Abstract Title: Surgical jig for the knee

A jig 2 for attachment to a femur is shaped to accommodate at least a part of a patella and/or a patella tendon in their normal anatomical positions with respect to the femur. The jig may comprise a recess or groove 30 in which the patella and/or patella tendon are accommodated. The jig may include an intramedullary rod 6 and/or adjustment means.
SURGICAL JIG

This invention relates to a surgical jig and particularly though not exclusively relates to a jig for preparing a distal end of a femur.

BACKGROUND

When a knee joint becomes damaged or diseased, it is known to replace all or part of the knee joint with a prosthesis. A common form of prosthesis comprises a femoral component, which is attached to a distal end of a femur, and a tibial component, which is attached to a proximal end of a tibia. The femoral and tibial components may articulate directly or may be separated by a meniscal bearing component. The femoral component also articulates with a patella, which is secured in position by a quadriceps tendon and a patellar ligament.

The articulation of a natural knee joint is stabilised by the action of medial and lateral collateral ligaments and anterior and posterior cruciate ligaments. Where possible, all of these ligaments are retained when a prosthesis is implanted, although in practice it is often necessary to remove at least the posterior cruciate ligament. It is desirable for tension in the knee ligaments after surgery to be balanced throughout the range of motion of the knee.

The most complex component of a knee prosthesis is the femoral component, since it carries not only the condylar bearing surfaces, but also the patella bearing surface, which extends along an anterior face of the distal femur. Conventional femoral components require resection of the distal end surface of the femur and the anterior and posterior faces of the femur. They also usually require two chamfered cuts to be made at the distal end of the femur anteriorly and posteriorly. The correct positioning of the femoral cuts is vitally important to ensuring equal tension in the ligaments after surgery.

Conventional jigs for resecting the femur use as a reference an intramedullary rod. The cutting jig is mounted on the rod adjacent the resected femoral surface and may be moved in the anterior/posterior direction relative to the rod. In order to mount a conventional jig adjacent the distal surface of a femur, it is necessary to move the patella from its normal positional. The patella is either everted or subluxed in order to
provide sufficient space for the jig. Once the jig is in the desired position, it is secured to the bone and the necessary cuts are made. The anterior/posterior position of the femoral cuts, and hence of the cutting jig, is vital in order to restore proper functioning of the knee and balance to the ligaments. Conventional jigs are provided in a range of sizes (usually five or six) in order to accommodate the range of knee sizes encountered.

Balancing of the knee ligaments during surgery conventionally takes place in three stages. Firstly, after the distal surface of the femur and the proximal surface of the tibia have been resected, the knee is placed in full extension and a spacer block is used to measure the gap between the bones. The ligaments are balanced with the knee in extension to achieve a rectangular gap between the adjacent bone surfaces and equal tension in the collateral ligaments. Then, with the knee in 90 degrees of flexion and the femoral cutting jig attached, the spacer is again inserted, this time between the proximal tibial surface and the posterior surface of the cutting jig. The aim is to achieve the same rectangular gap and equally tensioned collateral ligaments with the knee in 90 degrees of flexion as in extension. Balancing of the joint at this stage is complicated by the position of the patella. The quadriceps mechanism exerts a large force on the knee joint via the patella and the patella tendon. This force usually acts within the plane of articulation of the joint. However, with the patella either everted or subluxed to allow space for the femoral cutting jig, this force acts to skew the joint either laterally or medially. Correct balancing of the collateral ligaments at this stage is therefore extremely difficult. Finally, after the anterior and posterior resections have been performed, trial prosthesis components are attached to the femur and tibia and a trial reduction is performed. Only at this point can the tension of the ligaments be checked throughout the range of motion of the knee.

SUMMARY OF INVENTION

According to the present invention, there is provided a jig for attachment to a femur, the jig being shaped to accommodate at least a part of a patella and/or a patella tendon.

Preferably, the jig is shaped to accommodate at least a part of a patella and/or a patella tendon substantially in their normal anatomical positions with respect to the femur.
The jig may comprise a recess, which may be a groove. The recess or groove may be dimensioned to accommodate at least a part of a patella and/or a patella tendon.

According to another aspect of the present invention there is provided a jig comprising:

- a guide member having at least one tool guide,
- an alignment member which engages with the femur, and
- an adjusting means which acts between the guide member and the alignment member to move the guide member relative to the alignment member.

The alignment member may comprise an attachment portion and an intramedullary rod. The attachment portion of the alignment member may include attachment means that engages with cooperating attachment means on a proximal side of the guide member.

The attachment means may comprise projections that are received in cooperating grooves on the proximal side of the guide member.

The adjusting means may comprise a threaded worm that is received within the guide member. The worm may engage a cooperating thread on the alignment member. The worm may be a cylindrical member having at least one recessed portion.

The adjusting means may further comprise a holding pin that engages the guide member and the recessed portion of the worm to prevent relative translation between the guide member and the worm.

The tool guide may comprise a guide hole for a drill.

The recess or groove may extend across a distal face of the jig in a substantially anterior/posterior direction. The recess or groove may extend across a distal face of the guide member in a substantially anterior/posterior direction.

The jig may further comprise a reference means. The reference means may comprise a stylus and a post. The stylus may be adapted to reference the jig with the anterior cortex of the distal femur.

The guide member may further comprise a cylindrical opening and the post may extend through the cylindrical opening parallel to the groove in the guide member. An anterior
end of the post may comprise a plurality of annular grooves. The stylus may be adapted to be received in any one of the annular grooves on the mounting post.

According to another aspect of the present invention, there is provided a jig for attachment to a femur, the jig having a groove for accommodating at least a part of a patella and/or a patella tendon.

According to another aspect of the present invention, there is provided a method of preparing a distal end of a femur, which articulates with a proximal end of a tibia and with a patella, using a jig comprising a guide member having a groove, an alignment member and an adjusting means acting between the guide member and the alignment member, the method comprising:

a) resecting a distal surface of the femur,
b) inserting the alignment member of the jig into the femur until a proximal surface of the guide member engages the resected femoral surface, with the groove on the guide member aligned in a substantially anterior/posterior direction,
c) inserting a spacer between the proximal surface of the tibia and a posterior surface of the guide member,
d) adjusting the adjusting means until the posterior surface of the guide member is flush against the spacer,
e) placing the patella in the groove of the guide member, and
f) balancing the tension of the ligaments joining the femur and tibia.

Step d of the method may further comprise:

d1) attaching a stylus to a selected one of a plurality of annular grooves on a post mounted in the guide member such that a free end of the stylus is adjacent the surface of the anterior femoral cortex, and
d2) adjusting the adjusting means such that the free end of the stylus is in contact with the anterior femoral cortex.

The method may further comprise:
g) drilling reference holes in the resected femoral surface through guide holes on the guide member,
h) removing the jig from the femur,
i) selecting an appropriately sized cutting block according to the groove in which the stylus is mounted in step d1, and
j) securing the cutting block to the distal femur using the reference holes drilled in
step g.

Step b of the method may comprise inserting an intramedullary rod into the
intermedullary canal of the femur.

Steps d and d2 of the method may comprise rotating a threaded worm.

The present invention separates the anterior/posterior adjustment and
anterior/posterior cutting functions of a conventional femoral jig. This separation of
functions replaces the large conventional jig with two separate instruments, a jig as
claimed in the current specification and a conventional cutting block. By removing the
requirement for saw cutting guides it is possible to significantly reduce the size of the
femoral jig. Size reduction of instrumentation is highly desirable in order to reduce the
amount of necessary soft tissue displacement during surgery and therefore reduce post
operative healing time.

The provision of a groove in the jig of the present invention enables pre resection soft
tissue balancing to be conducted with the patella in place and therefore with the force
exerted by the quadriceps mechanism acting in its correct anatomical direction. The
reduced size of the jig, and the provision of the groove, also enables the knee joint to be
balanced across the full range of motion of the joint before the anterior, posterior and
chamfered cuts are made. This provides a significant advantage over the existing
instrumentation, with which pre resection soft tissue balancing can only be performed
with the knee in full extension and 90° of flexion.

The jig of the present invention is generic, and suitable for use on any size of knee,
thus, only the relatively simple cutting blocks need be provided in a range of different
sizes. The more complicated anterior/posterior translation mechanism need not be
replicated for use on differently sized patients.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show more clearly how it
may be carried into effect, reference will now be made, by way of example, to the
following drawings, in which:
Figure 1 is a perspective view of a surgical jig for use on the left knee of a patient.

Figure 2 is another perspective view of the jig of Figure 1.

Figure 3 is a perspective view of a mounting post of the jig of Figure 1.

Figure 4 is a perspective view of an alignment member of the jig of Figure 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

With reference to the Figures, a surgical jig 2 comprises a guide member 4, an alignment member 6, and a reference member 8, comprising a mounting post 52 and a stylus 60. An adjusting means 10 acts between the guide member 4 and the alignment member 6 to permit relative translational movement between the guide member 4 and the alignment member 6. A plurality of tool guides 5 extend through the guide member to guide the bit of a drill (not shown).

With reference particularly to Figure 2, the guide member 4 comprises a substantially rectangular guide body 12 having a proximal surface 18, a distal surface 20, an anterior surface 19 and a posterior surface 21. The proximal and distal surfaces 18, 20 terminate at upper, anterior edges 22 and lower, posterior edges 24. The guide body 12 is divided into a mounting portion 14 and a guide portion 16. The mounting portion 14 is disposed on the medial side 26 of the jig 2 and the guide portion 16 is disposed on the lateral side 28 of the jig 2. In the illustrated embodiment, the medial side is to the left of the jig 2, as viewed from the distal approach, but it will be appreciated that in a jig for use on the right knee of a patient, the medial side will be to the right side of the jig when viewed from a distal approach. The distal surface 20 of the guide portion 16 includes a longitudinal groove 30 that runs in a substantially anterior/posterior direction.

In the illustrated embodiment, the groove 30 extends from the anterior edge 22 of the distal surface 20 and terminates adjacent to the posterior edge 24 of the distal surface 20, thus defining a seat 32. However, the groove 30 may extend the length of the guide body 12, terminating at the posterior edge 24 of the distal surface 20.

A recess 34 extends across the proximal surface 18 of the guide portion 16, opposite to the groove 30 in the distal surface 20. The recess 34 extends the length of the
proximal surface 18 from the anterior edge 22 to the posterior edge 24. The recess 34 is defined by lateral and medial ridges 36, 38 that protrude from the proximal surface 18 of the guide portion 16. The ridges 36, 38 curve toward each other, defining respective grooves 40, 42 at opposite sides of the recess 34. A longitudinal slot 44 extends into the guide body 12 from the proximal surface 18 adjacent the medial ridge 38 and parallel to the recess 34. The slot 44 is integral with a first cylindrical bore 46 that also extends the length of the guide body 12. An adjusting screw (not shown) is located in the cylindrical bore 46 such that threaded portions of the screw protrude into the slot 44. The adjusting screw is waisted between the threaded portions to form an annular groove in a central region of the adjusting screw. A grub screw 48 extends through the guide body 12, engaging the groove of the adjusting screw and holding the adjusting screw captive within the cylindrical bore 46, such that relative translational movement between the adjusting screw and the guide body 12 is prevented.

A second cylindrical bore 50 extends through the mounting portion 14 of the guide body 12. A mounting post 52, as shown in Figure 3, is received within the second cylindrical bore 50. The mounting post 52 comprises a posterior section 54, which is received within the second cylindrical bore 50, and an anterior section 56, which is of greater diameter than the posterior section 54. A plurality of annular grooves 58 extends around the anterior section 56. A stylus 60 is received within any one of the grooves 58.

With reference particularly to Figure 4, the alignment member 6 comprises an attachment portion 62 and an intramedullary (IM) rod 64. The attachment portion 62 comprises a body 66, lateral and medial projections 68 and 70 and an engagement arm 72. The projections 68, 70 and the engagement arm 72 each extend the length of the body 66 in a substantially anterior/posterior direction. The engagement arm 72 carries on its medial face a thread 74, which may be a rack. The IM rod 64 is formed integrally with the attachment portion 62 and extends from a proximal side of the body 66 of the attachment portion 62 at an angle that is chosen to replicate the natural valgus angle of the average patient. A range of alignment members may be provided, each having a different angle formed between the IM rod 64 and the body 66 of the attachment portion 62. An appropriate alignment member may then be selected according to the requirements of a particular patient.
In an assembled condition of the jig, as illustrated in Figures 1 and 2, the attachment portion 62 of the alignment member 6 is received within the recess 34 of the guide body 12. The lateral and medial projections 68, 70 are received within the lateral and medial grooves 40, 42 of the recess 34. The engagement arm 72 is received within the slot 44 such that the rack 74 on the engagement arm 72 protrudes into the first cylindrical bore 46. The rack 74 engages the threaded portions of the adjusting screw (not shown). The adjusting screw is prevented from translational movement relative to the guide body 12 by the interaction of the grub screw 48, the guide body 12 and the annular groove on the adjusting screw. Rotation of the adjusting screw therefore causes both the adjusting screw and the guide body 12 to be moved along the rack 74 of the engagement arm 72, thus translating the guide body 12 in the anterior/posterior direction relative to the alignment member 6. Rotation of the adjusting screw is effected by means of an Allen key or other device.

In use, the jig 2 may be employed in conjunction with a plurality of differently sized cutting blocks. The cutting blocks are sized according to the corresponding size of femoral prosthesis, and include guide portions for guiding a saw in making the required anterior, posterior and chamfered cuts to the distal end of the femur. Prior to use, the jig 2 is placed in an assembled condition and the stylus 60 is removed. Following standard proximal tibial resection and distal femoral resection, the knee is placed in extension and an appropriately sized spacer is selected, permitting tension of the relevant soft tissues to be checked. The knee is then placed in 90° of flexion and the IM rod 64 of the jig 2 is inserted into the medullary canal of the femur until the proximal surface 18 of the guide body 12 is flush with the resected distal surface of the femur. The selected spacer is introduced into the gap between the posterior surface 21 of the guide body 12 and the resected tibial surface. The adjusting screw is rotated causing the guide body 12 to translate relative to the IM rod 64, and hence the femur, until the posterior surface 21 of the guide body 12 is flush with the spacer. The stylus 60 is attached to a selected one of the annular grooves 58 on the mounting post 52 such that an end of the stylus 60 is adjacent the anterior femoral cortex. The anterior/posterior position of the guide body 12 is then finely adjusted by rotation of the adjusting screw until the end of the stylus 60 is in contact with the anterior femoral cortex.

Prior to fixing the position of the jig 2 with respect to the femur, a partial reconstruction of the knee is effected. The patella is returned from its everted or subluxed position
and placed to rest in the groove 30 of the jig 2. The tension of the soft tissues may then be checked with the force exerted by the quadriceps mechanism acting in its correct anatomical direction. Further, the tension of the soft tissues may be checked throughout the range of motion of the knee with the jig 2 still in place, as the patella is able to track within the groove 30. Fine adjustment of the position of the jig may be conducted as necessary. Once the correct position of the jig has been ascertained, guide holes are drilled through the guides 5 of the jig 2 and into the resected femoral surface. The jig 2 may then be removed and replaced with an appropriately sized cutting block. The size of cutting block may be selected to correspond with the annular groove 58 on which the stylus 60 was mounted. The cutting block is attached to the femur using the guide holes drilled through the guides 5 in the jig. Anterior, posterior and chamfered cuts may then be made in the standard manner.
CLAIMS

1. A jig for attachment to a femur, the jig being shaped to accommodate at least a part of a patella and/or a patella tendon.

2. A jig as claimed in claim 1, wherein the jig comprises a recess.

3. A jig as claimed in claim 2, wherein the recess comprises a groove.

4. A jig as claimed in any of the preceding claims, further comprising: a guide member having at least one tool guide, an alignment member which engages with the femur, and an adjusting means which acts between the guide member and the alignment member to move the guide member relative to the alignment member.

5. A jig as claimed in claim 4, wherein the alignment member comprises an attachment portion and an intramedullary rod.

6. A jig as claimed in claim 5, wherein the attachment portion includes attachment means that engage with cooperating attachment means on a proximal side of the guide member.

7. A jig as claimed in claim 6, wherein the attachment means comprise projections that are received in cooperating grooves on the proximal side of the guide member.

8. A jig as claimed in any one of claims 4 to 7, wherein the adjusting means comprises a threaded worm that is received within the guide member.

9. A jig as claimed in claim 8, wherein the worm engages a cooperating thread on the alignment member.

10. A jig as claimed in claim 8 or 9, wherein the worm is a cylindrical member having at least one recessed portion.
11. A jig as claimed in claim 10, wherein the adjusting means further comprises a holding pin that engages the guide member and the recessed portion of the worm to prevent relative translation between the guide member and the worm.

12. A jig as claimed in any one of claims 4 to 11, wherein the tool guide comprises a guide hole for a drill bit.

13. A jig as claimed in any one of claims 2 to 12, wherein the recess extends across a distal face of the jig in a substantially anterior/posterior direction.

14. A jig as claimed in any one of claims 4 to 12, wherein the recess extends across a distal face of the guide member in a substantially anterior/posterior direction.

15. A jig as claimed in claim 13 or 14, wherein the recess is dimensioned to accommodate at least a part of a patella and a patella tendon.

16. A jig as claimed in any one of the preceding claims, further comprising a reference means.

17. A jig as claimed in claim 16, wherein the reference means comprises a stylus and a post.

18. A jig as claimed in claim 17, wherein the stylus is adapted to reference the jig with the anterior cortex of the distal femur.

19. A jig as claimed in claim 17 or 18, wherein the guide member further comprises a cylindrical opening.

20. A jig as claimed in claim 19, wherein the post extends through the cylindrical opening parallel to the groove in the guide member.

21. A jig as claimed in claim 20, wherein an anterior end of the post comprises a plurality of annular grooves.

22. A jig as claimed in claim 21, wherein the stylus is adapted to be received in any one of the annular grooves on the mounting post.
A method of preparing a distal end of a femur, which articulates with a proximal end of a tibia and with a patella, using a jig as claimed in any one of the preceding claims, the method comprising:

a) resecting a distal surface of the femur,
b) inserting the alignment member of the jig into the femur until a proximal surface of the guide member engages the resected femoral surface, with the groove on the guide member aligned in a substantially anterior/posterior direction,
c) inserting a spacer between the proximal surface of the tibia and a posterior surface of the guide member,
d) adjusting the adjusting means until the posterior surface of the guide member is flush against the spacer,
e) placing the patella in the groove of the guide member, and
f) balancing the tension of the ligaments joining the femur and tibia.

A method as claimed in claim 23, wherein the step d further comprises:
d1) attaching the stylus to a selected one of the annular grooves on the post such that a free end of the stylus is adjacent to the surface of the anterior femoral cortex, and
d2) adjusting the adjusting means such that the free end of the stylus is in contact with the anterior femoral cortex.

A method as claimed in claim 24, further comprising:
g) drilling reference holes in the resected femoral surface through the guide holes on the guide member,
h) removing the jig from the femur,
i) selecting an appropriately sized cutting block according to the groove in which the stylus is mounted in step d1, and
j) securing the cutting block to the distal femur using the reference holes drilled in step g.

A method as claimed in any one of claims 23 to 25, wherein step b comprises inserting the intramedullary rod into the medullary canal of the femur.

A method as claimed in any one of claims 23 to 26, wherein steps d and d2 comprise rotating the threaded worm using a key.
Application No: GB0602055.6  
Examiner: Mr Alex Robinson  
Claims searched: 1 to 22  
Date of search: 26 May 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>1 to 3 and 16</td>
<td>US 5458645 A (Bertin) Whole document.</td>
</tr>
<tr>
<td>X</td>
<td>1 to 3 and 16</td>
<td>US 6080196 A (Bertin) Whole document.</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>US 5667512 A (Johnson)</td>
</tr>
</tbody>
</table>

Categories:

- X  Document indicating lack of novelty or inventive step
- Y  Document indicating lack of inventive step if combined with one or more other documents of same category.
- &  Member of the same patent family
- A  Document indicating technological background and/or state of the art.
- P  Document published on or after the declared priority date but before the filing date of this invention.
- E  Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC$^X$ :

- A5R

Worldwide search of patent documents classified in the following areas of the IPC

- A61B

The following online and other databases have been used in the preparation of this search report

- EPODOC, WPI.