

# LES BENEFICES CLINIQUES DE LA NAVIGATION

- Cette technique chirurgicale permet de perfectionner l'exactitude du geste chirurgical.
- Il y a moins d'étapes à accomplir pour l'intervention.
- La procédure est plus rapide et « facile » à réaliser.
- Le chirurgien bénéficie d'avantage d'informations fournies par le système.
- Les décisions chirurgicales sont plus flexibles.

# LES AVANTAGES DE LA NAVIGATION

- Elle augmente l'exactitude de l'acte chirurgical.
- L'opération est moins invasive, il n'y a pas d'instrument en intra médullaire.
- Les procédures chirurgicales sont vérifiées étape par étape.
- On peut reproduire et comparer les résultats obtenus.
- On réduit les expositions du patient aux RX et on ne réalise pas de CTscan.
- **C'est le chirurgien qui décide et non la machine.**
- Il y a un contrôle plus précis de la position et de l'alignement de l'implant.
- Il y a une convalescence plus rapide du patient.
- Une longévité accrue des implants.
- La cicatrice est plus petite / discrète.
- Tension adéquat des ligaments

# Les inconvénients de la navigation

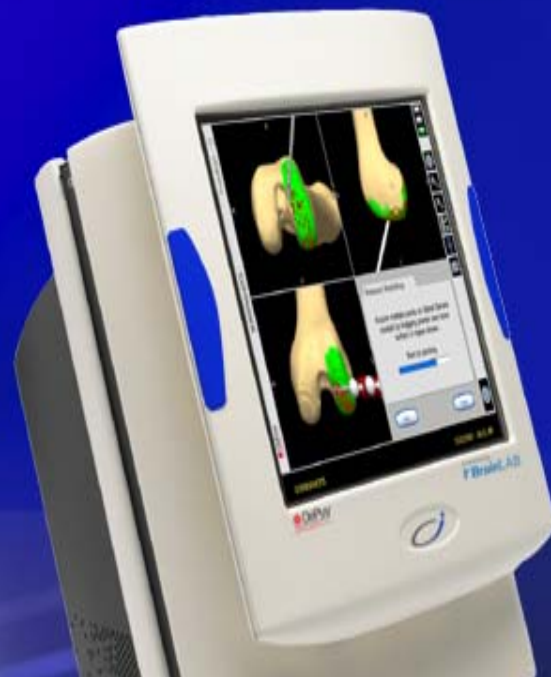
- Coût du matériel.
- Durée de l'intervention plus longue que pour une PTG classique (+/- 15-30 min).
- Demande un apprentissage de la part du chirurgien et du personnel paramédical (utilisation et instruments ancillaires).
- Un appareil supplémentaire dans la salle.

# Indications générales

- Déviation axiale importante.
- Patient chez qui on ne peut mettre de tige centro médullaire dans le fémur (ex: PTH, Tige fémoral,...).
- Patient jeune et actif.

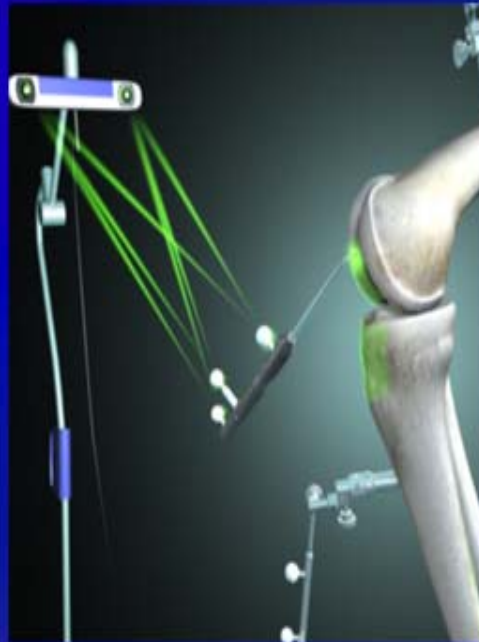
## How does it work?

- **System can be compared with a GPS for automobile navigation.**



## How does it work?

- **The camera replaces the satellite**





# How does it work?

- **The surgical instruments replace the car.**



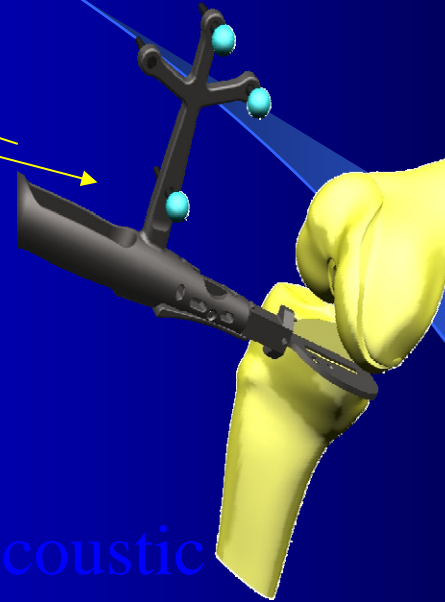
## How does it work?

- **Patient Anatomy compares with roadmap.**



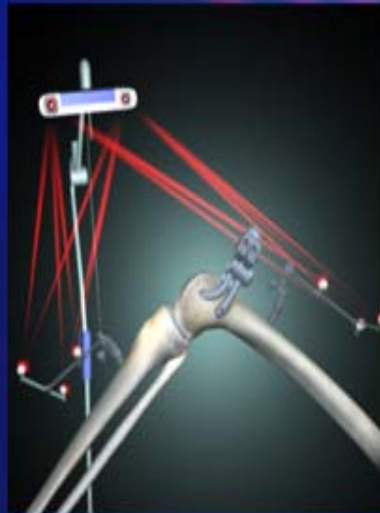
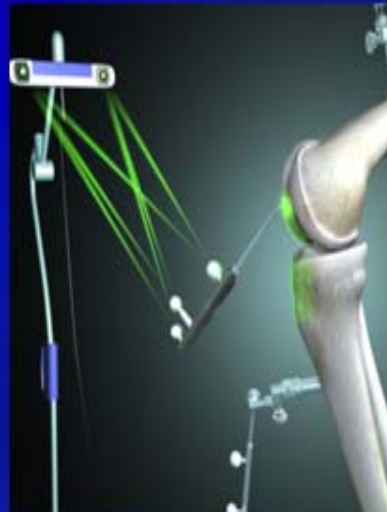


# How does it work?

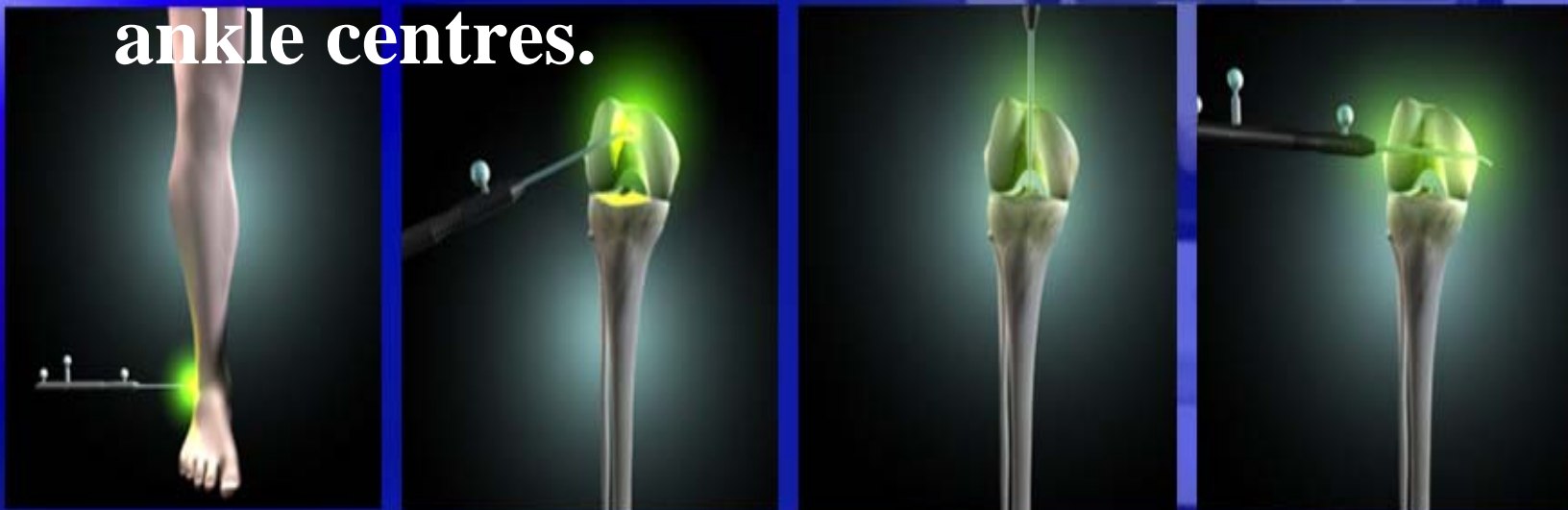


Optical tracking - Magnetic-Acoustic  
patient = reflectors = source  
patient = source...cables....

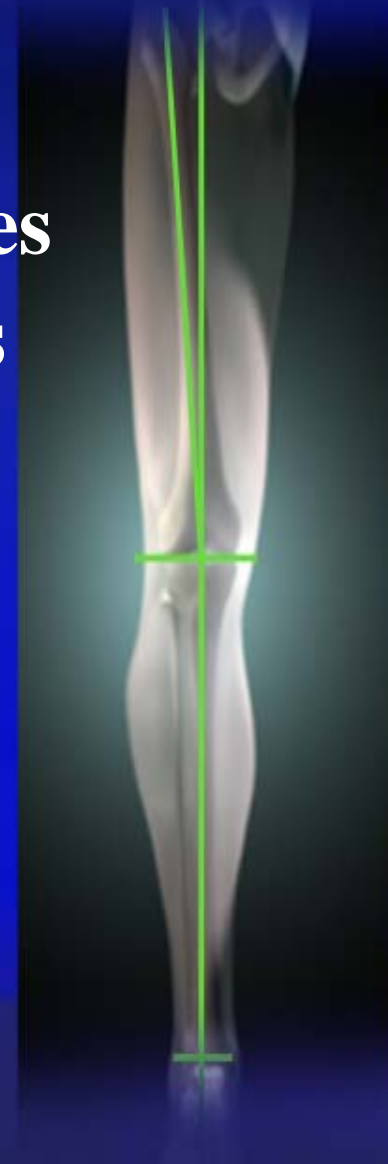
- The computer calculates the position data and displays the information to the screen



**Our Ci system calculates, based on the acquired points, hip, knee and ankle centres.**



**The location of these centres defines the mechanical axis for femur and tibia.**



# Points picking

Ci Knee

PIEROT B - 241624

DePuy

S

M

L A

P

S

S

Tibial Anterior Cortex

Acquire multiple points on anterior, medial and lateral side of the tibial epiphysis by scratching pointer over bone surface in region shown.

Start by pivoting.

Try Again

Back

Next



# Points picking

**Ci Knee**

**PIEROT B - 241624**

**DePuy**

**Medial Tibia Plateau**

Acquire multiple points on medial tibial plateau by scratching pointer over bone surface in region shown.

Start by pivoting in center of plateau.

Try Again Back Next

# Points picking

**Ci Knee**

**PIEROT B - 241624**

**DePuy**

**Lateral Tibia Plateau**

Acquire multiple points on lateral tibial plateau by scratching pointer over bone surface in region shown.

Start by pivoting in center of plateau.

Try Again Back Next

# Points picking

Ci Knee  
PIEROT B - 241624

Medial Femoral Condyle

Remove osteophytes.  
Acquire multiple points on medial femoral condyle, including points located posteriorly, by scratching pointer over bone surface in region shown.

Start by pivoting.

Try Again Back Next

DePuy

# Points picking

Ci Knee  
PIEROT B - 241624  
DePuy

A

M

L

P

S

P

I

L

M

**Lateral Femoral Condyle**

Remove osteophytes.  
Acquire multiple points on lateral femoral condyle, including points located posteriorly, by scratching pointer over bone surface in region shown.

Start by pivoting.

Try Again Back Next

DePuy

# Points picking

Ci Knee

M

S

L A

P

PIEROT B - 241624

S

Femoral Anterior Cortex

Acquire multiple points on anterior femoral cortex by scratching pointer over bone surface in region shown.

Start by pivoting.

Try Again

Back

Next

DePuy



# Tibial Planning

*Genu valgum*

The software interface displays three views of the knee joint: Frontal View, Lateral View, and Axial View. The Frontal View shows a yellow horizontal line across the tibial plateau. The Lateral View shows a yellow line representing the tibial slope. The Axial View shows a top-down view of the tibial plateau with a yellow line indicating the varus/valgus alignment. A yellow arrow points from the text 'Genu valgum' to the lateral view, indicating the valgus deformity.

**Tibial Implant Planning**

Posterior Slope	7.0°
Varus	0.0°
Resection High	8.0mm
Resection Low	8.0mm
Internal Rotation	0.0°
Lateral Shift	2.8mm
Posterior Shift	0.1mm

**Implant Size**

3

- Freesize +

Reset Back Next

# Tibial cut navigation / Check



Ci Knee

Frontal View

Planned Verified

Lateral View

Planned Verified

PIEROT B - 241624

Oblique View

Planned Verified

**Tibia Resection Data**

Press "Next" to proceed with updated values.  
Press "Back" to repeat verification.

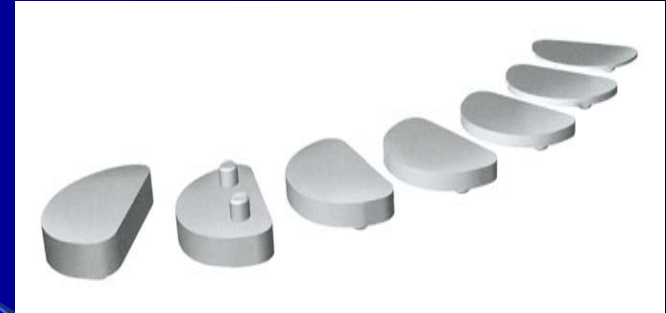
	Actual	Planned	Deviation
Varus	0.0°	0.0°	0.0°
Posterior Slope	7.7°	7.0°	0.7°
Resection	7.7mm	8.0mm	0.3mm

Back
Next

DePuy

PIEROT B

# *Ligament balancing*



*1° Extension*



Figure 81

*2° Flexion*

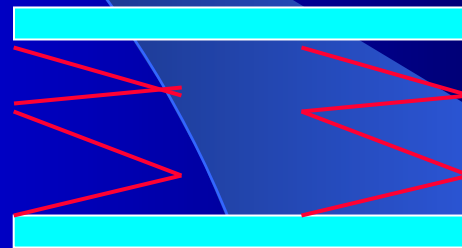


Figure 83

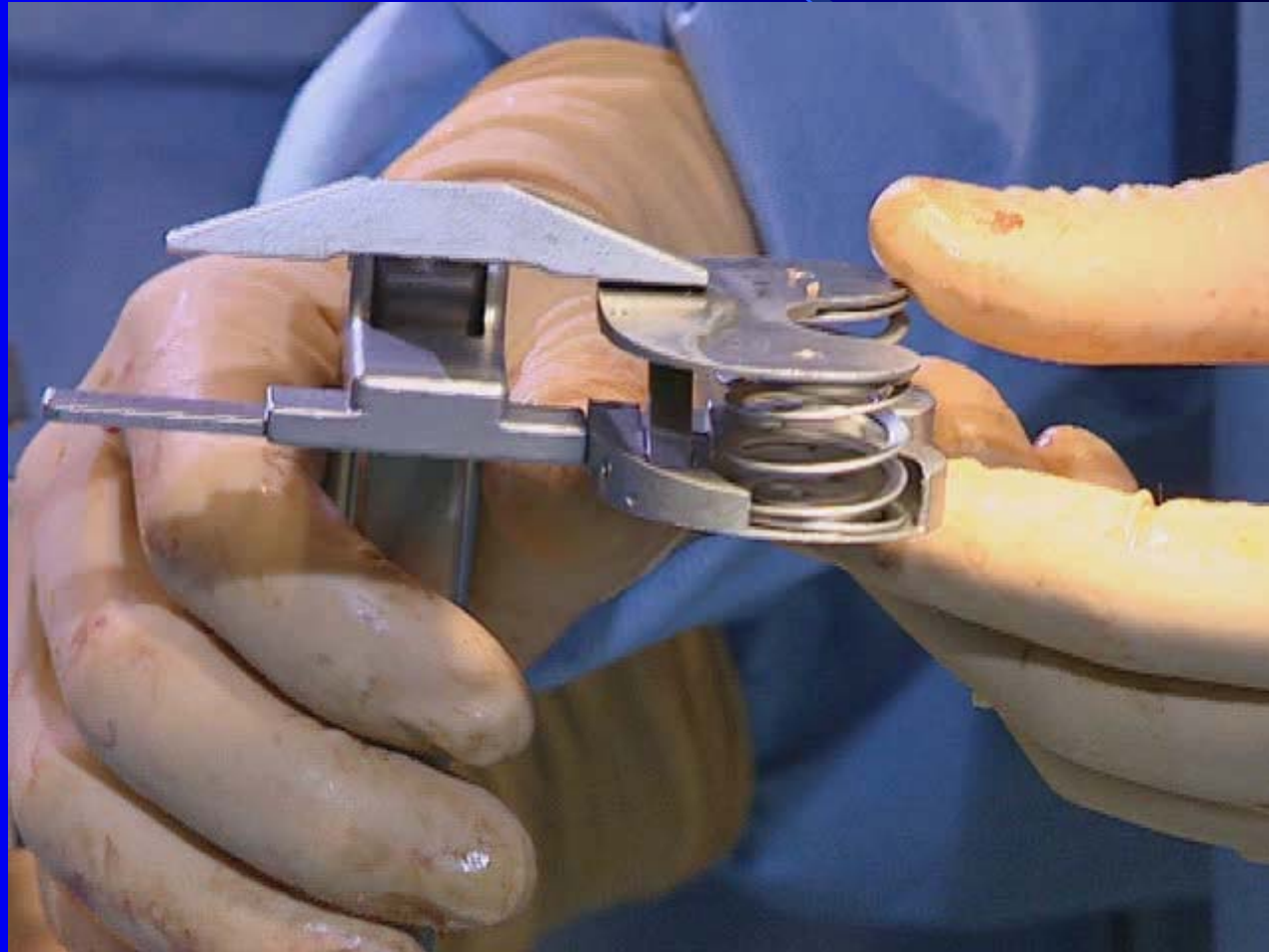
# LCS TKR Navigation & Soft tissues balancing

## DEVICES

-springs tensors “sensor tensor”



# CAS Ligament Tensor



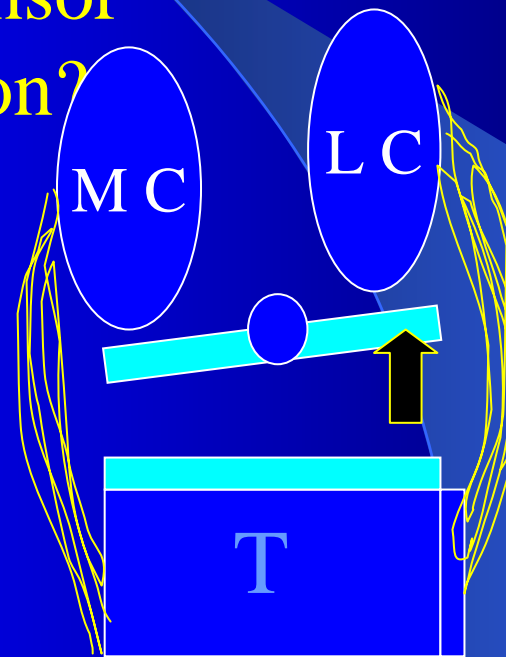


# LCS TKR Navigation & Soft tissues balancing

## DEVICES

- springs tensors “sensor tensor”
- fixed tensor
- dynamometric tensor

? Tension?



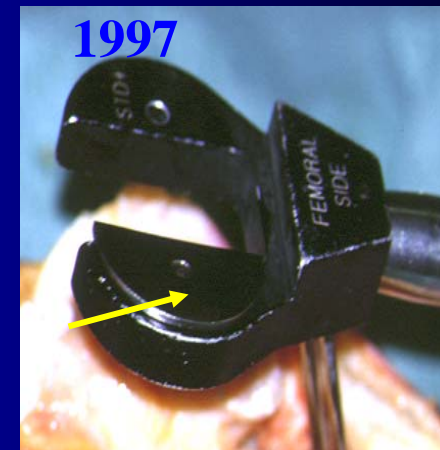
At same time:

- External Rotation
- Gap stored

# LCS TKR Navigation & Soft tissues balancing

## DEVICES

- springs tensors “sensor tensor”
- fixed tensor
- dynamometric tensor  
? Tension ?
- quarter blocks



Separately:

- External Rotation
- Gap stored

# LCS TKR Navigation & Soft tissues balancing

## DEVICES

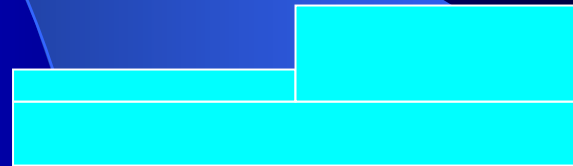
- springs tensors “sensor tensor”
- fixed tensor
- dynamometric tensor
- ? Tension ?
- quarter blocks



# LCS TKR Navigation & Soft tissues balancing

## DEVICES

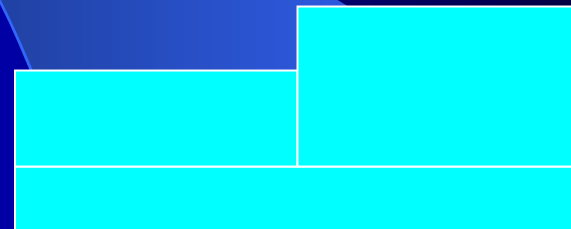
- springs tensors “sensor tensor”
- fixed tensor
- dynamometric tensor
  - ? Tension ?
- quarter blocks
- tunable blocks?



# LCS TKR Navigation & Soft tissues balancing

## DEVICES

- springs tensors “sensor tensor”
- fixed tensor
- dynamometric tensor
  - ? Tension ?
- quarter blocks
- tunable blocks?



# Femoral Planning

PE Thickness

Gap optimisation

Ci Knee  
PIEROT B - 241624  
DePuy

Lateral View A S

Frontal View A M L

**Femoral Implant Planning**

Flexion	4.5°
Resection Level	12.3mm
Anterior Shift	0.0mm
Insert Thickness	10MM
Joint line in Ext	0.0mm (Prox)
Joint line in Flex	0.5mm (Ant)
Extension Gap	19.1mm
Flexion Gap	19.1mm

Implant Size  
standard+  
- Freesize +

Reset Back Next



# External rotation

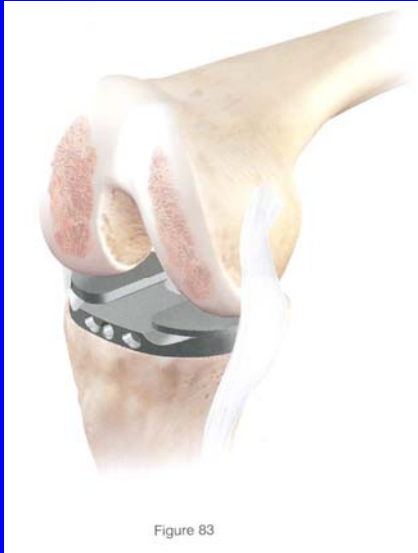


Figure 83

CI Knee  
PIEROT B - 241624  
DePuy

Frontal View

Axial View

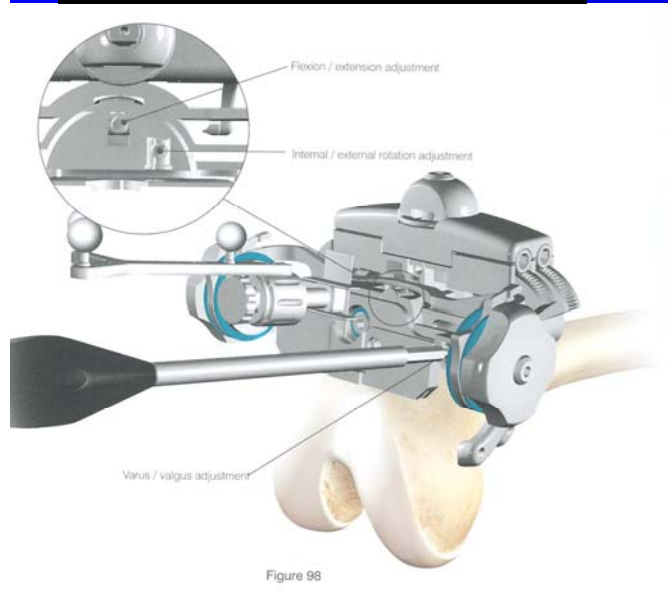
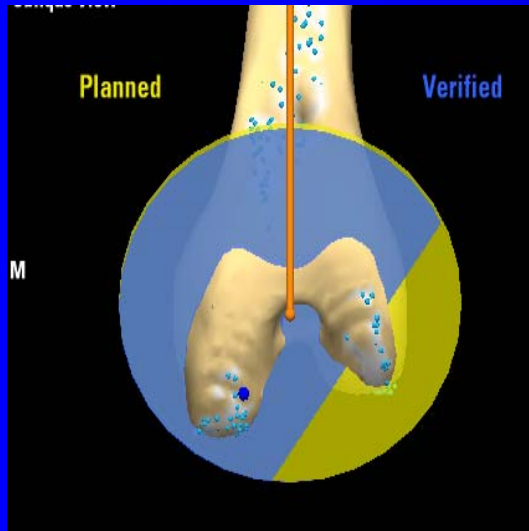
Epi: 0.4° WS: -2.7° Post: 9.0°

Medial Shift 0.0mm  
Varus 0.0°  
Internal Rotation 0.0°  
Implant Size standard+

Reset Back Next

Detailed description: This is a screenshot of a surgical navigation software interface for knee surgery. The interface is split into two main views: 'Frontal View' on the left and 'Axial View' on the right. The 'Frontal View' shows a 3D model of the femur and tibia with a red femoral implant planned. The 'Axial View' shows the same model from a top-down perspective, with a blue horizontal line representing the implant's position. Key alignment parameters are displayed in yellow text: 'Epi: 0.4°', 'WS: -2.7°', and 'Post: 9.0°'. Below the views is a 'Femoral Implant Planning' panel with a table of settings: 'Medial Shift 0.0mm', 'Varus 0.0°', 'Internal Rotation 0.0°', and 'Implant Size standard+'. At the bottom of the panel are three buttons: 'Reset', 'Back', and 'Next'. The interface also includes a vertical toolbar on the right with various icons for navigation and information, and a DePuy logo on the left side.

# Distal navigation / fine tuning / Cut



# Distal cut check

CI Knee  
PIEROT B - 241624

Frontal View

Planned Verified

M L

Lateral View

Planned Verified

M L

Oblique View

Planned Verified

M L

DePuy

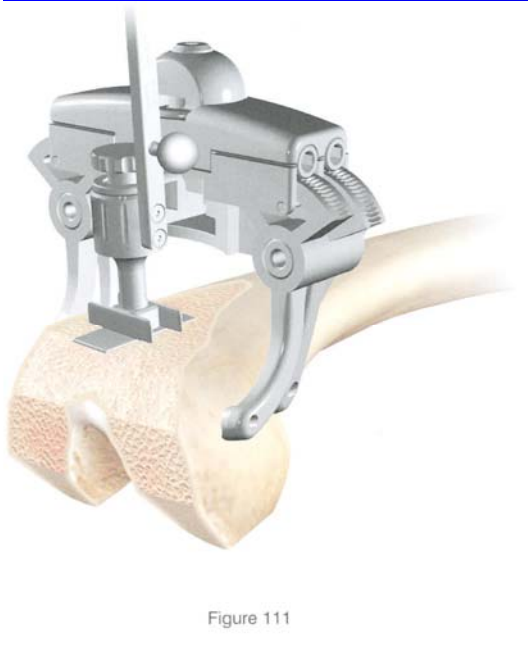
Distal Resection Data

Press "Next" to proceed with updated values.  
Press "Back" to repeat verification.

	Actual	Planned	Deviation
Valgus	0.6°	0.0°	0.6°
Flexion	4.9°	4.5°	0.4°
Resection	11.4mm	12.3mm	0.9mm

Back Next

# Ant cut check



**Ci Knee**

**PIEROT B - 241624**

**DePuy**

**Axial View A**

Planned Verified

**Lateral View A**

Planned Verified

**Oblique View**

Planned Verified

**A/P Resection Data**

Press "Next" to proceed with updated values.  
Press "Back" to repeat verification.

	Actual	Planned	Deviation
Internal Rotation	0.0°	0.0°	0.0°
Anterior Shift	1.0mm	0.0mm	1.0mm

Back
Next

# Final Alignment

The screenshot displays a knee alignment software interface with two main views: Frontal View and Lateral View. The Frontal View shows a 3D model of the knee with a vertical axis and a horizontal axis. A white arrow indicates a rotation of 1.0°. The text 'Max: 7.0°' and 'Max: 6.5°' is displayed. The text 'Gap: 19.0 mm' and 'Valgus: 1.5°' is displayed at the bottom. The Lateral View shows a 3D model of the knee with a vertical axis and a horizontal axis. The text 'Flexion: 2.0°' is displayed. A data panel on the right side of the interface shows 'Final Extension Alignment' with the instruction 'Bring leg to extension.' and the following data:

Final Extension Alignment	
Bring leg to extension.	
Extension Gap	19.2mm
Preoperative Information:	
Valgus	7.2°
Extension	3.1°

At the bottom of the interface, there are three buttons: 'Store', 'Back', and 'Next'. A red arrow points to the 'Store' button.

Vertical text on the left side of the interface includes 'Ci Knee', 'PIEROT B - 241624', and 'DePuy'.

## **The potential advantages of computer assisted surgery (CAS) are:**

- 1.increase in accuracy**
- 2.More information...flexible surgical decisions**
- 3.less invasive operations (no intra-medullary instruments)**
- 4.step by step verification of surgical procedures**
- 5.reproducible and comparable results**
- 6.Surgical tool teaching**
- 7.reduction of “tourniquet time”...after learning curve!**
- 8.reduces Xray CT Free!!**
- 9.surgeon decision NO ROBOTIC!**



# Benefits for LCS Users

- Better and more sophisticated soft tissue ligament balancing due to the sensor-tensor
- More accurate bone cuts due to elimination of stack up of errors
- Less invasive due to elimination of IM rods
- Increased accuracy due to execution of a well established plan based on acquired landmarks



C'est le chirurgien  
qui décide et non la  
machine....

# Rôles de l'infirmier(e) en salle (au CHBAH)

- Préparation et vérification du matériel la veille.



## Avant l'arrivée du patient

- l'infirmière circulante branche la navigation et lance la procédure.

# préparation de la navigation

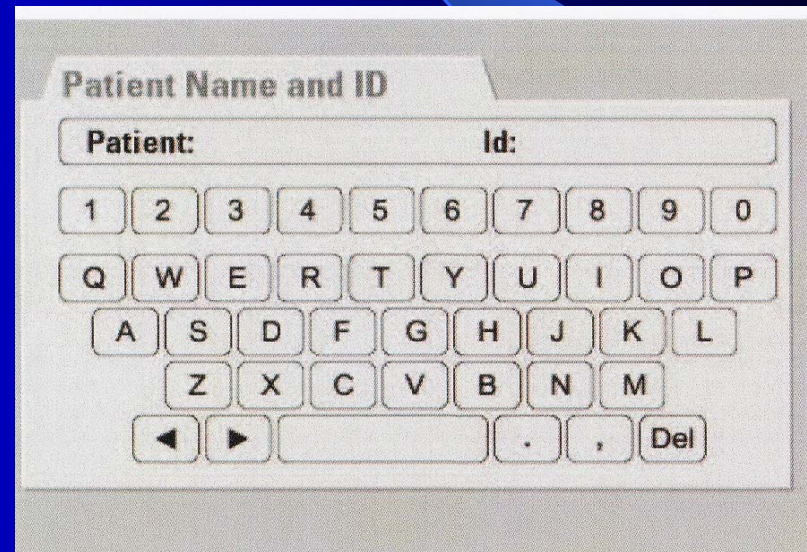
## Connexion du système

- Câble d'alimentation.
- Vérifier que le voltage soit sur 220 volts avant de brancher le système.
- Prise de terre qui est jaune.
- Câble de l'unité de caméra qui est orange.
- **!!! La caméra doit être branchée 20 min avant de lancer toute procédure !!!**



# lancement de la procédure

- Allume la navigation.
- Attend deux bips sonore.
- Encode les données.
- La suite de la procédure est faite avec le chirurgien et le délégué .



The image shows a handheld medical device keypad. At the top, it is labeled "Patient Name and ID". Below this, there are two input fields: "Patient:" and "Id:". The keypad features a standard QWERTY layout with the following keys: a numeric row (1-0), a top row (Q-W-E-R-T-Y-U-I-O-P), a middle row (A-S-D-F-G-H-J-K-L), a bottom row (Z-X-C-V-B-N-M), and a bottom row with navigation arrows (left and right), a blank space, and a "Del" key.



# installation du patient



- DD.
- Bras en croix.
- Garrot pneumatique.
- Cale genou électrique jambe opérée.
- Dépend du chirurgien.





# Préparation site opératoire.



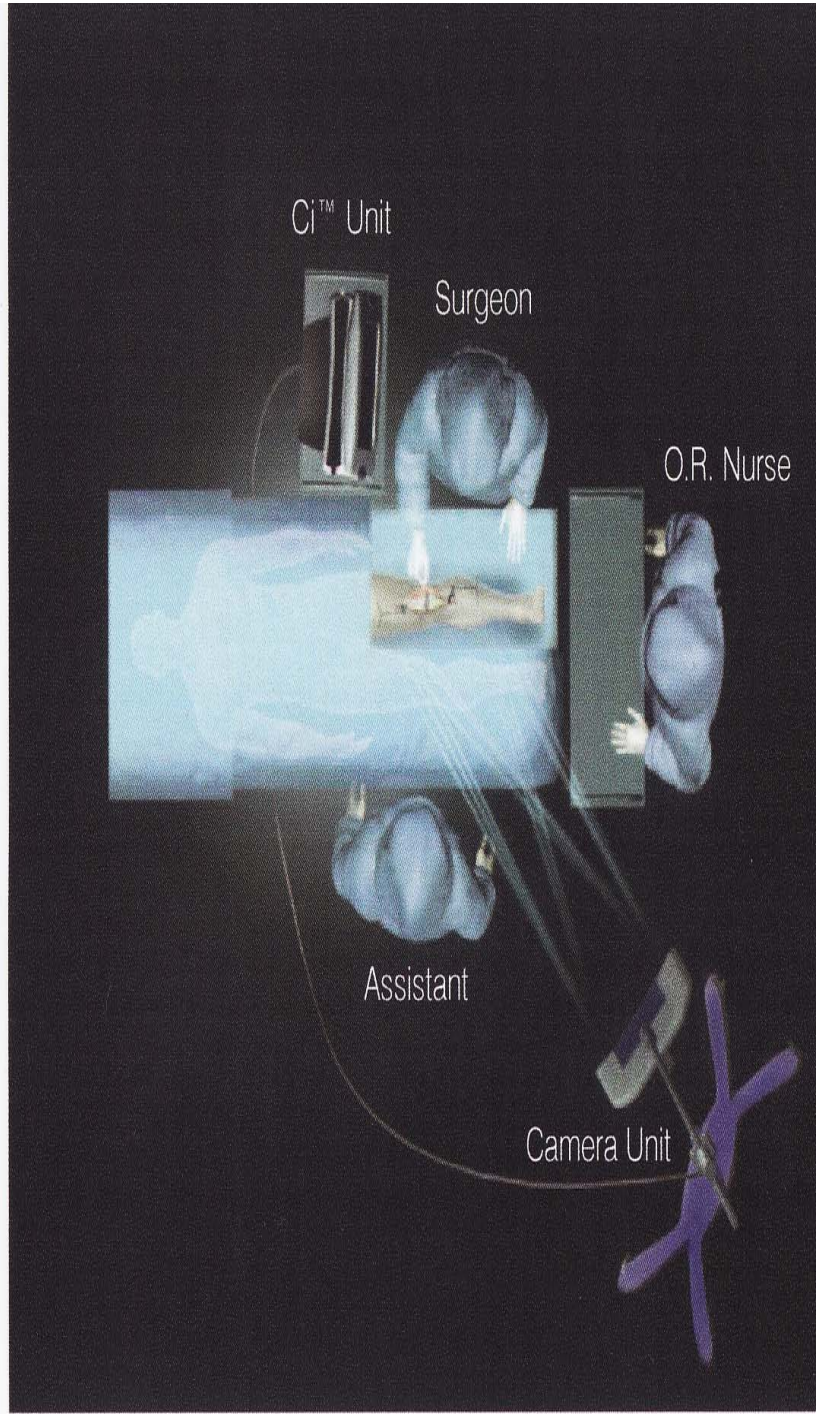
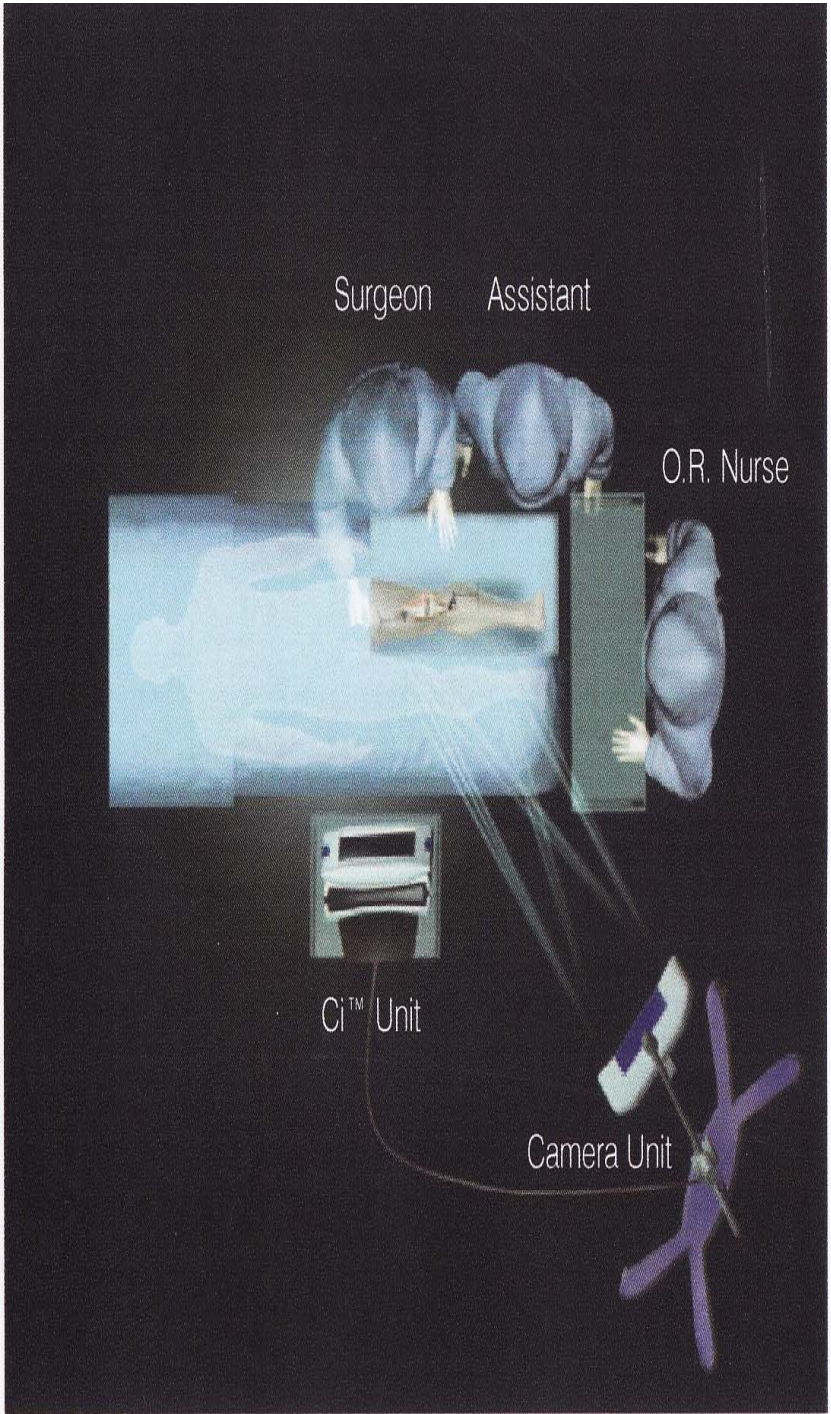
- drapage.



# disposition du matériel

- Chirurgien → une bonne vue sur l'écran.
- Caméra infrarouge a une vue ininterrompue des *marqueurs* tibiaux ou fémoraux.
- caméra → 1.5 – 2 mètres du site opératoire.
- Autres matériels coté non opéré.

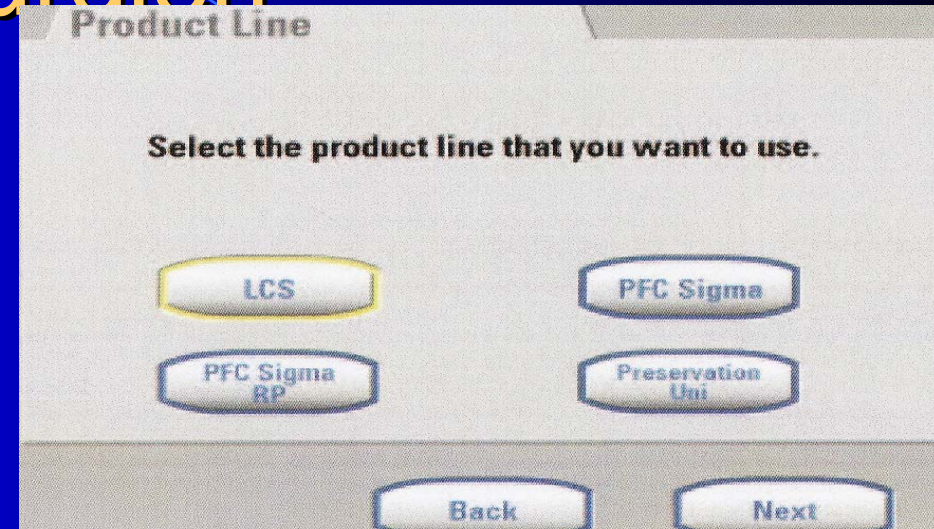




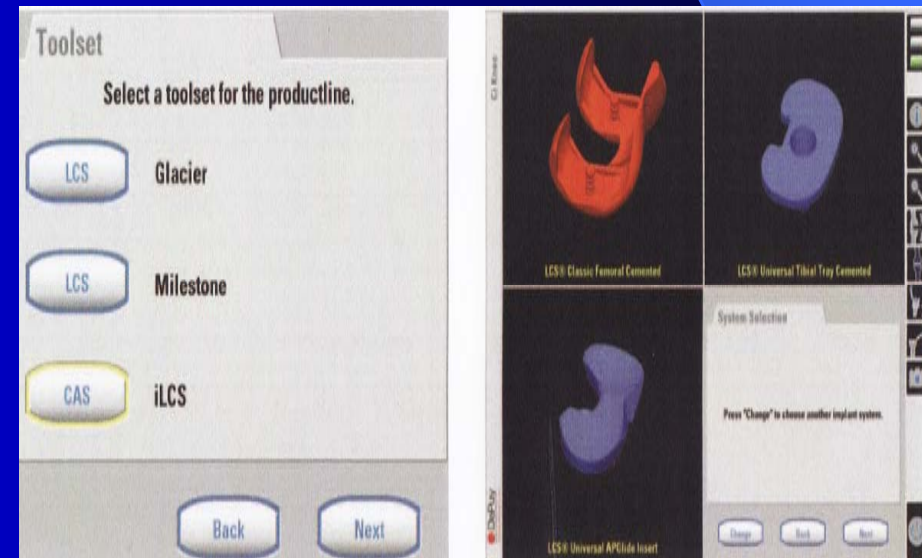


# Suite de la procédure pour le chirurgicalien

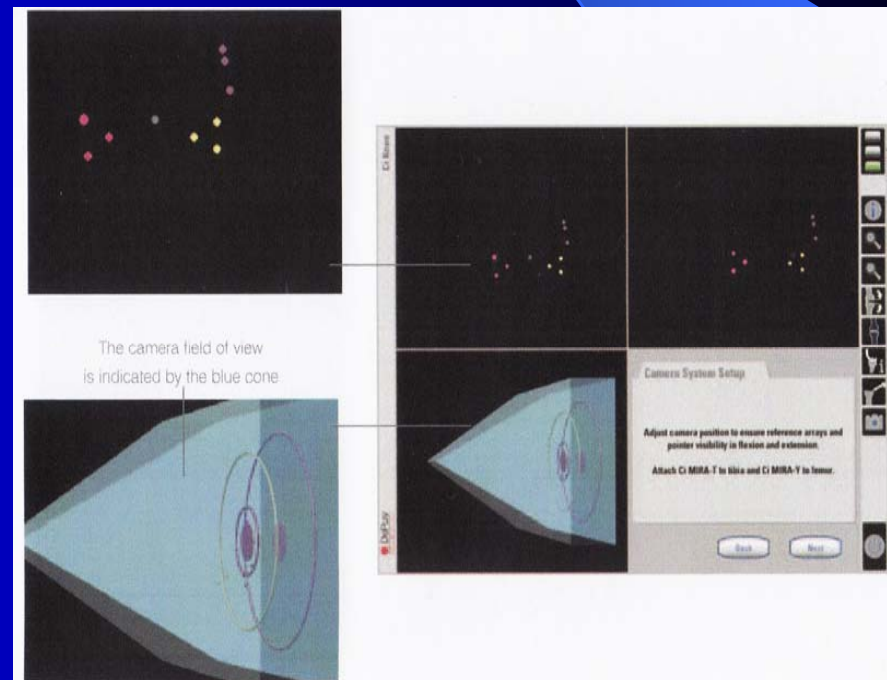
- Ligne de produit (LCS, PFC sigma, .....).



- Choix des instruments et la ligne de produit.



- Choix du genou droit ou gauche.
- Alignement de la caméra.
- A cette étape, la procédure est lancée et la navigation peut commencer.



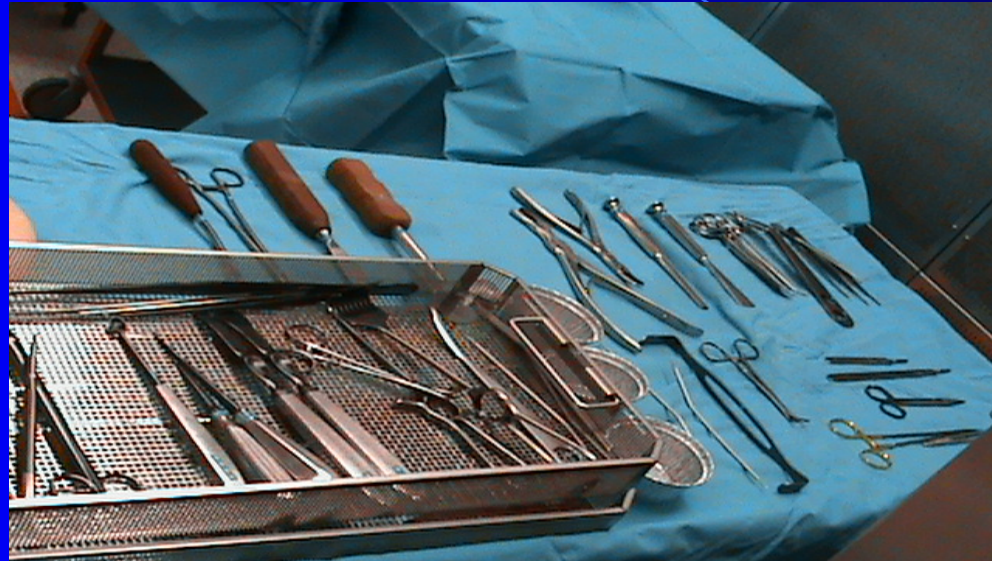
**Durant l'intervention: IC  
reste a proximité de l'écran .**



il existe des housses stériles que l'on peut mettre sur l'écran pour que l'équipe chirurgicale puisse le faire elle-même. Tout dépend de l'habitude du service.

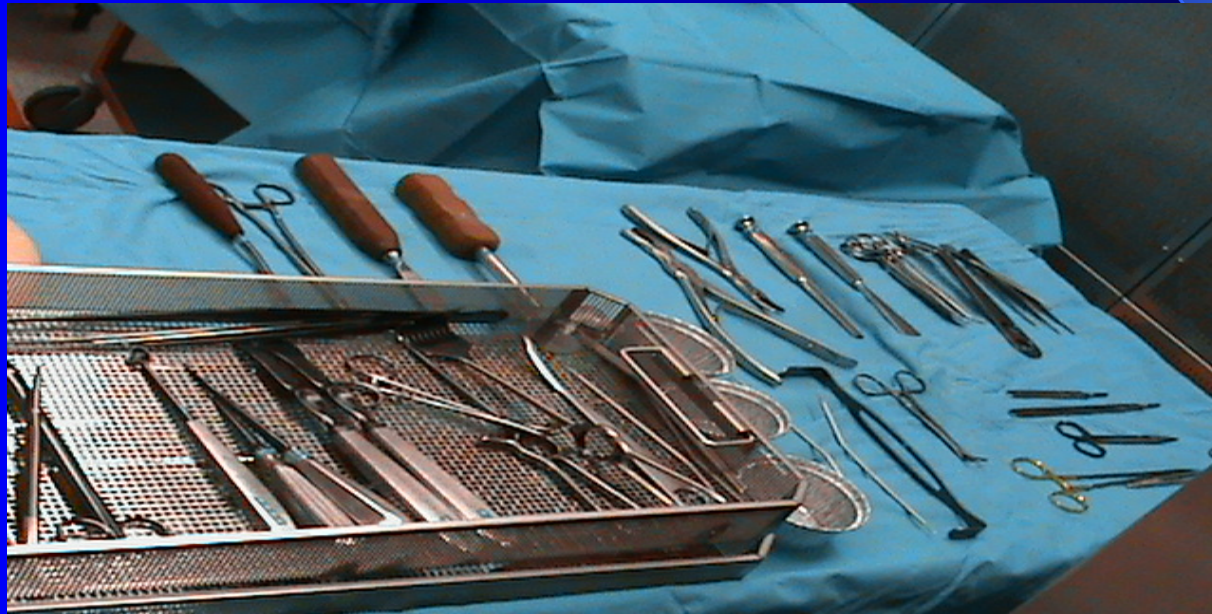


# l'instrumentation

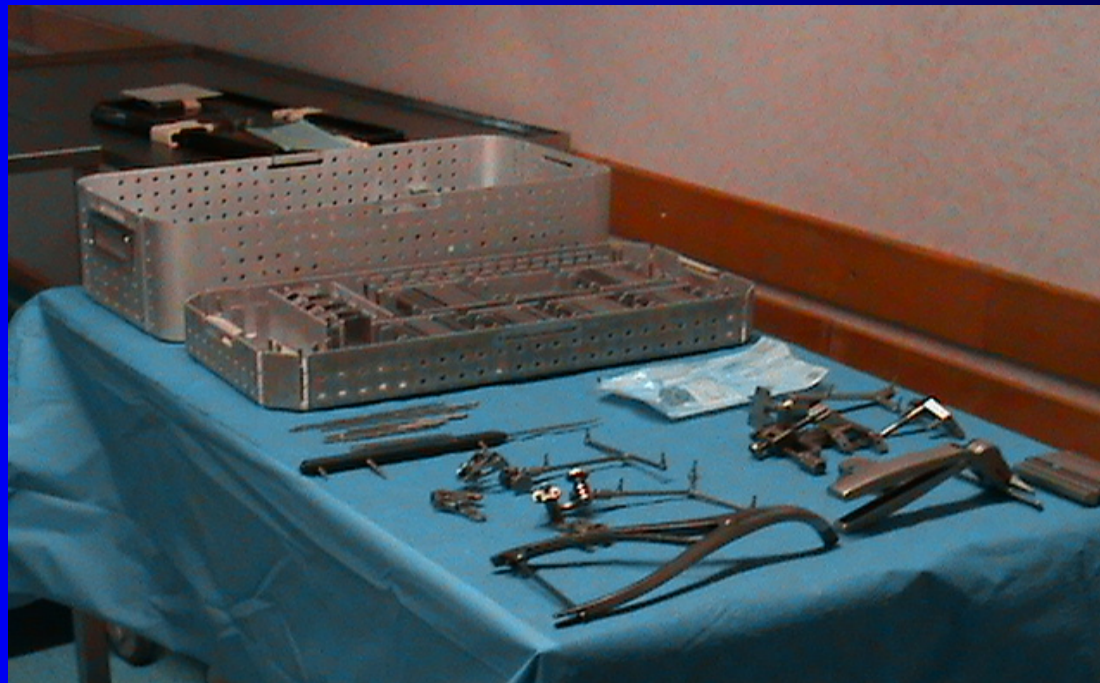




- Durant l'intervention, la gestion du matériel standard est réalisé par l'instrumentiste.



- Le matériel spécifique à la navigation est géré par le délégué et l'instrumentiste.



# conclusion

- La navigation est une technique opératoire qui permet de réaliser des actes avec une grande précision en guidant et en donnant une visualisation 3D au le chirurgien.
- C'est néanmoins une technique peut fréquemment utilisée et pour des indications chirurgicales bien précise.

# Remerciement à:

- Au DDI du CHBAH qui m'a autorisé à faire mon tfe dans son établissement.
- K. VERMEALEN; chef infirmière au bloc d'orthopédie du CHBAH, qui m'a aidé dans la réalisation de mon travail.
- P. LONCHAY; délégué de la firme DEPUY qui m'a apporté des explications.
- Dr JP DELCOUR et H. CHARLIER, chirurgien orthopédiste au CHBAH, pour l'aide apportée pour la réalisation du travail.
- Toute l'équipe du bloc d'orthopédie du CHBAH.





**QUESTIONS?**





MERCI DE VOTRE  
ATTENTION