result in simulations which represent varying compromises between the different functional characteristics of the natural joint. Indeed, each device can be regarded as suffering from one or more disadvantages.

For example, the more recently proposed forms of such devices commonly comprise two components which are respectively secured to the femur and tibia to be held in mutual articulatory bearing engagement, in substitution for the natural condyles, by the ligaments and other elements of the joint capsule. One facet of the variations between the recent forms involves the shapes of the bearing surfaces of the relevant components. However, insofar as these shapes are predetermined for any given device and these shapes are to be fixed relative to the femur and tibia, the intended simulation result requires that the component be secured in, or close to, predetermined locations on the respective bones.

An object of the present invention is to reduce the stringency of this requirement without necessarily or unduly compromising the resultant simulation in other respects.

For this purpose, there is provided an endoprosthetic knee joint device comprising first and second components of generally slab shape, one face of each component defining a substantially planar bearing surface for mutual sliding engagement between such faces, said faces being further formed to prevent rotational sliding movement therebetween, the other face of the first component being adapted for securement to the tibia as a tibial condylar substitute, and other face of the second component defining a concave bearing surface for mutual articulatory engagement with a femoral condylar surface.

It is presently contemplated that the concave surface of the second component will normally be engaged with a natural femoral condyle, but it is probable that some circumstances will require the provision of a femoral condylar substitute. In the latter case the proposed device will additionally comprise a third component which has one face defining a convex bearing surface for mutual articulatory engagement with said second component concave bearing surface, and an opposite face adapted for securement to the femur.

In practice the first and third components of the proposed device can be likened to the tibial and femoral components of the known devices discussed above, but the second component has no equivalent in the latter devices and can be regarded as a meniscal substitute component.

Also, it is to be understood that the components of the proposed device are intended for application normally to an individual, lateral or medial, compartment of the knee so that two sets of components will be employed for a total joint prosthesis.

The above and other features of the invention will be further understood by the following description, given by way of ex-

ample, of one embodiment thereof with reference to the accompanying drawings, in which:-

Figures 1 and *2* respectively show a plan view and an end elevation of the relevant tibial component;

Figures 3 and *4* respectively show side and an elevations of the associated meniscal component, and

Figure 5 schematically illustrates in side view these components in working relation relative to the tibia and femur.

The illustrated tibial component is denoted generally at 10 and comprises a main body 11 in the form of a rectangular slab of uniform thickness. One face of this body defines a planar bearing surface 12, which face is additionally formed with a open-ended slot 13 extending centrally therealong in the direction of the major rectangular dimension, and this slot has a dove-tailed cross-sectional shape. The other face of the body 11 is adapted for securement to the tibia by use of bone cement and is formed with a relieved configuration for this purpose. In this instance, the configuration involves the provision of a rib 14 extending integrally from the relevant face, this rib being complementary in shape and corresponding in location and extent to the slot 13.

The illustrated meniscal component is denoted generally at 20 and comprises a main body 21 in the form of a rectangular slab of the same width as, but shorter length than, body 11 of the tibial component. One face of the body 21 defines a planar bearing surface 22, this face being additionally formed with an integral rib 23 complementary with, and correspondingly located as, the slot 13 of the tibial component. The other face of the body 21 is wholly dished to define a concave bearing surface 24, this surface being of a part-circular-cylindrical shape with its axial direction parallel to that of the minor rectangular dimension of body 21.

Use of this embodiment is indicated by Figure 5. The tibial component is secured with cement to a suitably prepared site in the tibia 40 as a unicondylar substitute, with the slotted planar surface uppermost, and with the slot and rib of the component extending in the antero-posterior direction. The meniscal component is located between the tibial component and the corresponding femoral condyle of the femur 50 with the planar bearing surface 22 engaged with the corresponding surface 12, and with the rib 23 slidably engaged in the slot 13 and located longitudinally therein so that the relevant femoral condyle seats in the concave bearing surface 24. The resultant arrangement is such that, during flexion-extension movement, dynamic loads between the femur and tibia are conveyed by rolling and sliding between the femoral condyle and meniscal component, and by sliding between the meniscal and tibial components.

This arrangement is advantageous from several points of view. There is advantage from a surgical point of view in the facility whereby the meniscal component can be slidably located to the seat the femoral component in an optimum position for a given securement of the tibial component. Also, the meniscal component can be selected from a range of such components of different thickness to appropriately stiffen the ligaments and avoid any undesired laxity. In addition, the meniscal component can be replaced by way of a simple meniscotomy incision to take account of displacement of, or wear in, the original component.

There is also advantage from an engineering point of view in that contact stresses arising from rolling of the femoral condyle on the meniscal component are reduced by sliding of the meniscal component on the femoral component. The fact that the last-mentioned sliding is constrained to the antero-posterior axis does not significantly reduce this advantage since the flexion-extension movements occur predominantly in this direction at the relevant bearing interfaces. As to the sliding constraint itself: this serves to provide lateral stability between the two components.

While these advantages have been discussed in relation to the illustrated two-component device, they are equally relevant to the situation where a femoral component is also employed. For completeness in general description, such a component is illustrated in broken outline at 30 in Figure 5, this component being of any compatible known form such as that of a so-called 'Polycentric' endoprosthetic knee joint device as developed by Gunston, for example. In the case of the illustrated embodiment the femoral component preferably defines an articulatory bearing surface having a major cross-sectional profile of circular arcuate shape complementary to the circular cylindrical shape. In any event, it is a further advantage of the invention that it can be applied for the purposes of a hemiarthroplasty when the condition of the femoral condyles permit this, or for the purposes of a total arthroplasty, and the latter can be provided by addition of the femoral component to take account of later femoral condylar degeneration after hemiarthroplasty.

Lastly, while the invention has been described with more particular reference to the illustrated example, it will be appreciated that variations of detail are possible within the broader scope of the invention as initially discussed. In particular the rib and slot engagement between the tibial and

meniscal components can be varied, and so also can the securement surface configuration of the tibial component. Also variations in the choice of materials among those in current usage is possible: although generally speaking the components are preferably of respectively integral contruction from plastics material or metal, and it is preferred that component interfaces be between plastics material and metal.

WHAT WE CLAIM IS:-

1. An endoprosthetic knee joint device comprising first and second components of generally slab shape, one face of each component defining a substantially planar bearing surface for mutual sliding engagement between such faces, said faces being further formed to prevent rotational sliding movement therebetween, the other face of the first component being adapted for securement to the tibia, and the other face of the second component defining a concave bearing surface for mutual articulatory engagement with a femoral condylar surface.

2. A device according to Claim 1 wherein said one faces are respectively formed with a rib and a groove which co-operate to prevent rotational sliding movement therebetween.

3. A device according to Claim 2 wherein said rib and groove are of complementary dove-tailed cross-sectional shape.

4. A device according to Claim 2 or 3 wherein first and second components are respectively formed with said groove and rib.

5. A device according to Claim 4 wherein said other face of said first component is adapted for securement to the tibia by the provision of a rib formation thereon, such rib having a corresponding location and extent to said groove.

6. A device according to any preceding claim wherein said first and second components are each of substantially non-square rectangular shape in plan view.

7. A device according to Claim 6 and any one of Claims 2 to 5 wherein each said rib and groove extends longitudinally in the direction of the major dimension of the respective rectangular shape.

8. A device according to Claim 6 or 7 wherein said second component has substantially the same as, but lesser length than, said first component.

9. A device according to any preceding claim wherein said concave surface is of circular cylindrical shape.

10. A device according to Claim 9 and any one of Claims 6 to 8 wherein the axis of said concave surface extends in the direction of the minor dimension of said second component.

11. A device according to any preceding claim wherein said components are respectively of integral plastics material and metal construction.

12. An endoprosthetic knee joint device substantially as herein described with reference to the accompanying drawings.

13. A device according to any preceding claim comprising a third component adapted for securement to the femur as a femoral condylar substitute and defining a convex bearing surface for mutual articulatory engagement with said concave surface.

14. A device according to Claims 9 and 13 wherein said convex surface has a major cross-sectional profile of circular arcuate shape complementary to said circular cylindrical shape.

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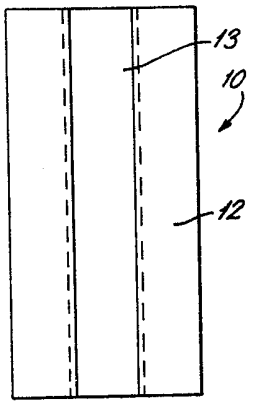

Fig. 1

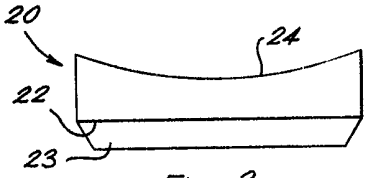

Fig. 3

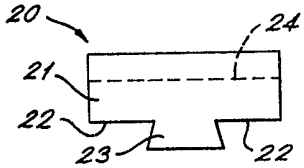

Fig. 4

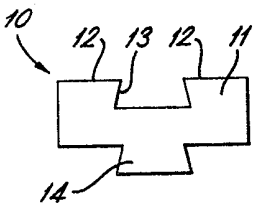

Fig. 2

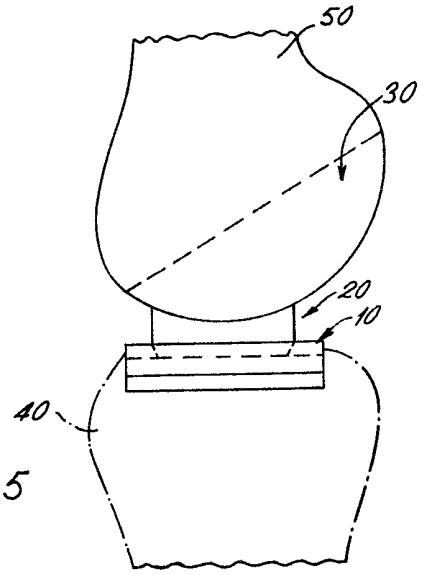

Fig. 5