Rationale and Surgical Technique
The implant system

Trekking® is one of the most advanced systems for total knee arthroplasty available today. All the principal technical and clinical issues have been analysed and solved in the most efficient way, with a lot of new and exciting solutions.

One of the most important features is the flexibility of all the Components - primary and revision, mobile and fixed, cruciate retaining, posterior stabilised or ultra-congruent, cemented and uncemented - which can be implanted with the same set of instruments, enabling the surgeon to choose the final Components at the very last moment, and even to combine “hybrid” primary and revision Components in a single implant for maximum customisation of the surgical treatment.

The Trekking System includes two sets of primary implants (Fig.1): cemented and uncemented, and a revision set.

All metal Components, except augments and stems are made of CoCrMo alloy, while all bearings are made of UHMWPE. Augments and stems are made of Ti6Al4V alloy.

Both Fixed and Mobile bearing systems, cemented and uncemented, come in cruciate retaining (CR) and posterior stabilized (PS) options; the revision set includes a semi-constrained fixed bearing, a non constrained, high flex fixed bearing, a single radius-high kinematic condyle, a Tibial plate, Tibial and Femoral stems, augments and offsets.

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**Fig.1 - Trekking Primary System**

The press-fit version is available with a coating of pure titanium applied by vacuum plasma spray. The coated surface is perfectly flat and in contact with the bone. Both cemented and uncemented system are also available with a Nitrate Titanium (TIN) ipoallergenic coating.
Fixed bearing

The fixed bearing system offers both Cruciate Retaining (CR) and Posterior Stabilized (PS) options. The connection between the insert and the Tibial plate is secured by means of a simple metal wire applied to the anterior part of the insert and a bowl-shaped Tibial plate with a mirror-polished ‘floor’.

The Tibial plate is flat, with no additional spines, ripples or screw-holes, in order to minimize backside polyethylene wear. The Tibial plate has a 4° posterior slope and a 6° articular surface slope.

Mobile bearing

The mobile bearing system includes a Posterior Stabilized and an Ultra-Congruent Component. Thanks its 1:1 congruency, and to the anterior leap distance ranging from 6.6 (size 1) to 11.4 mm (size 5), the indication of the Ultra-Congruent implant is both for preserving and sacrificing the posterior cruciate ligament without compromising joint stability.
The rotation, based on a central-pivot design, is obtained by a PE peg articulating into the Tibial plate keel hole. The insert peg has been designed with sufficient length to prevent dislocation and minimise polyethylene wear. The Tibial plate has a 0° posterior slope and 6° articular surface slope.

**Design features**

During the last 30 years, knee implant design has had a dramatic evolution. Huge problems have been overcome in many different fields, including anatomy, biology, mechanics and materials.

Today, implant design has achieved a satisfactory level of standardization. However, some issues are yet to be completely addressed. The scientific challenge is now open in four main areas: polyethylene wear, gait kinematics, bone preservation and specific surgical instruments.

**Polyethylene wear**

The stress induced by the Femoral Component on the polyethylene bearing depends on three main factors:

- Weight of the patient
- Ligament tension
- Loading conditions (including the mechanical characteristics of the implant)

Surface roughness and stresses have a major impact on the wear process. The best way to reduce stresses on the PE insert and to influence the loading conditions, is to maximize the contact area between the insert and the Femoral Component. In order to do this it is necessary to design the Femoral Component and the insert with the same radius, for perfect and complete contact (Figs.4-5).
The same concept applies to the central spine of the PS liner. In the vast majority of cases, the spine has a squared design, hit at each step by the posterior bar of the Femoral Component in a very narrow spot. The spine in the Trekking PS insert has a large surface and rounded corners in order to offer maximum and highly conforming contact to the congruent Femoral counterpart.

Also the design of the articular surface in the fixed bearing knee has been subject to important improvements: the Spherical Track surface of the Trekking fixed bearing knee (Fig.6) enhances the contact area across the whole flexion and rotation range. The polyethylene backside wear has been carefully addressed as well.

The simple mirror-polished, bowl-shaped metal back (Fig.7) and the connection mechanism with a metal wire engaging the notched edge of the metal back prevents polyethylene debris from spreading into the surrounding tissues.

**Kinematics**

In the Posterior Stabilized option, the shape of the insert is the most important factor affecting the relative movement of the femur and the tibia.

The geometry of the post in the Trekking PS insert has been studied to guide the movement of the femur throughout the gait cycle, to obtain a consistent and early rollback starting from 40° of flexion, with close-to physiological movement and enhanced ROM. The rollback feature also helps reducing the patellar pressure, which in return has a positive effect on the ROM.

The single radius for each Femoral Component in the frontal plane enables maximum contact in all the loading condition, even in a critical case of extreme lift-off one condyle is always completely in contact with the liner. This leads to higher stability and knee comfort.

The shape of the troclear groove is a good compromise between stability and patellar loading and optimizes the patellar tracking.
Bone preservation

Minimally Invasive Surgery is currently one of the most discussed techniques. A widely accepted aspects of MIS is the tissue sparing concept, a technique aiming at maximum tissue preservation and minimum damage, regardless of incision length.

The Trekking System has been carefully designed for maximum bone stock respect. The Tibial plate has been totally redesigned using a Finite Element Model, for exact evaluation of stresses and optimisation of thickness, which has been reduced from the usual 5 mm down to 3 mm still preserving safety.

The same process has been used with the Femoral Component. The FEM computer calculation allowed our designers to keep an optimal mechanical resistance still with a reduced thickness (8 mm) of the Femoral Component, both distally and posteriorly (Fig.8).

Finally, thanks to the quality of the Ethylene Oxide-sterilised polyethylene, and the attention paid to tribological issues, the minimum Trekking insert thickness has been reduced down to 6 mm, still preserving the poly strength.

Thanks to this careful design, the Tracking System is one of the most bone preserving in the market. Maximum total bone saving for a size 5 CR model is 20 cm³ (Fig.9).

**Fig.8** Finite element study of a CR Femoral Component

**Fig.9** Total bone sparing with a size 5 Trekking tibia, insert and femur vs two different competitor systems.
Innovative instruments

Unlike implants, the basic principles of TKA instruments have not changed for at least 25 years and concepts and techniques defined for the first systems have remained in use ever since. With the Trekking instrument set, SAMO developed a really new, compact, modular, integrated instrumentation, making the procedure safer, more accurate, faster and simpler. All the terms above are not casual. Let’s analyse them:

• Integrated: all the Trekking Components (primary and revision) can be implanted by means of the same instrument set, with the addition of only 3 baskets for a complete revision implant.

• Modular: the instruments are available in containers that can be either used or left aside, depending on the implant system the surgeons is planning to use. As an example, Fig. 10 shows the solution for a PS, Fixed Bearing implant.

Fig.10 Instruments set for a Posterior Stabilized Fixed bearing implant

• Compact: only 5 trays, plus two small square baskets, are necessary for one implant.

• Simple and fast: the unique 6-Actions Femoral Guide (Fig.11) allows for time-saving, unique 3-Steps Femoral Cuts (Fig.12).

Fig.11 6-actions Femoral guide
The classical bone-cut-sequence of most current instrument sets typically includes 5 steps:
1 – Varus Valgus setup; 2 – Distal cut; 3 – Size setup; 4 – A/P and oblique cuts; 5 – Box or troclear groove cuts.

Accurate:
• Fixed, wide Femoral stylus with size reference for perfect sizing each time

• Stable guides - cuts are always precise and accurate allowing easy press-fit implant application.

• All the anatomical rotational landmarks (Whiteside line, Epycondilar line, posterior condyles) can be considered in order to determine the correct external rotation of the implant.

• Unique Reference Switch system for automatic anterior or posterior referencing, depending on the surgeon’s preference.
surgeon chooses the smaller size, the guide behaves as an anterior referencing system (the posterior reference, in such cases, would generate a risk of notching on the anterior cortex), while the guide behaves as a posterior referencing system if the surgeon chooses the larger size (an anterior reference system, reducing the flexion gap, would cause tightness in flexion).

In current systems, either the choice is forced (always larger OR always smaller size every time), or the surgeon must switch instruments in order to change the reference from posterior to anterior or vice-versa.

**Safe:**

- Recutting is allowed with minimal time loss and without affecting cut precision - Thanks to the particular sequence of the cuts, tissue balance becomes a central step in the technique, and recutting, when needed, is a simple and fast procedure.

- 100% notching avoided - Thanks to the floating anterior cut guide, notching is made impossible. Regardless of how precisely the cutting guide is placed, the cut will always be over the surface of the anterior cortical bone (Fig.14).

![Fig.14 0-notching system](image)

These are only general concepts about the highly innovative Trekking System Instrument Set. Please, read the following chapters to learn more about all the smart solutions introduced by this system.
The surgical technique of the TREKKING® Primary Knee System has been designed to provide precision, ligament balance check, and simplicity.

The surgery can be summarized in the following 3 steps:

1. **Main cuts**

2. **Ligament balance check**

3. **Femoral chamfering/Finishing**

   Note: Performing ligament balance checks before chamfering allows for improved stability of femoral cutting blocks if additional bone resection is necessary

   While it is possible to start the procedure either from the tibia or from the femur, the ‘tibia first’ technique provides better access to the femoral side

   At any stage, the surgeon can check articular alignment accuracy with a metal rod inserted in the eyelets available in most of the cutting blocks.

   ![Diagram](image)

   **ADVICE:** It is recommended to use 1.27 mm (1/20”) thick, 13 mm (1/2”) wide and 90 mm (6.5”) long saw blades. Different sized saw blades may compromise bone resection steps. In particular, thicker saw blades are not compliant with the height of the guides, and must be avoided.
1. Mobile bearing

(The proposed surgical technique is based on a “tibia first” approach. (Note: For a ‘femur first’ technique, steps 1 to 7 should follow after step 15.)

1. Fixed Bearing & TCK

The proposed surgical technique is based on a “tibia first” approach. (Note: For a ‘femur first’ technique, steps 1 to 7 should be followed after step 15.)


2.

Spring loaded push-buttons (1,2) and a Screw (3) allow the orientation of the cutting block in the proximal-distal, medio-lateral and antero-posterior (A/P) directions. For improved stability, a short headed pin may be inserted into the hole placed in the upper part of the fixation arm (2 in step 3).

Prior to making the tibial resection it is essential to ensure the alignment guide and anatomical axis of the tibia are parallel. (The variation in the slope of the cut for Mobile Bearing and Fixed Bearing designs (0° for the mobile bearing implant and 4° for the fixed bearing implant) is provided by the specific cutting block.

NOTE: Each graduation marked on the Anterior/Posterior orientation guide provides a 0.5° slope of the Tibial Cutting Block; the same applies to Varus/Valgus orientation, i.e. by moving the vertical bar one graduation in A/P or V/V direction, the A/P or V/V inclination of the Tibial Cutting Block changes by ±0.5°.
3. The height of the tibial resection is controlled by the dual tipped Tibial Stylus [12.], which is positioned on the lowest point of the least affected tibial compartment. One tip of the stylus is marked as “Slot” and should be used if the surgeon intends to resect through the slot of the Cutting Block the other tip is marked as “Top”, and should be used if the resection is performed over the top of the Cutting Block. In both cases, the resection thickness is 9 mm, i.e. the minimum total thickness of the Tibial Implant (insert + metal back). A knurled knob (1) may be used to vary the resection level. When the Tibial Cutting Block is in the correct position, pins should be placed in the “zero” holes. The “+2” and “+4” holes are for additional resection if required. The Tibial resection can be checked by using the Resection Tester [27.].

4. The Tibial Extramedullary Guide is removed by releasing the locking lever (1) in front of the block and by using the “fork tip” of the Extractor [41.].

For additional block stability, it is recommended to secure the Tibial Cutting Block with three pins as shown in steps 5 and 6.

5. Before resecting the tibia, the alignment with the tibial axis can be checked by inserting the checking rod [24.;25.] into the hole of the modular handle [33.], previously fixed on the Tibial Cutting Block [11.]. This should point distally to the centre of the ankle.
6. The tibial resection is completed either using the slot or the top plane as guide as previously described.

Remove the cutting guide leaving the parallel pins in position in the event that additional resection is required.

7. The intramedullary canal of the femur is opened with the femoral drill and the Femoral Intramedullary Rod [2 and modular handle (23) is introduced into the canal. Make sure the Rod is fully inserted. The handle can then be removed with a push-button (1).

8. Prior to positioning of the Orientation Jig [4.b.], the proper varus-valgus and internal-external rotation angle must be chosen.

The appropriate varus-valgus angle is set using the varus-valgus block (1) [5.] assembled on the Orientation Jig. The internal/external rotation of the implant is set either by introducing a short headed pin [47.] in the 0° (2) or 3° (3) hole, by positioning the Jig with Whiteside line through the vertical bars or by aligning the guide with the -epicondilar axis.

In all cases, both posterior prongs must be kept in contact with the posterior condyles.
9.  
If necessary the checking rod inserted into the hole of the modular handle [33.], (1), can be used to check the conformity of the varus-valgus block and individual patient’s anatomy.

If the varus-valgus angle is placed correctly, the checking rod will coincide with the centre of the femoral head. (2).

10.  
Fix the Orientation Jig by means of [48.] pins (1). Once the jig has been properly positioned and fixed, let the Size Jig [4.a.] slide into the Orientation Jig, until the stylus touches the anterior aspect of the femur.

At this point it is important to check that both the anterior stylus and the posterior prongs are touching the bone. If necessary remove interposing soft tissues and osteophytes. Set the stylus at temporarily to size ‘3’ on the scale on the upper part of the guide (step 11, left).

ADVICE: Prior to the next step, temporarily set the graduated scale (2) to zero by placing a pin on the hole (2). This will be removed prior to placing pins in the final size holes in the next step.
11. Read the size at the level of the red pins (1), which coincide with the centre of the sizing holes. If the coincidence is not exact, it is recommended to chose the larger size when the pointer is very close (. or more) to the upper size. Set the chosen size on the stylus size scale (below).

12. IMPORTANT NOTE: If the smaller size has been chosen, remove the temporary pin in central hole now.

Introduce two headed pins [46.] into the hole corresponding to the chosen size. The device will automatically slide, setting the cutting slots to the chosen size.

ADVICE: In order for the device to reach the optimal position, the pins should NOT be hammered, but inserted by hand instead, vibrating it a bit in the vertical direction to facilitate the sliding of the mechanisms. As the system slides into the correct position, and the pins have reached the Femoral bone, use a hammer to drive the pins to the bone.

If the smaller size is chosen, the graduated scale (1) will indicate +2 or +4; these numbers can be used in the distal cut (step 15).
13. Make the anterior and posterior cuts through the corresponding slots. The stylus will always indicate the proximal border of the anterior cut.

14. Insert two pins into the anterior holes and remove the assembly of cutting blocks, leaving the 2 anterior pins in place.

15. The Distal Femoral Cutting Block incorporates 3 pairs of holes, marked as 0, +2, +4. In order to balance ligament tension in flexion and extension, these holes will vary the position of the cutting block and subsequent resection level of the distal femur to increase or decrease the extension space depending on the patients anatomy.

Cut the distal condyles by using the slot and remove the Distal Cut Block, leaving the parallel pins in place.
16. Use the appropriate spacer (26) to measure the flexion and extension gaps. Note: The chamfer cuts are delayed at this point to allow additional stability of the cutting blocks and more precise measurement if additional distal resection is required. The position of the distal cutting block for additional resection is facilitated by locating the block on the pins in the original position (steps 6; 15). Assemble the Male Control Rod [25.] onto the Female Control Rod [24.], to check the mechanical axis alignment.

17. Spacer Augmentations [35.] are labelled with thickness reference number of the corresponding insert.

Read the thickness reference number on the used Spacer Augmentation (+2, +4, +7), which corresponds to the insert dimension. If the tension of the collateral ligaments is satisfactory without using any augmentation, then use the +0 insert.
18. The Femoral Chamfering Jig [19.] has the same lateral dimension as the Femoral Component. This will facilitate the position of the jig, and of the Final implant position. Make the oblique anterior and posterior cuts using the appropriate guides.

19. Posterior Stabilized & TCK
For the PS and TCK implant options, after the chamfer cuts, make the proximal box cut (1) using the osteotome [38.] and the appropriate box template (figs a, b, c); Complete the box by leaning the sawblade onto the two lateral and medial sides of the box template (2), keeping the osteotome as a shield. Then remove the osteotome and perform the cut shown in step 20; then remove the jig. Do not drill the holes for the pins, which are not included in the PS implant.
20. For both CR and PS implant, make the central oblique cut leaning the blade on the oblique plane, or using the osteotome through the appropriate guide. In CR implants, drill the holes for the pin (drill 6.) and remove the Jig.

21. Position a Trial Tibial Tray after engaging the modular handle. Vary the tray size to maximize coverage over the tibial surface. Spike it with at least four headed pins.

22. Put the Trial-Insert Adapter into its slot on the Trial Tibial Tray and insert the previously measured trial insert thickness (Note: with the Mobile Bearing option, the insert must match the size of the Femoral Component exactly, while the Tibial Component can be ±1 size. However, in case of the Fixed Bearing option, the insert must match the size of the Tibial Component exactly, while the Femoral Component can be ±1 size.)

Position the Trial Femoral Component and perform flexion and extension reduction to check the stability and fit of the implant.
23. Mobile Bearing

Remove all the trial Components, except for the Trial Tibial Tray. If necessary, the Trial Femoral Component can be removed by using the Extractor. By inserting the flat tip of the Extractor [41.] into the tracks placed on either side of the trochlear groove of the trial Component.

Set the drill height in the MBH Tibial Drill [31.] at the size chosen in step 23. Place the MBH Tibial Drill Guide [21.] into its slot on the Trial Tibial Tray. Use the MBH Drill Guide [31.] to drill the hole to the fixed depth.

23. TCK

For the TCK option, after removing the trial components except for the Trial Tibial Tray, place the TCK Tibial Drill Guide [18.] into its slot on the Trial Tibial Tray. Use the TCK Drill Guide [17.] to drill the hole to the fixed depth.
24. Mobile Bearing

Remove all the instruments, except for the Trial Tibial Tray. Set the Tibial Plate size on the scale of the Arrow Broach (22) (1). Place the Arrow Broach (0°) into its slot on the Trial Tibial Tray. Impact the Broach To the level indicated by the lower scale (2).

24. Fixed Bearing & TCK

Remove all the instruments, except for the Trial Tibial Tray. Set the Tibial Plate size on the scale of the Arrow Broach (22) (1). Place the Arrow Broach (4°) into its slot on the Trial Tibial Tray. Impact the broach to the level indicated by the lower scale (2).

25.

Assemble the final Femoral/Tibial Components on the Positioner [43.] and insert the Components, then reduce the joint. Place the plastic liner on top of Tibial plate. In the case of Fixed Bearing follow this procedure:

• push the liner posteriorly until it’s perfectly flush and engaged with the posterior lip of the Tibial Component

• push with the finger or use the Tibial impactor to snap the liner into the Tibial plate

ADVICE: Engage the Components on the Positioner by turning the lateral screw (1), push the plastic piston against the Component by turning the central knob (2).
26.  
If a Patellar Component is to be implanted, the first step is measuring the thickness of the patella. Subtract 9 mm (the thickness of the patellar Component) from the measured value, then set the resulting measurement on the graduated scale carved on the hinge pole (1) of patellar resection pliers [37].

Grasp the patella using the Patellar Pliers and lean it on the stylus. Pay attention to patellar resection slope. Cut the posterior part of the patella.

27.  
From the available patellar Components, choose the one that best fits the resection. Holding the Component by the side, make three holes with the Patellar Pin Drill. Trial patellar Components are available in the instrument set. During the cementing process, the Patellar Cementing Pliers [39.] can be used to keep the patellar Component compressed onto the bone. Optional: Intramedullary Alignment on the Tibia The figure to the right shows the intramedullary system with the Checking Rod [24.] mounted on the tibia. Open the intramedullary canal using the Tibial twisted drill [9.]. Insert the intramedullary Tibial rod [10.] and mount the intramedullary Tibial guide (1) [29.]. Both in the extra and intramedullary technique, it is advisable to insert the slanting pin after removing the Tibial guide, in order to find the right distance from the block to the tibia. The use of the Intramedullary guide with heavily bent tibias is not recommended.
Intramedullary Alignment

The figure to the right shows the intramedullary system with the Checking Rod [24.] mounted. Open the path for the intramedullary Tibial rod using the Tibial twisted drill [9.]. Insert the intramedullary Tibial rod [10.] and mount the intramedullary Tibial guide (1) [29.]. Both in the extra and intramedullary technique, it is advisable to insert the slanting pin after removing the Tibial guide, in order to find the right distance from the block to the tibia.

The use of the endomedullary guide with heavily bent tibias is not advised.
# Trekking® Instrument Set

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Images are not full scale; not all the parts are represented.
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<td>Tibial Impactor GS.T3100</td>
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<td>Spacer Augmentations</td>
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<td>+2 GS.T9300</td>
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<td>Patellar Pin Drill GS.P0300</td>
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<td>Patellar Resection Pliers GS.F1700</td>
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JRI Services/Education

- Research Funding
- Nurse Training
- Factory Tours
- Educational Courses
- In service support
- Consignment stock checks:
  - Implants
  - Instruments
- PACS Digital X-Ray templates