Abstract:

Arthroprosthesis (1) with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, comprising a femoral shank (2) and a spherical head (3) which is accommodated rotatably in an artificial cotyloid element (4) and is associated with the femoral shank (2) by way of a variable-geometry neck (5) which acts as a connection between the shank (2) and the spherical head (3), the neck (5) having an end portion (5a) inserted with a conical interference in a slot (6) defined in the free end (2a) of the femoral shank (2) thus defining a conical coupling with the slot (6), the slot (6) being substantially frust-um-shaped with an end portion (6a), defined at a distance (11) from the bottom (8) of the slot (6), that has a substantially cylindrical shape in order to prevent the end portion (5a) of the neck (5) from jamming or seizing with the walls of the slot (6) if the neck (5) sinks, the cylindrical end portion (6a) interrupting the conicity of the walls at a distance (11) from the bottom (8) of the slot (6), thus preventing sticking or jamming in the distal end of the slot (6) if the neck (5) sinks.
ARTHROPROSTHESIS WITH FACILITATED IMPLANTATION, PARTICULARLY FOR BIOMECHANICAL RECONSTRUCTION OF THE COXOFEMORAL JOINT

The present invention relates to an arthroprosthesis with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint.

The use is known of arthroprostheses for biomechanical reconstruction of the coxofemoral joint, which comprise a femoral shank and a spherical head that can be mutually coupled to each other by way of a conical coupling between a slot and a distal end of a neck which are defined, respectively, in the free end of the femoral shank and on the portion of the spherical head directed toward the free end of the femoral shank.

More precisely, the spherical head is engaged in an artificial cotyloid element that replaces the acetabular cavity.

In order to obtain an arthroprosthesis that reconstructs as faithfully as possible the structure and the functionality of the coxofemoral joint that it is to replace, the use is known of femoral shanks of different shapes and geometries.

In particular, in order to provide an arthroprosthesis that is "modular", i.e. capable of being implanted in the majority of patients, a conventional technique is to provide the femoral shanks and artificial cotyloid elements in standard sizes and geometries so as to have to make only the neck to measure, which at one end is inserted in the proximal end of a femoral shank which is in turn inserted in a bone cavity that is provided artificially in the femur along a usually curvilinear trajectory.

More specifically, a plurality of necks can be provided of different length, lever arm and angle thus enabling the orthopedic surgeon to select the most suitable one for the implant under consideration.

Given the vast range of necks available to the orthopedic surgeon, such choice can even be made during the implant operation.
In fact, the ability to select from a vast range of necks makes it possible to adapt an arthroprosthesis implant to the different anatomical characteristics of patients, while also offering, without removing the shank from its seat, the great advantage of being able to replace the neck both during the primary surgical operation, and also in subsequent operations.

Modularity, in the prosthesization of the coxofemoral joint, is a necessity that orthopedic surgeons have felt as surgical operating technique has been refined over the years and as patients have expressed their desire that the surgical operation not only eliminates the pain caused by the malfunctioning of the joint to be prothetized, but also provides a functional restoration thereof.

Substantially, in preoperative planning the surgeon has to take care to identify the ideal dimensions of the shank and of the cotyloid element according to the anatomical characteristics of the patient to be operated on, in respect of the center of rotation of the femoral head, and can select the dimensions of the neck at another time, even during the actual operation.

In fact, certain particular situations present in the patient can be discovered by the surgeon only during operation, even with some components already implanted, a fact that inevitably precludes being able to completely dimension the arthroprosthesis in preoperative planning.

Such conventional arthroprostheses for biomechanical reconstruction of the coxofemoral joint are not devoid of drawbacks among which is the fact that during the insertion of the neck in the corresponding slot defined in the femoral shank, phenomena can occur of local seizing of the surfaces of the two elements in contact, which prevent the positioning and correct implanting of the arthroprosthesis.

This drawback derives from the fact that, since the insertion is done manually by the surgeon, the neck might not be perfectly in axial alignment with the slot of the femoral shank, which leads to a decentralization and/or to a jamming of the first with respect to the second and, owing to the thrust
necessary for insertion, localized points of excess pressure can be generated at the points of contact which lead to the formation of micro-welds between the two components, making them stick as a consequence.

As is known, sticking is facilitated when the two bodies in contact are made of the same material.

Since both the neck and the femoral shank are usually made of technologically advanced alloy, such as alloy of titanium, the possibility of sticking is very high.

Another drawback of conventional arthroprostheses for biomechanical reconstruction of the coxofemoral joint consists in that they are particularly subject to the phenomenon of fatigue.

More precisely, this drawback is due to the presence of very long lever arms which, with truly considerable loads in play - especially in the case of patients who are relatively young, active and heavy - not in axial alignment as a result of incorrect conical coupling, lower the fatigue limit of the arthroprosthesis.

The aim of the present invention is to eliminate the above mentioned drawbacks, by providing an arthroprosthesis, particularly for biomechanical reconstruction of the coxofemoral joint, that makes it possible to carry out an implant with ease by reducing to the minimum the possibility of incorrect mountings that could result in or increase phenomena of sticking and fatigue as in the known art.

Another object of the invention consists in providing an improved arthroprosthesis with facilitated implantation that is capable of offering the widest guarantees of reliability and safety in use.

Another object of the invention consists in providing an improved arthroprosthesis with facilitated implantation that is easy to provide and economically competitive when compared to the known art.

This aim and these and other objects, which will become better apparent hereinafter, are achieved by an improved arthroprosthesis with
facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, comprising a femoral shank and a spherical head which is accommodated rotatably in an artificial cotyloid element and is associated with said femoral shank by way of a variable-geometry neck which acts as a connection between said shank and said spherical head and has an end portion inserted with mechanical interference in a slot defined in the free end of said femoral shank, said end portion of said neck and said slot defining a conical coupling, characterized in that said slot is substantially frustum-shaped with an end portion, defined at a distance from the bottom of said slot, that has a substantially cylindrical shape in order to prevent said end portion of said neck from jamming or seizing with the walls of said slot if said neck sinks.

Further characteristics and advantages of the present invention will become better apparent from the description of a preferred, but not exclusive, embodiment of an improved arthroprosthesis with facilitated implantation particularly for biomechanical reconstruction of the coxofemoral joint, according to the invention, which is illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of an embodiment of an improved arthroprosthesis with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, according to the invention;

Figure 2 is an exploded perspective view of the arthroprosthesis shown in Figure 1;

Figure 3 is an enlarged-scale sectional view of the coupling between the femoral shank and the neck of the arthroprosthesis shown in Figure 1.

With reference to the figures, an improved arthroprosthesis with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, generally designated by the reference numeral 1, comprises a femoral shank 2, insertable in an artificially provided bone cavity in the femur of a patient, and a spherical head 3 which is
accommodated rotatably in an artificial cotyloid element 4 that can be fixed to the hip bone of the patient.

The spherical head 3 is associated with the femoral shank 2 by way of a variable-geometry neck 5 that connects the spherical head 3 with the femoral shank 2 and which is provided with an end portion 5a inserted with interference in a slot 6 defined in a free end 2a of the femoral shank 2.

More precisely, the end portion 5a of the neck 5 and the slot 6 have a substantially frustum-like shape defined around an axis of revolution 7 which coincides with the direction of insertion of the neck 5 in the slot 6 for the definition of a conical coupling.

Moreover an other end portion 5b of the neck 5 is frustum-shaped with a circular base and is inserted in an adapted cavity 20 defined at the base of the spherical head 3.

According to the invention, the slot 6 is substantially frustum-shaped with an end portion 6a that has a substantially cylindrical shape.

Advantageously, the cylindrical portion 6a interrupts the conicity of walls of the slot 6 at an edge 10 at a distance 11 from the bottom 8 of the slot 6. Such distance 11 may vary from 1.5 millimeter to 2 millimeters from the bottom 8 of the slot 6.

More specifically, the neck 5 is partially inserted in the cylindrical end portion 6a of the slot 6 along the axis of revolution 7 substantially for a depth that is variable from 0.1 millimeter to 1.5 millimeter.

Moreover, in order to prevent any form of jamming of the neck 5 in the slot 6, the end portion 5a is provided with a beveled and rounded profile 9.

In this manner, the frustum-shaped surface of the end portion 5a of the neck 5 comes out of contact with the edge 10 of the cylindrical end portion 6a of the slot 6 uniformly along the entire extension of the edge 10 of the cylindrical portion 6a of the slot 6.

For greater clarity, in Figure 3 the distance of the edge 10, the point of
6 interruption of the conicity of the walls of the slot 6, from the bottom 8 of the slot 6 and the distance of the neck 5 from the bottom 8 of the slot 6 (which may vary from 0.5 millimeter to 1.5 millimeter) are designated by the reference numerals 11 and 12, respectively.

In practice it has been found that the improved arthroprosthesis with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, according to the present invention, achieves the intended aim and objects in that, with the particular geometries described, occurrences of jamming of the neck in the slot are prevented.

Another advantage of the arthroprosthesis, according to the invention, consists in that it can be implanted while limiting to the minimum the possibility of decentralized insertions of the neck in the slot defined in the femoral shank, thus ensuring a correct contact between the two of them with consequent increase of the fatigue limit of the components employed, as well as limiting the possibility of sticking between the surfaces in contact.

The improved arthroprosthesis with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, thus conceived is susceptible of numerous modifications and variations all of which are within the scope of the appended claims.

Moreover, all the details may be substituted by other, technically equivalent elements.

In practice the materials employed, provided they are compatible with the specific use, and the contingent dimensions and shapes, may be any according to requirements.

The disclosures in Italian Patent Application No. MI2011A000782 from which this application claims priority are incorporated herein by reference.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such
reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.
CLAIMS

1. An improved arthroprosthesis (1) with facilitated implantation, particularly for biomechanical reconstruction of the coxofemoral joint, comprising a femoral shank (2) and a spherical head (3) which is accommodated rotatably in an artificial cotyloid element (4) and is associated with said femoral shank (2) by way of a variable-geometry neck (5) which acts as a connection between said shank (2) and said spherical head (3) and has an end portion (5a) inserted with mechanical interference in a slot (6) defined in the free end (2a) of said femoral shank (2), said end portion (5a) of said neck (5) and said slot (6) defining a conical coupling, characterized in that said slot (6) is substantially frustum-shaped with an end portion (6a), defined at a distance (11) from the bottom (8) of said slot (6), that has a substantially cylindrical shape in order to prevent said end portion (5a) of said neck (5) from jamming or seizing with the walls of said slot (6) if said neck (5) sinks.

2. The arthroprosthesis (1) according to claim 1, characterized in that the distance (12) between said bottom (8) of said slot (6) and the portion (5a) of said neck (5) is substantially equal to a minimum distance of 0.5 millimeter and a maximum distance of 1.5 millimeter.

3. The arthroprosthesis (1) according to claim 1, characterized in that said slot (6) and said end portion (5a) of said neck (5) have a frustum-like shape defined around an axis of revolution (7) which coincides with the direction of insertion of said end portion (5a) of said neck (5) in said slot (6).

4. The arthroprosthesis (1) according to one or more of the preceding claims, characterized in that said end portion (5a) of said neck (5) is partially inserted in said cylindrical end portion (6a) of said slot (6).

5. The arthroprosthesis (1) according to one or more of the preceding claims, characterized in that said end portion (5a) of said neck (5) is partially inserted in said cylindrical end portion (6a) of said slot (6) for a
length along said axis of revolution (7) which is substantially of the order of magnitude between 0.1 millimeter and 1.5 millimeter.

6. The arthroprosthesis (1) according to one or more of the preceding claims, characterized in that said end portion (5a) of said neck (5) ends with a beveled and rounded profile (9).

7. The arthroprosthesis (1) according to one or more of the preceding claims, characterized in that the frustum-shaped surface of said end portion (5a) of said neck (5) ceases contact with the walls of said slot (6) at the edge (10) that coincides with the beginning of said cylindrical end portion (6a) of said slot (6) uniformly along the entire extension of said edge (10) of said cylindrical end portion (6a) of said slot (6).
INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/053740

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61F2/32 A61F2/36
ADD.

According to International Patent Classification (IPC) and both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search
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30/05/2012

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