Quadriceps Tendon-Patellar Bone Autograft for ACL reconstruction

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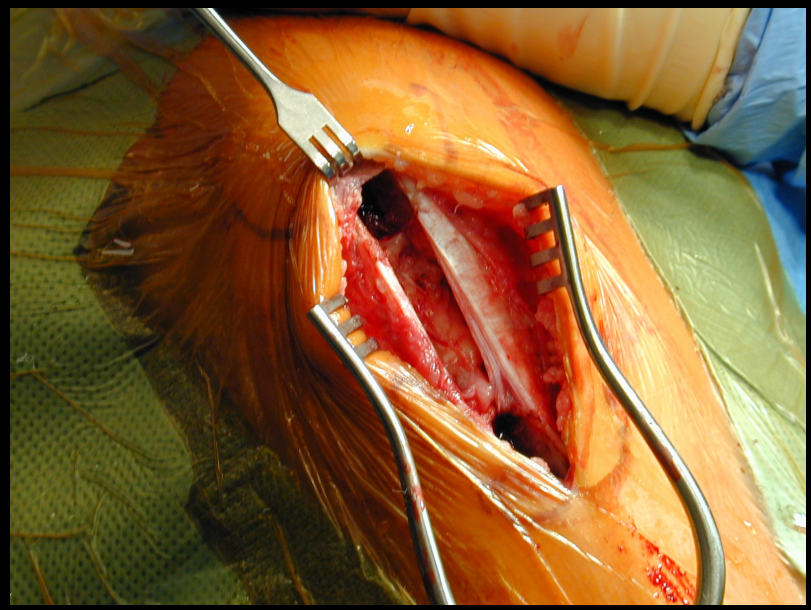
Graft Choices

- Contralateral B-PT-B
- Ipsilateral BPTB
- Hamstring tendons
- Quadriceps tendon
- Allograft
  - Achilles tendon
  - B-PT-B
  - Tibialis tendon(s)



Graft Issues

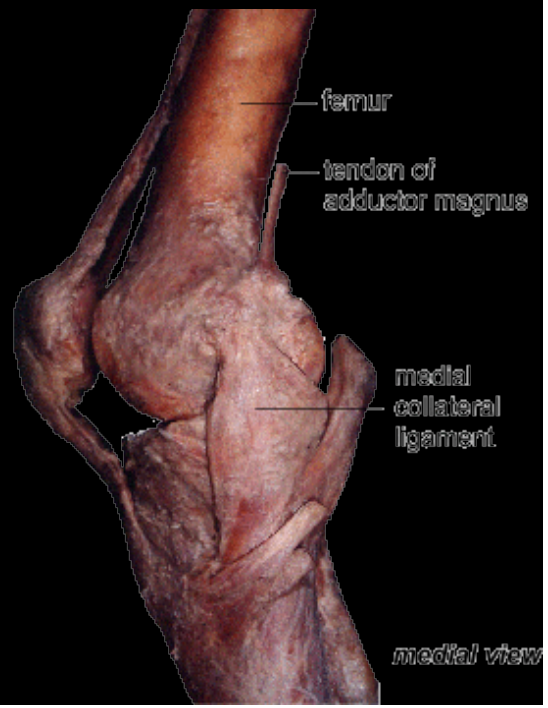
- *Harvest site morbidity*
  - Peri-operative
  - Long term
- *Fixation problems*
  - Bone versus soft tissue
- *Healing*
  - Bone-to-bone
  - Bone-to-tendon
- *Allograft*
  - Virus transmission
  - Unfriendly host

Rationale of using QT Autograft

- ✓ Comparable structural properties with respect to normal ACL
- ✓ Easy harvesting
- ✓ Versatility: can include bone block from patella or not
- ✓ Expendable ?

Quadriceps Tendon

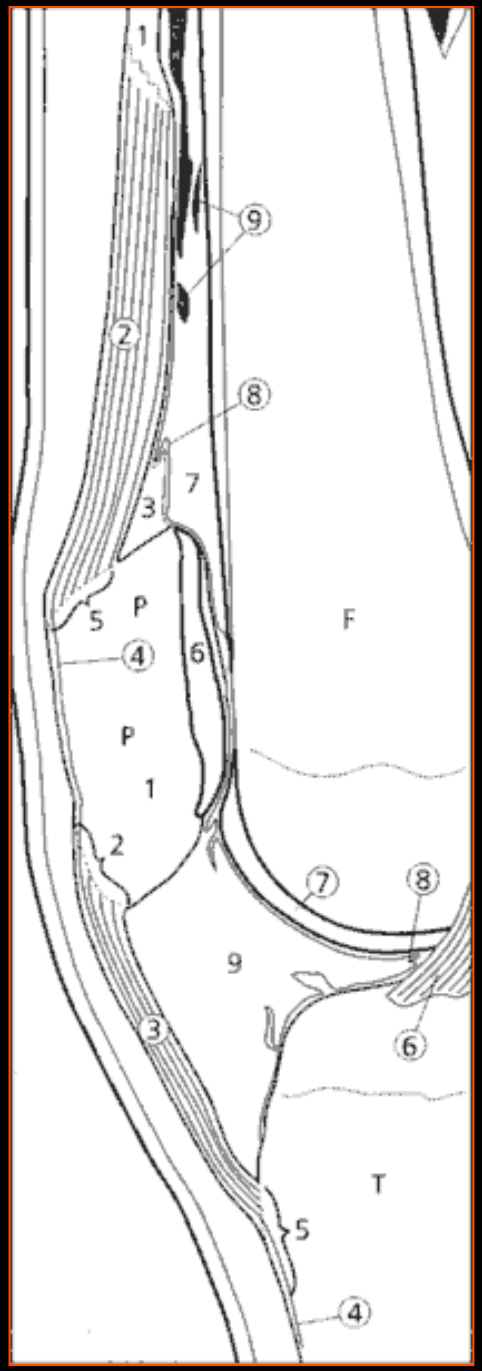
- Long-term results unknown
- Extensor mechanism response
- Harvest site morbidity



Why Use the Quadriceps Tendon Autograft ?

1. Difficulty harvesting the hamstring tendons

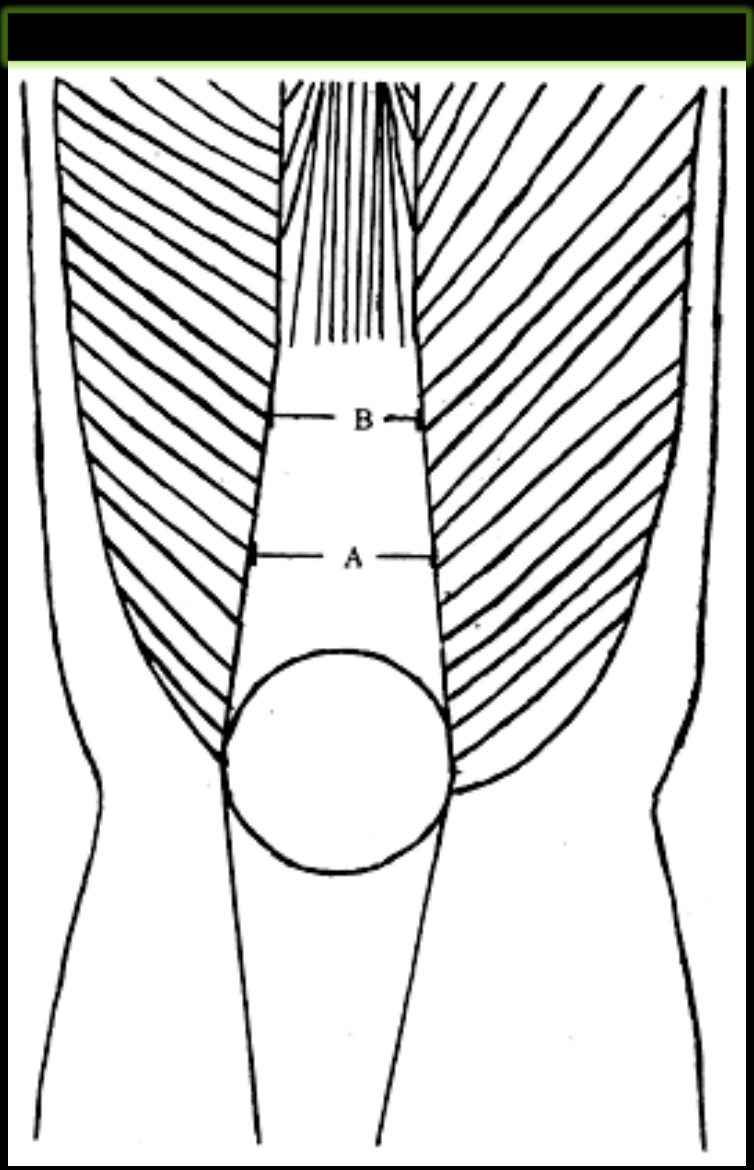
2. Revision ACL reconstruction



The Quadriceps Tendon

- ✓ consists of four leaves
- ✓ the anterior most layer coalesces to form prepatellar retinaculum
- ✓ inserts into anterior half of patellar base

STÄUBLI H.U. et al., Quadriceps tendon and patellar ligament : cryosectional anatomy and structural properties in young adults. Knee Surg Sports Traumatol Arthrosc, 1996,4 : 100-110

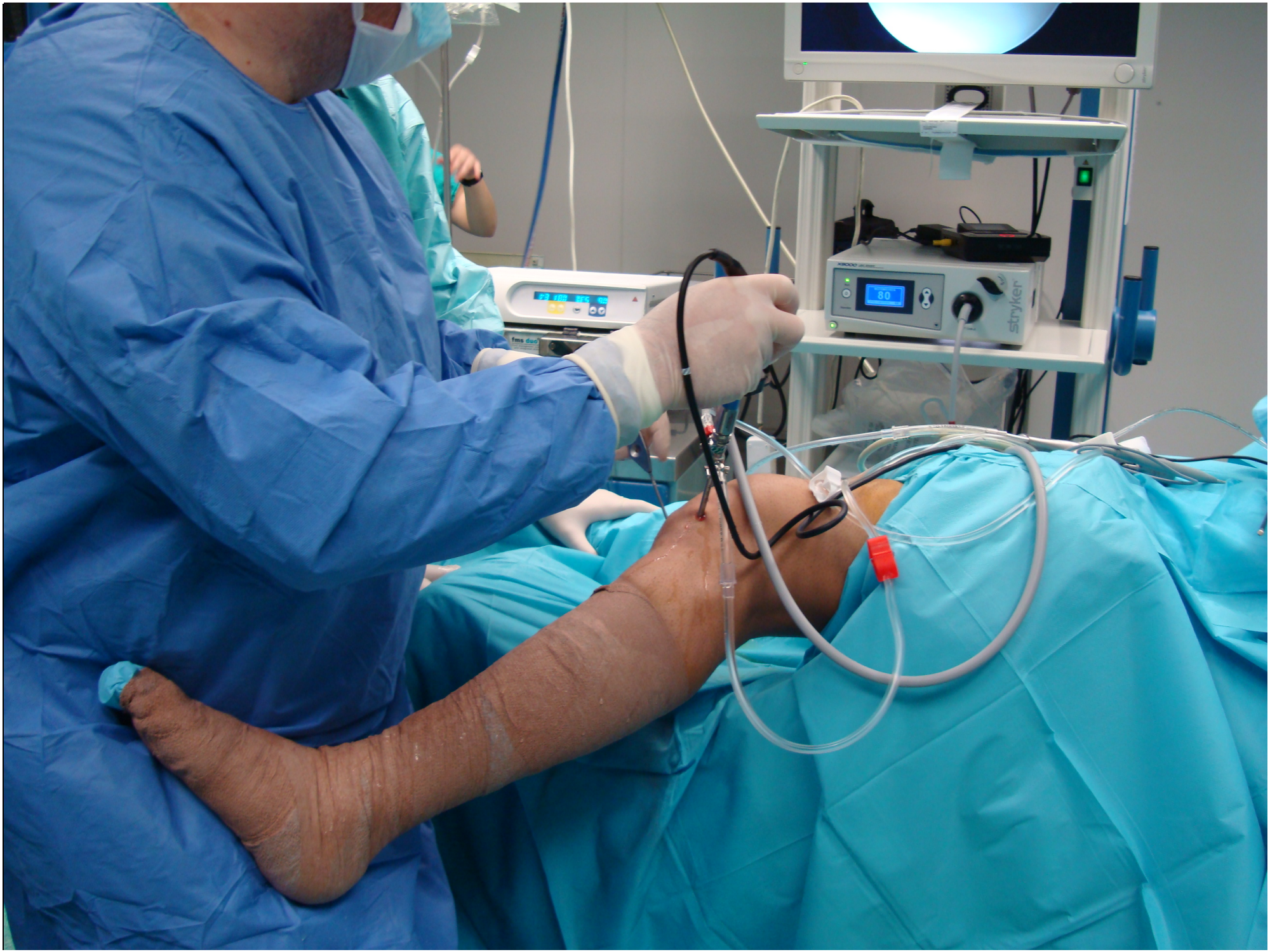


The mean quadriceps tendon width

2.1 cm (0.5 - 4.0 cm) at 5 cm

3.6 cm (1.5 - 7.0 cm) at 2 cm

Surgical Technique


stryker
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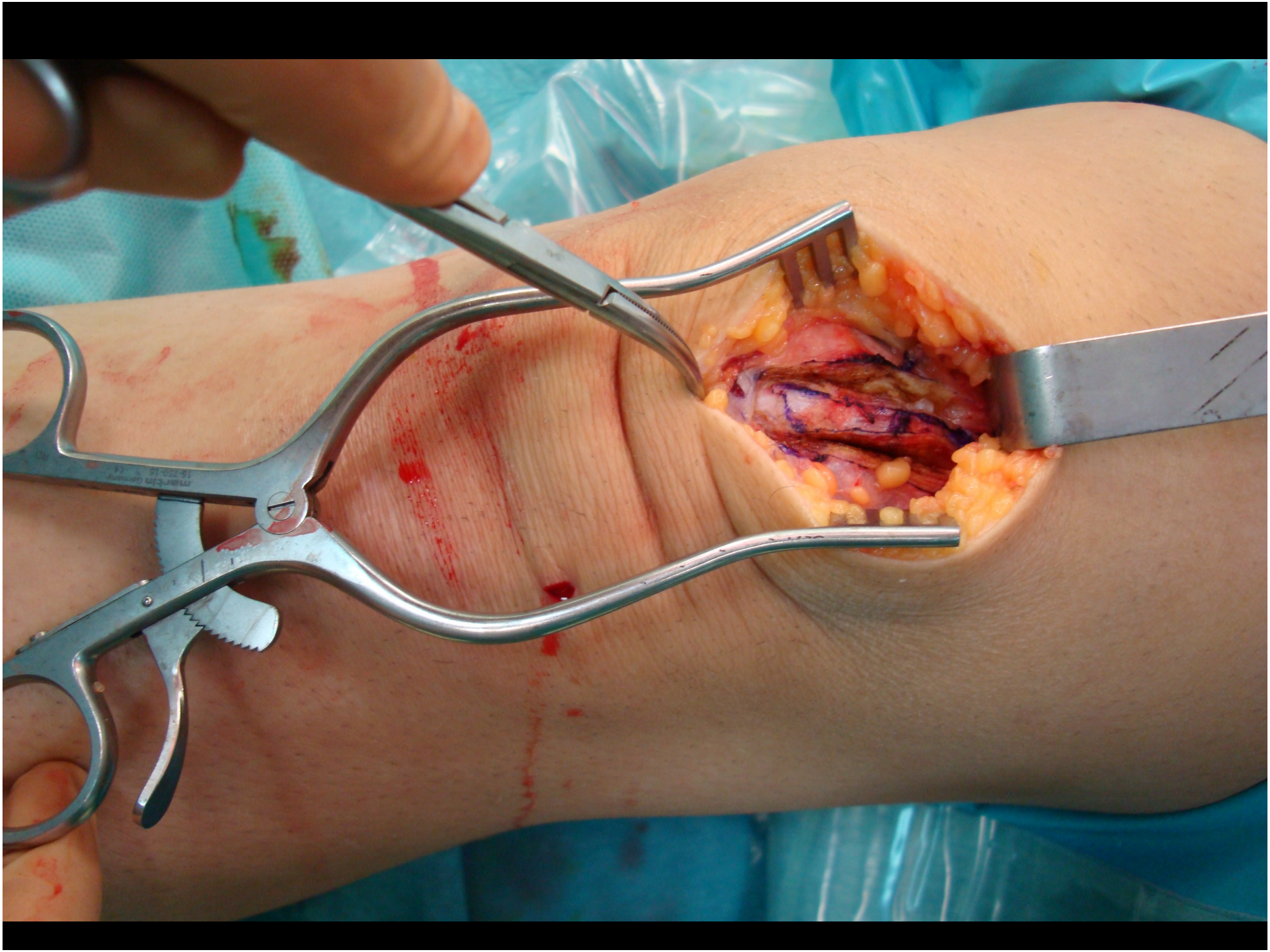

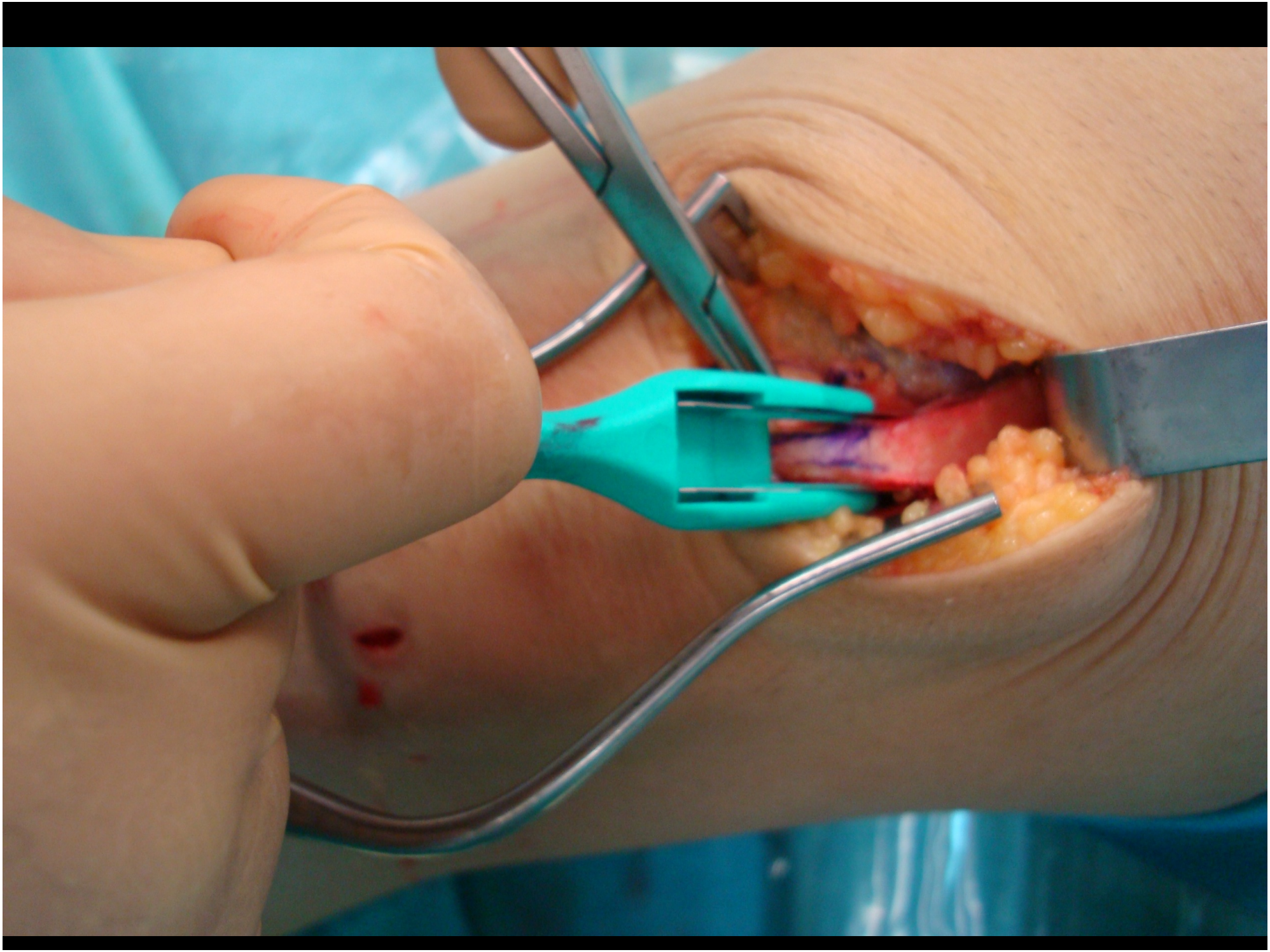

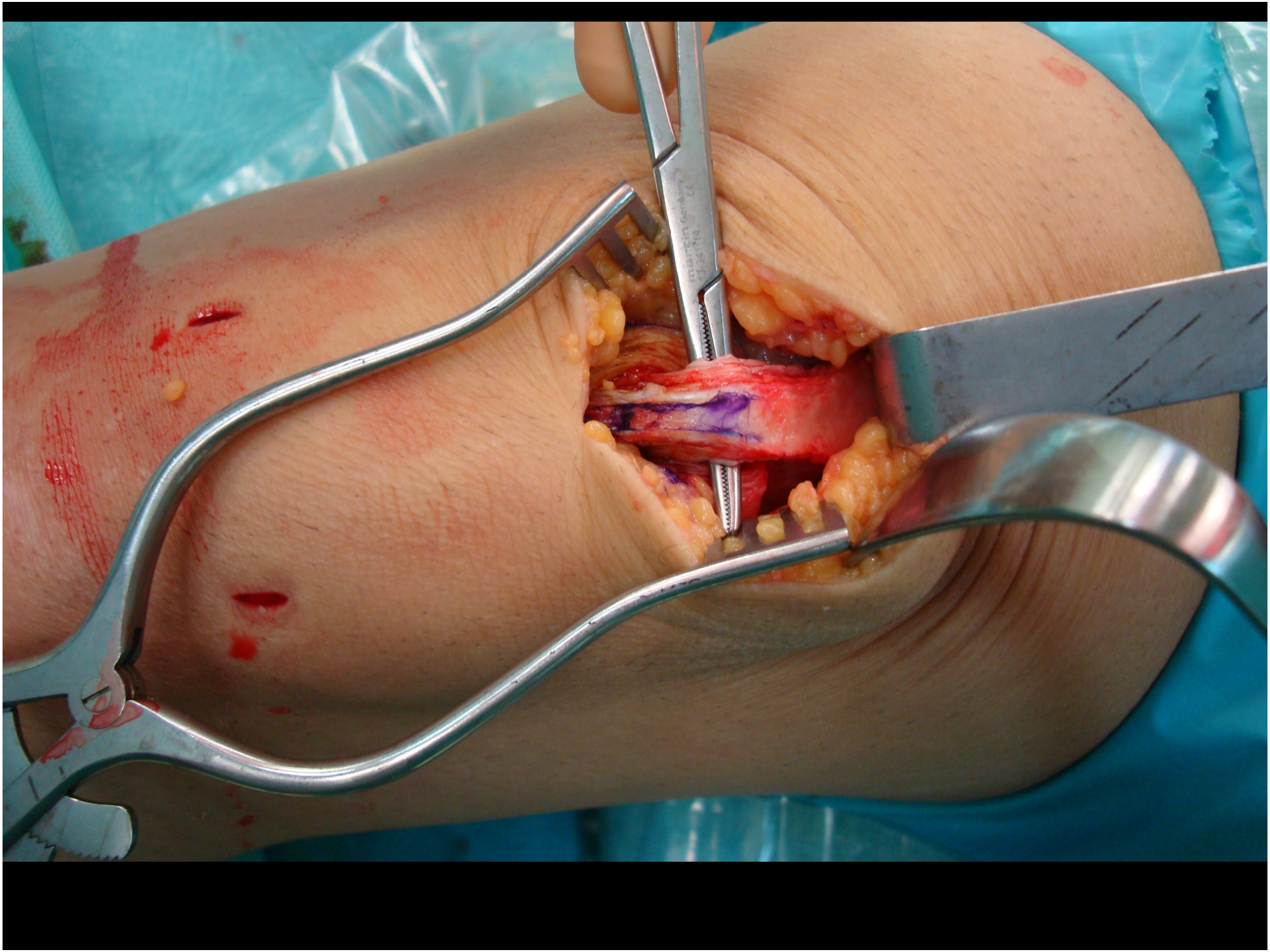

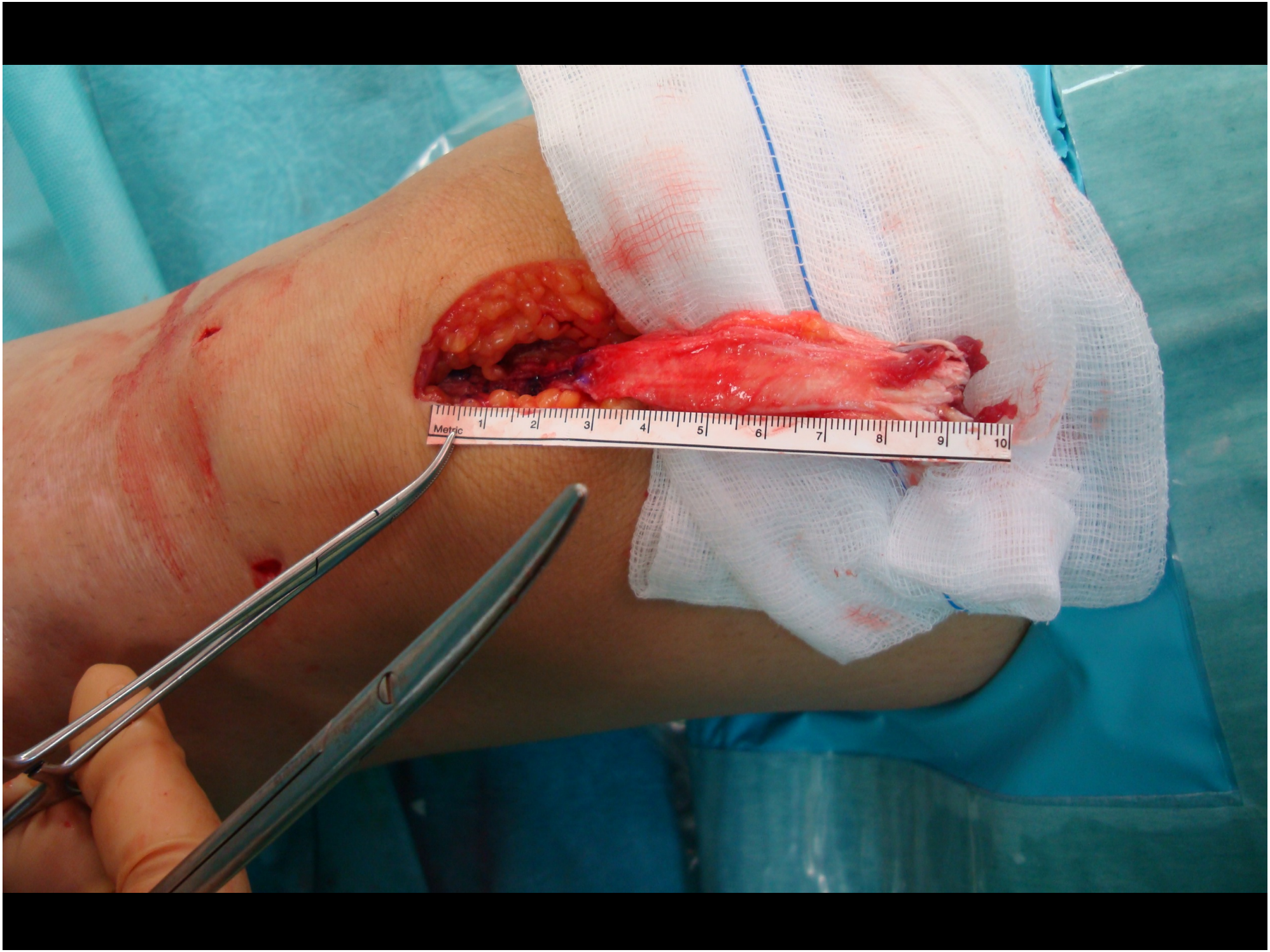
Metric
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2
3
4
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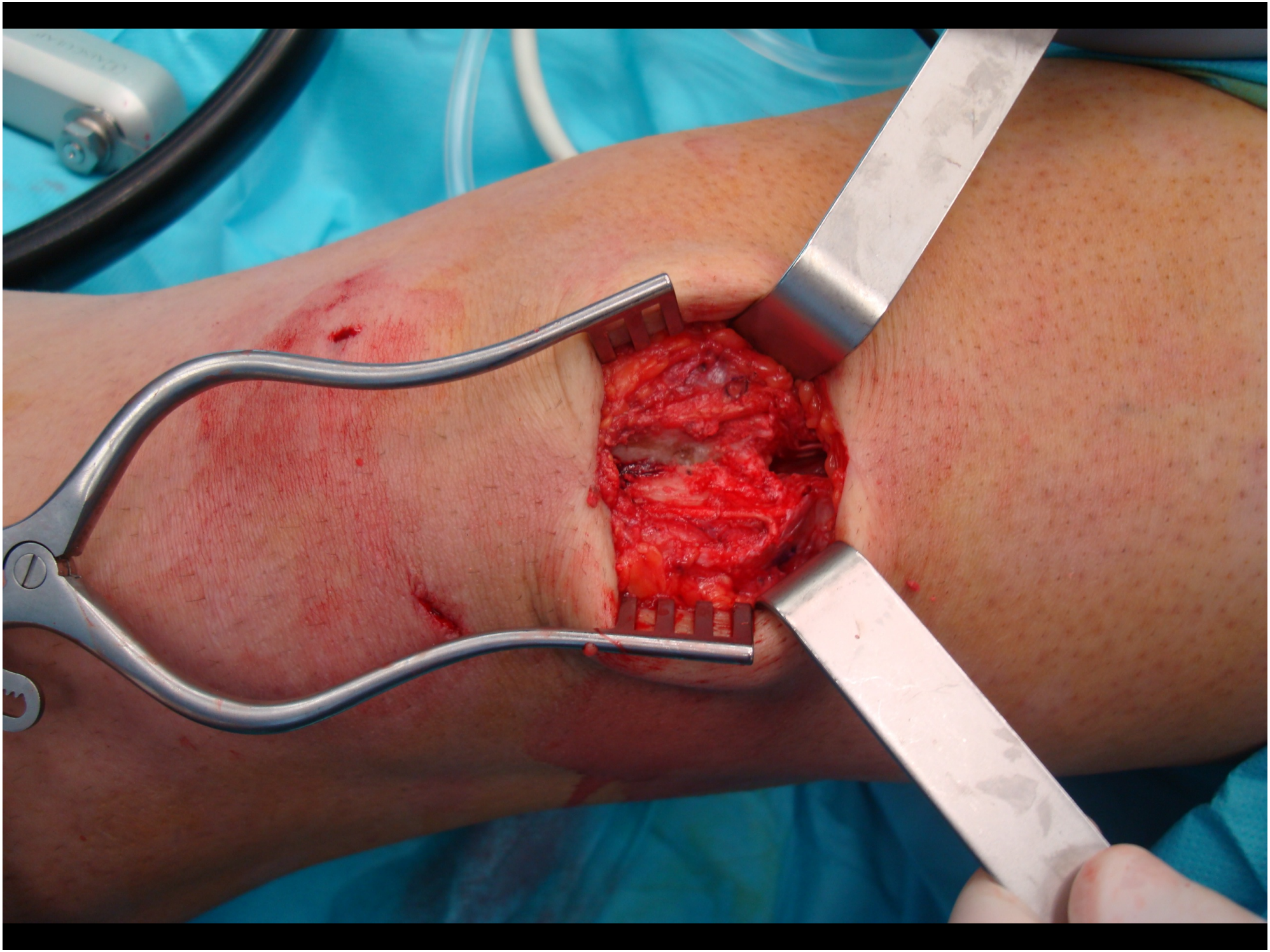
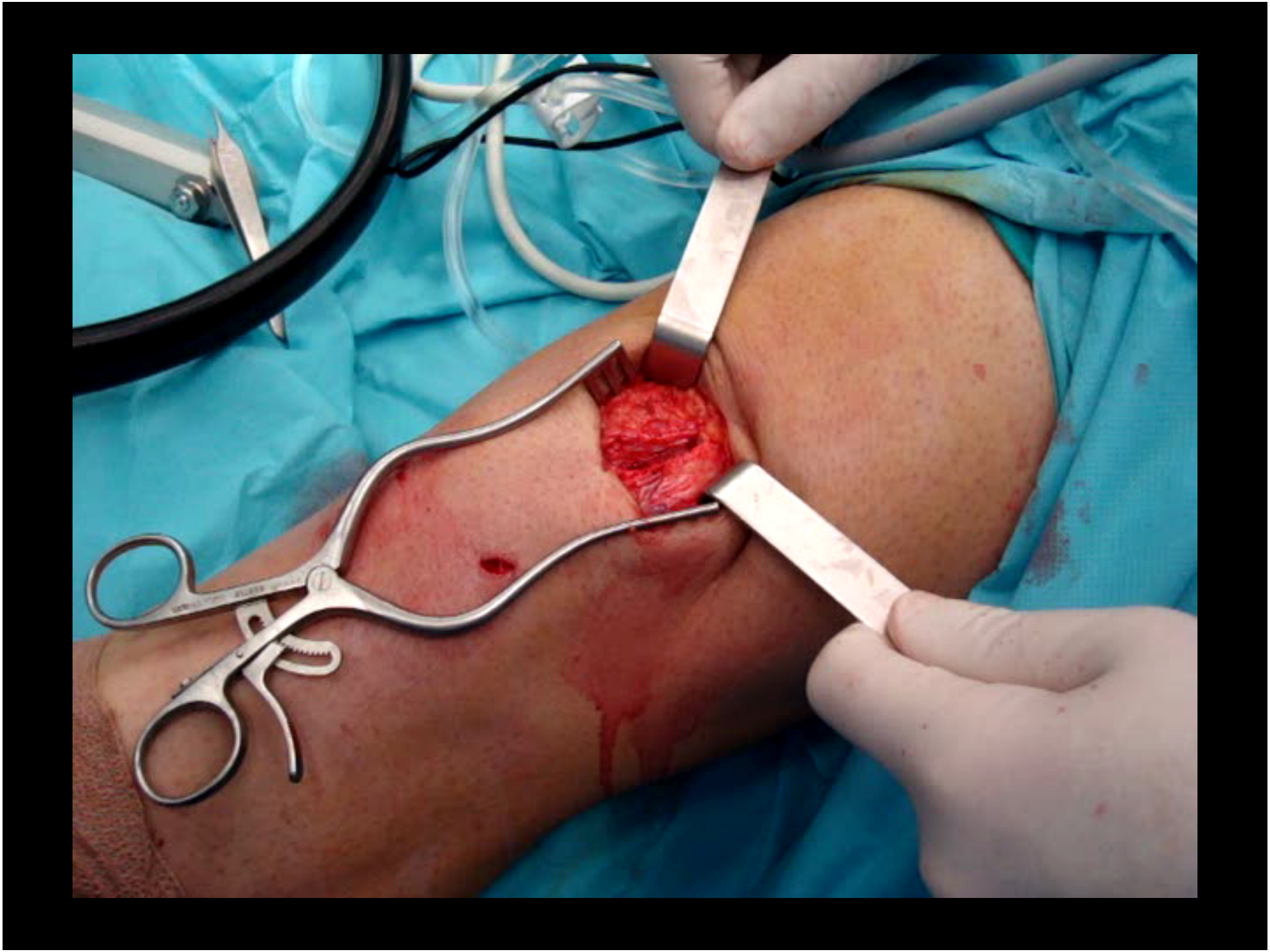
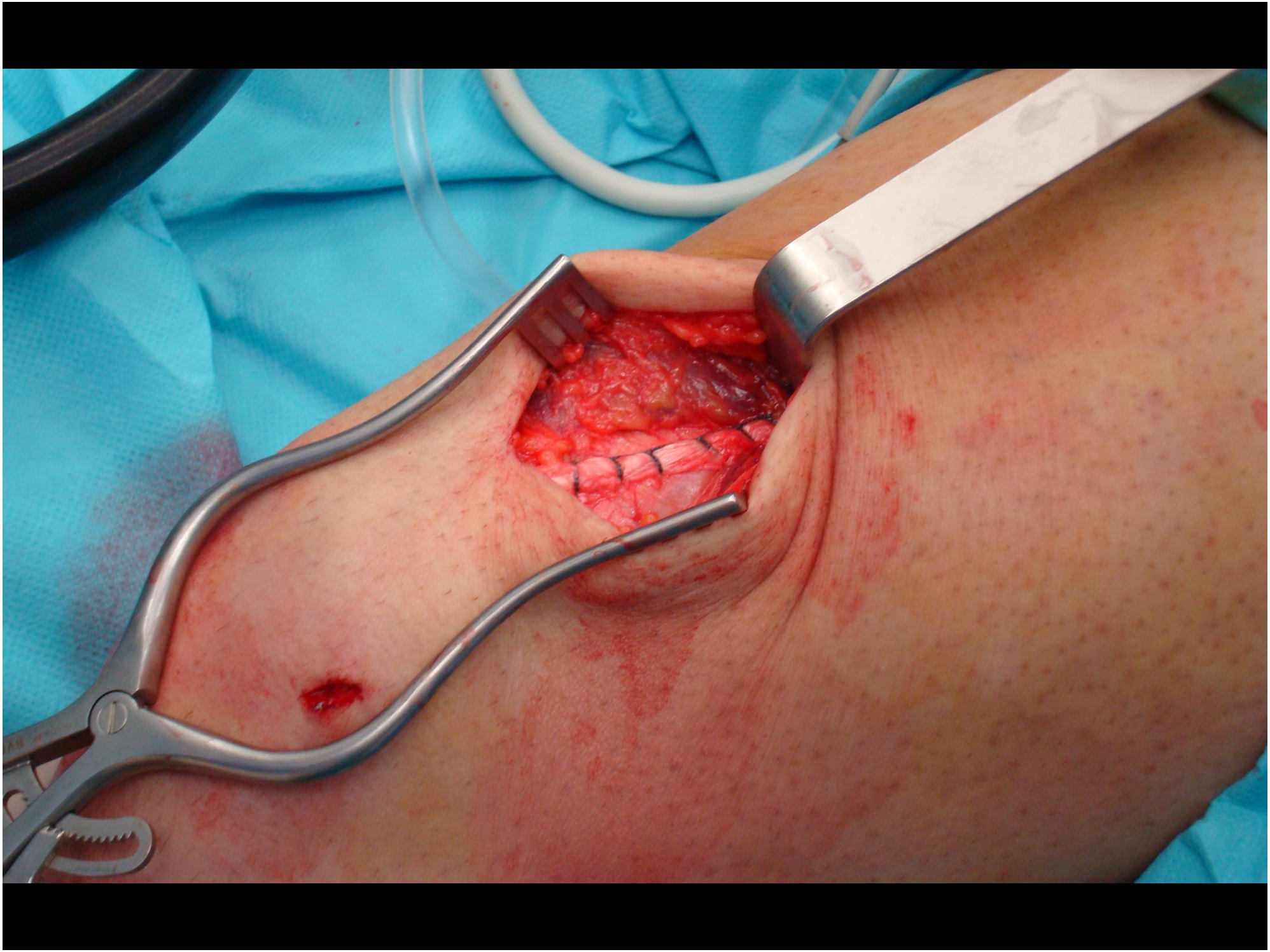
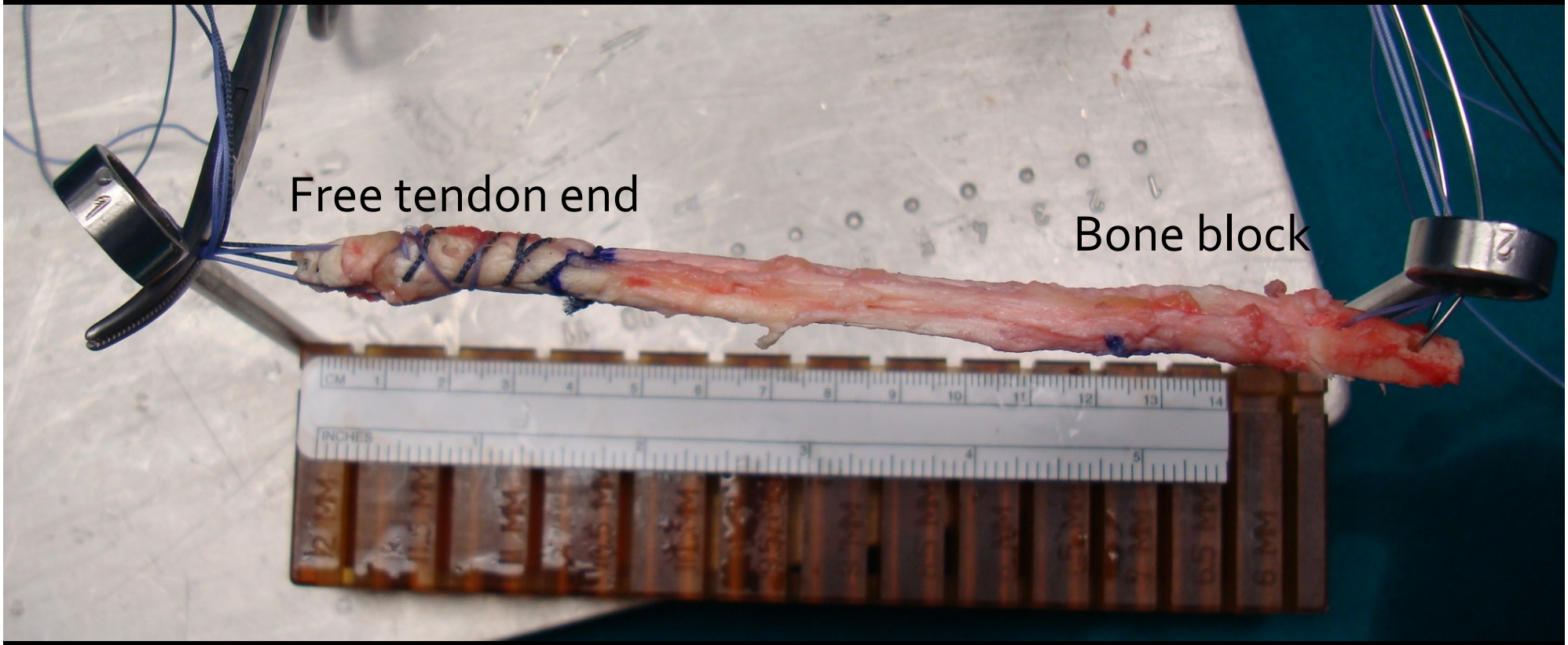
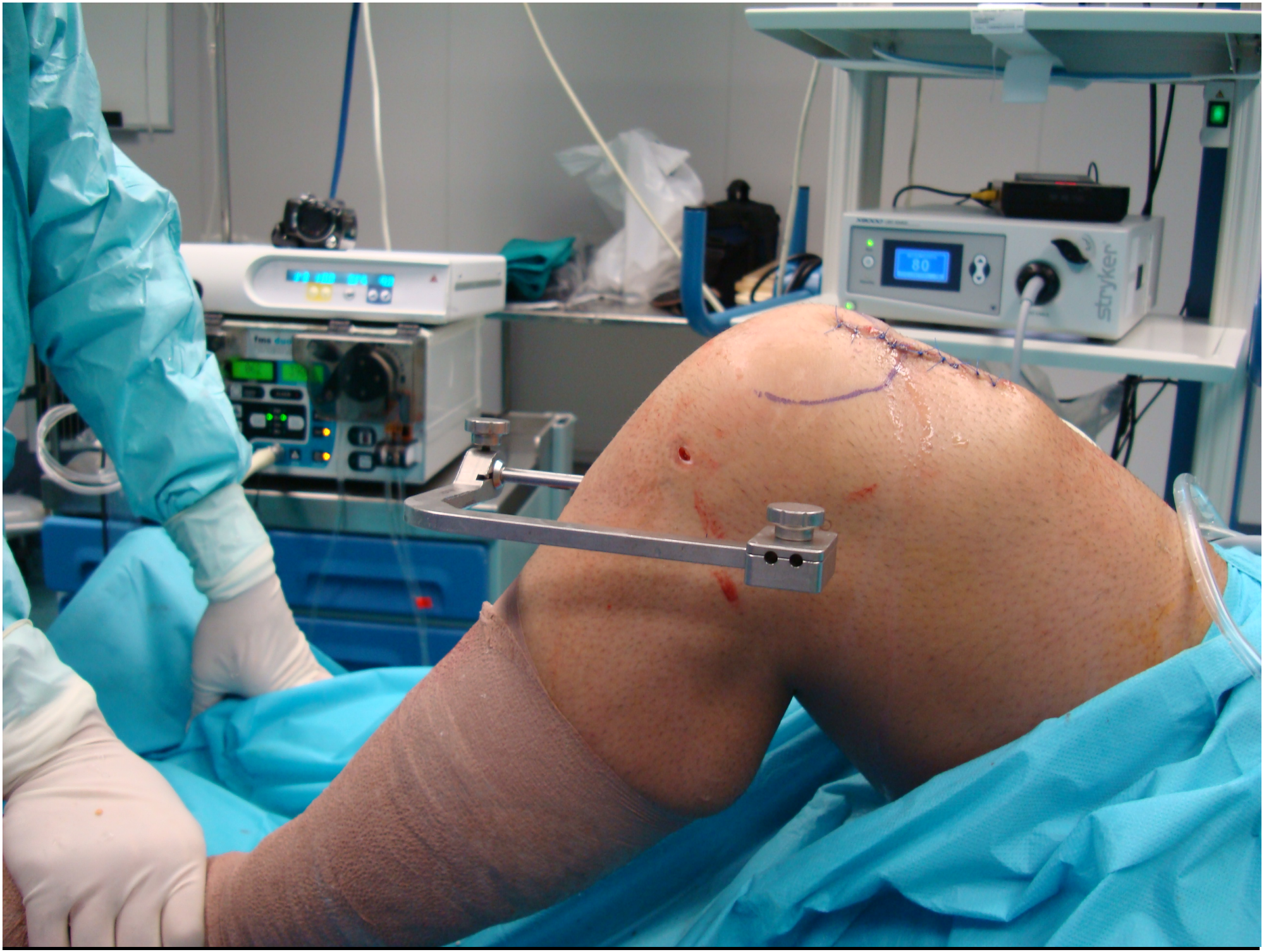
8
9
10








Free tendon end
Bone block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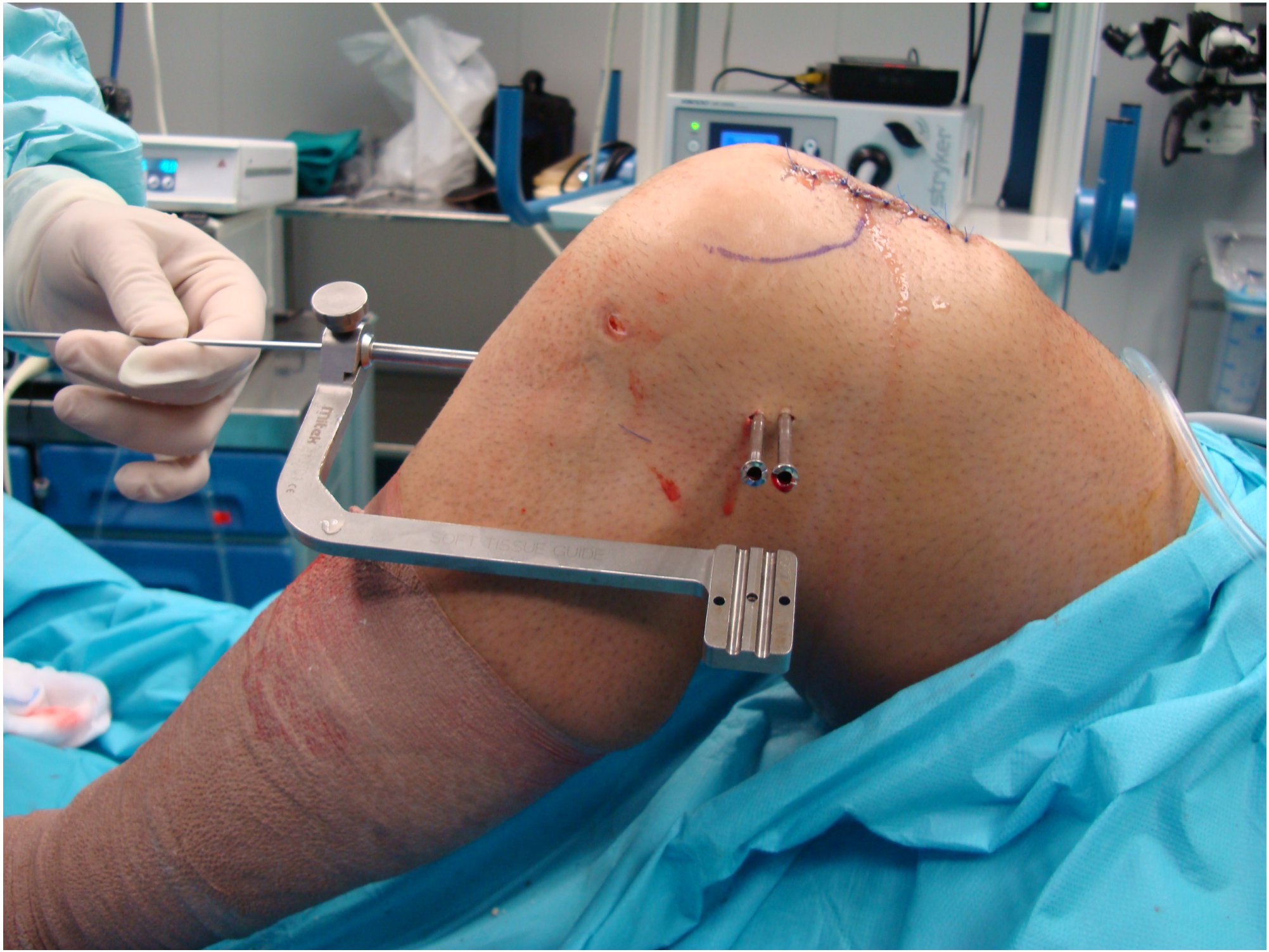
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SOFT TISSUE GUIDE
stryker


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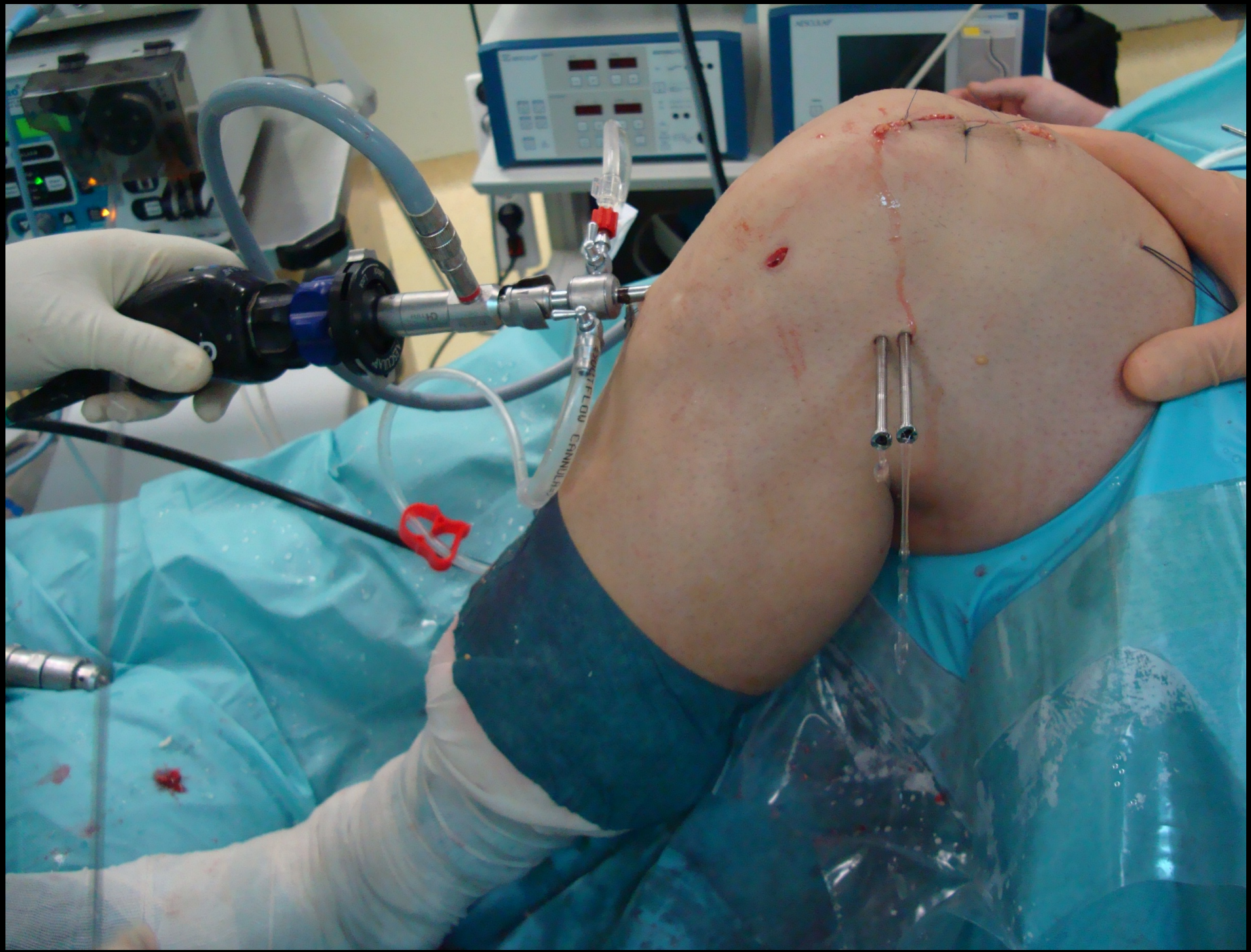
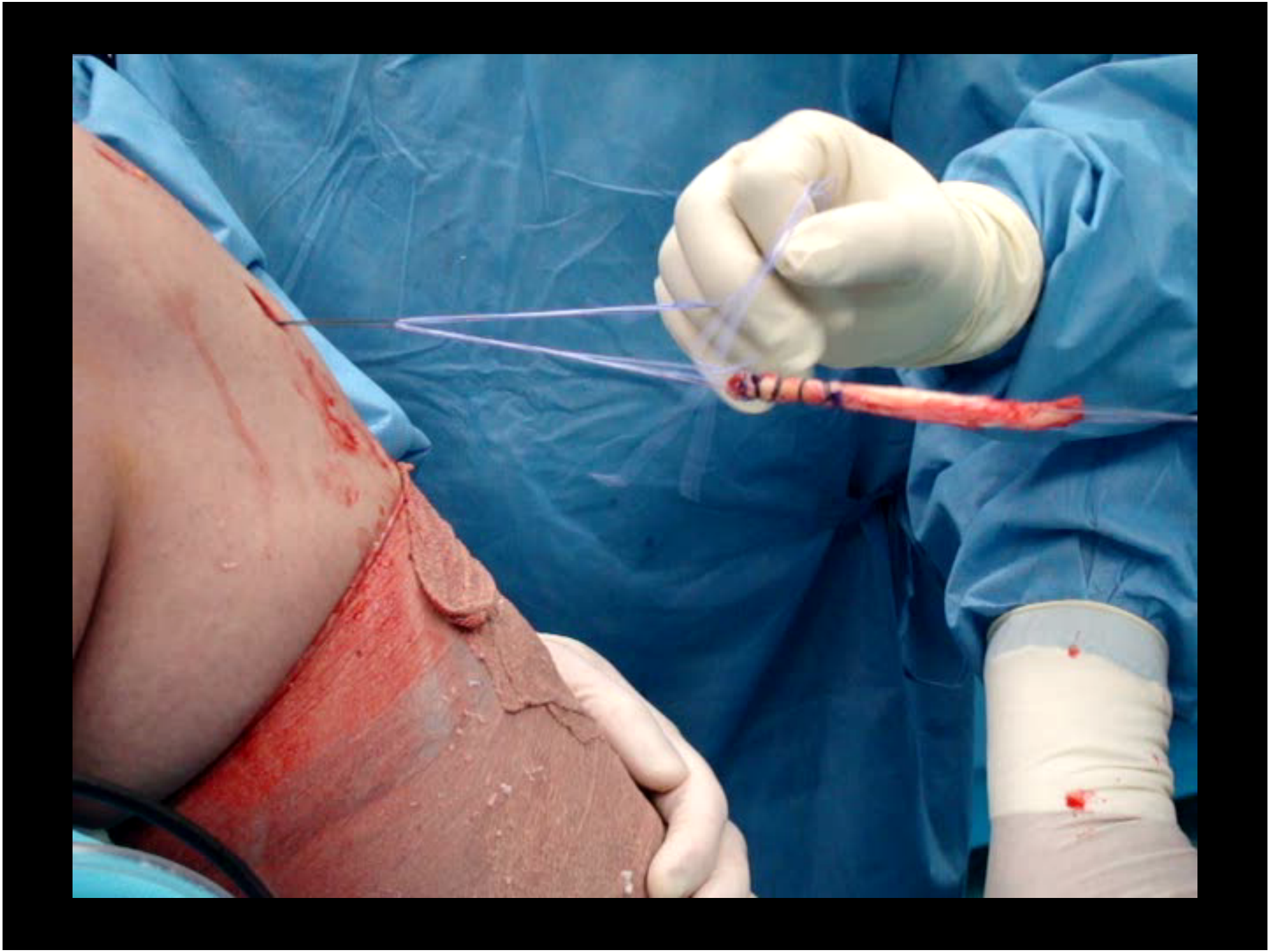
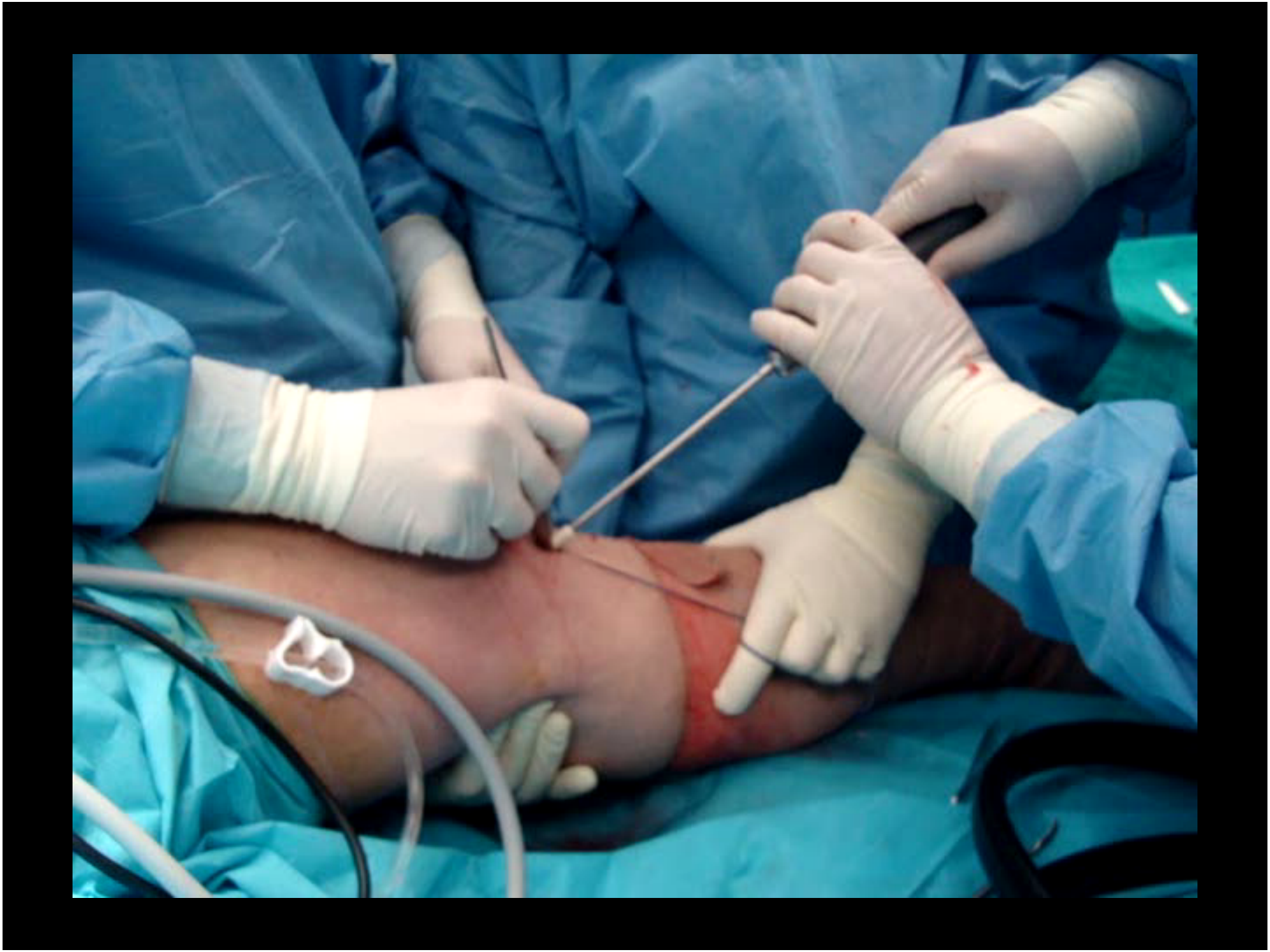
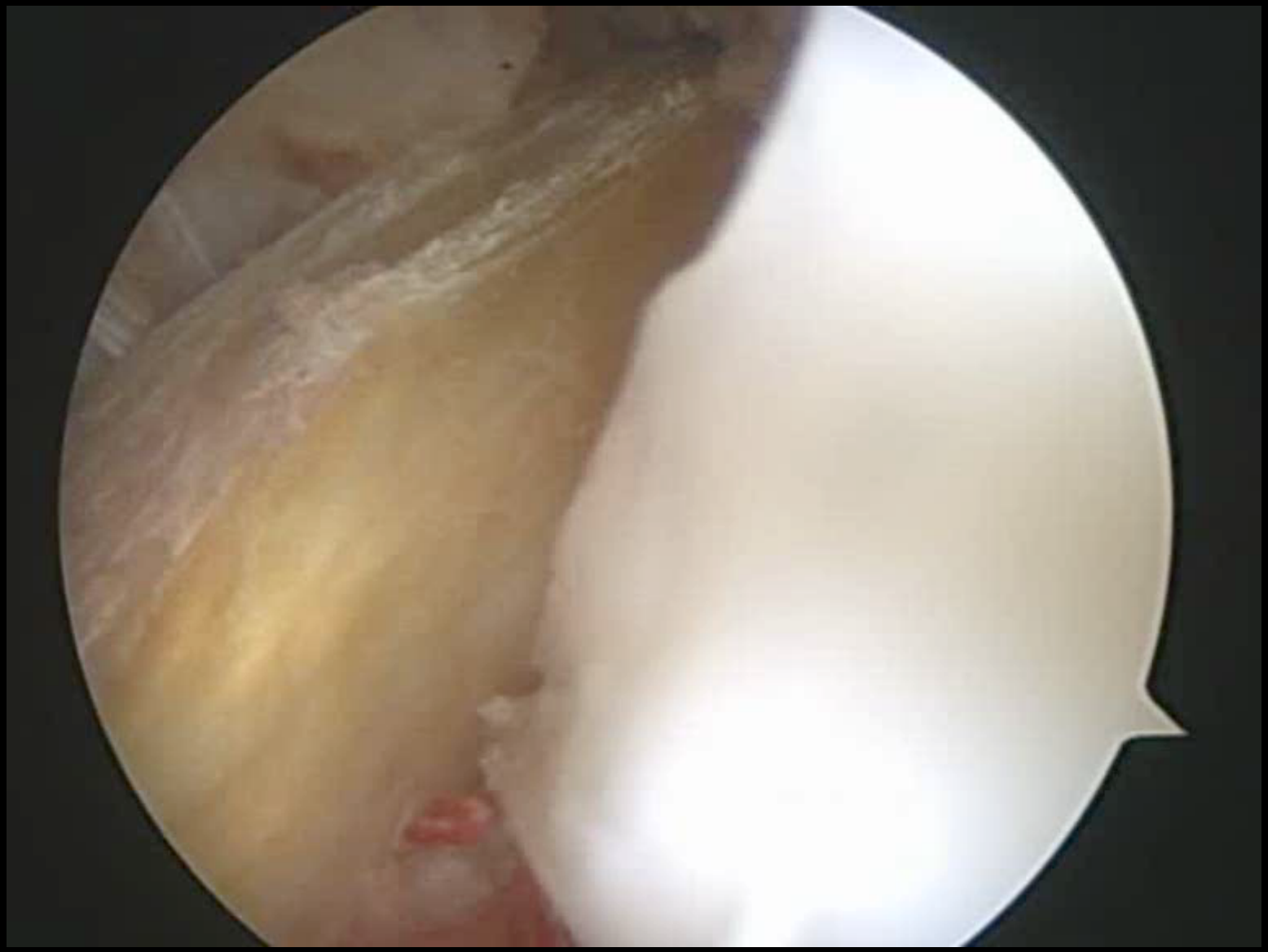
stryker










L

24 hours p-op

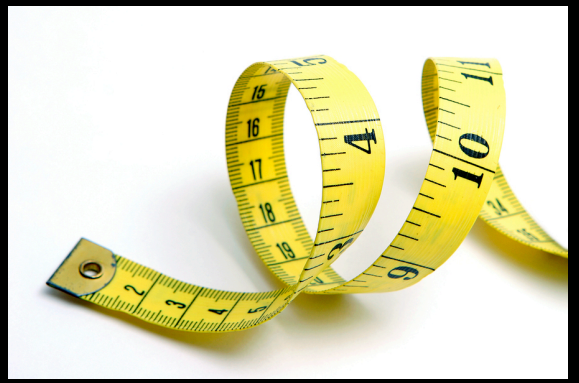
Personal Experience

Materials - Methods

- 32 patients
- Follow-up> 18 months
- Male: 25
- Female: 7
- Acute tears: 9
- Chronic tears: 23
- Concomitant procedures:
    - meniscal repair 6 cases
    - microfractures, 4 cases
    - ACT, 1 case

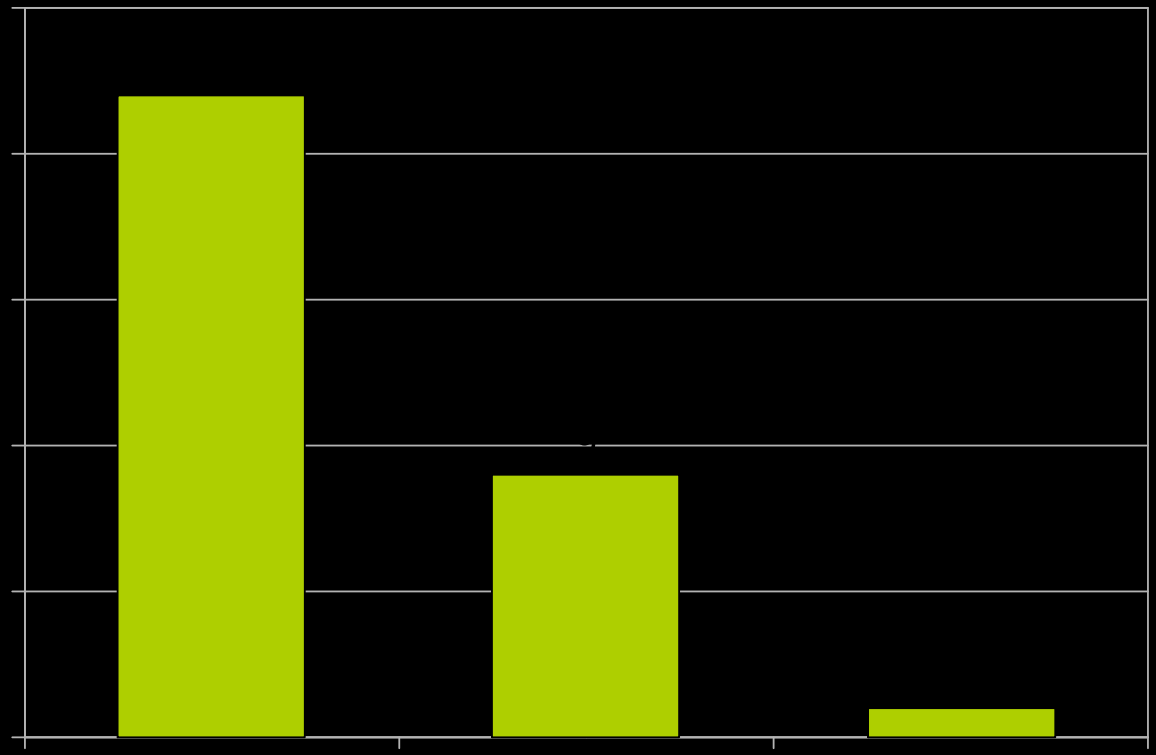
Results

- Complications
- Donor site tenderness
- SLR after 36 hrs: 31/32
- SLR after 48 hrs: 100%
- ROM loss> 5 degrees 2 patients



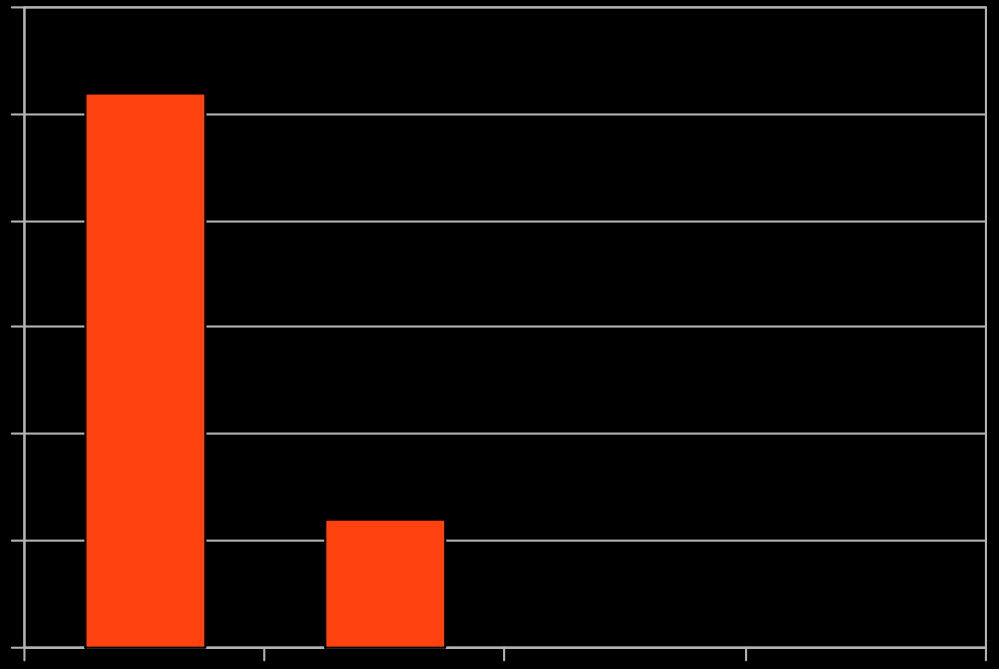
KT 1000 manual maximum testing

-1 to 1 mm	22
1 to 2 mm	9
3 to 5 mm	1



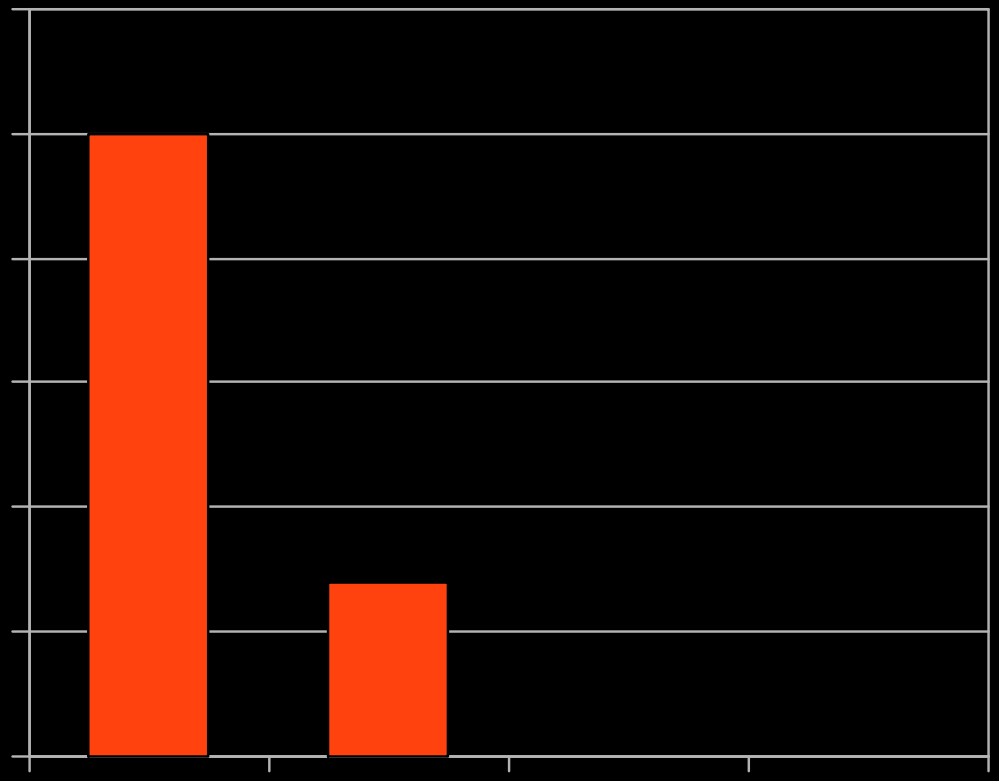
Pivot Shift

A equal	26
B glide	6
C clunk	0
D gross	0



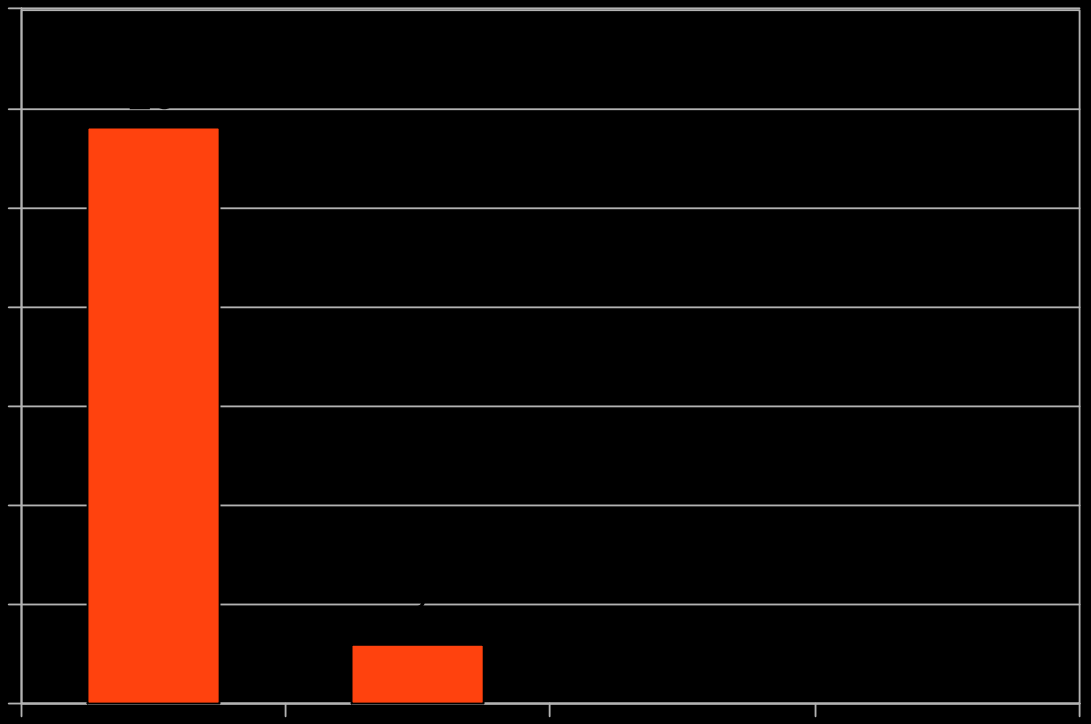
IKDC global score postop

A	25
B	7
C	0
D	0

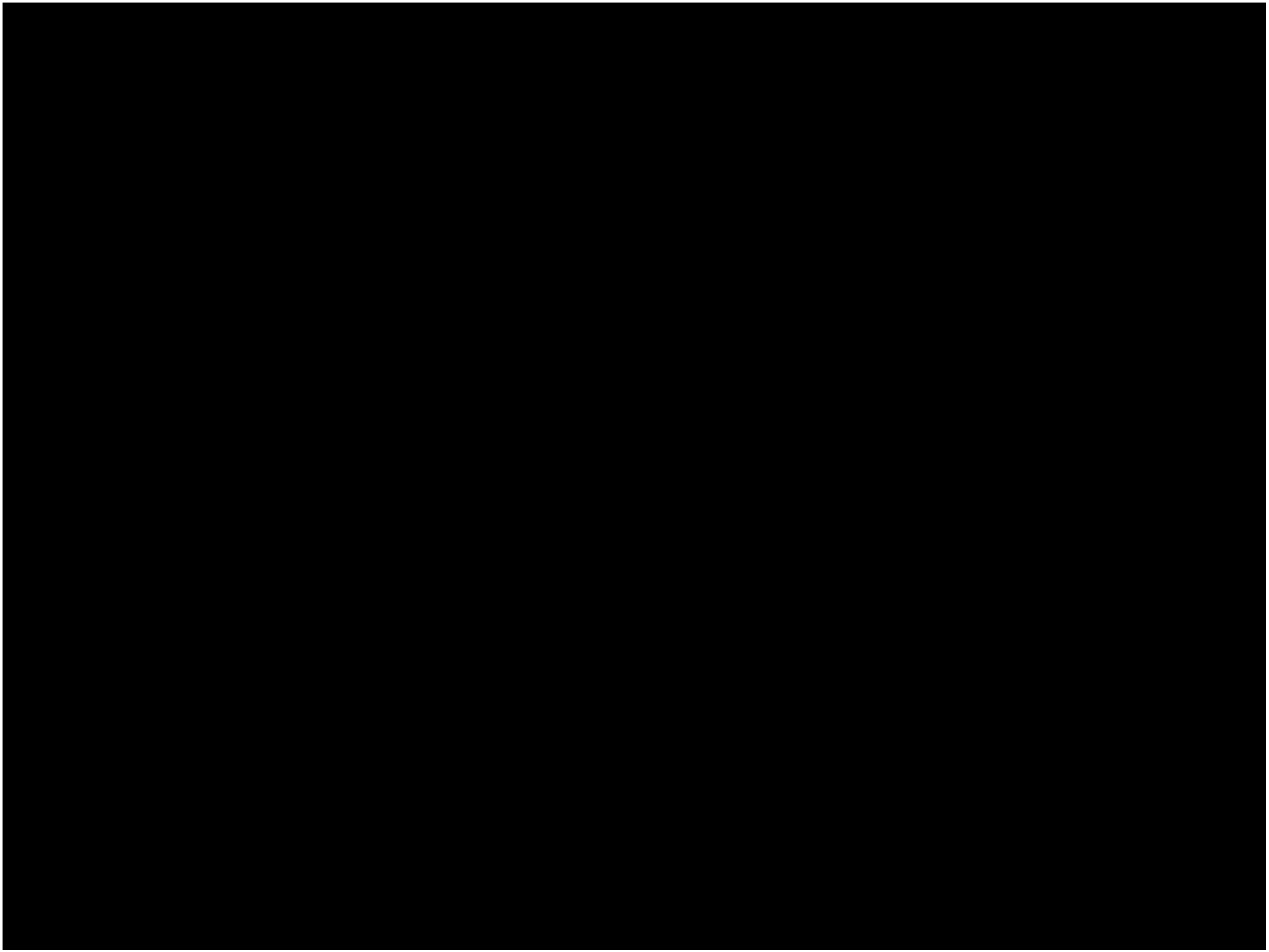


Harvest site pathology

A none	29
B mild	3
C moderate	0
D severe	0

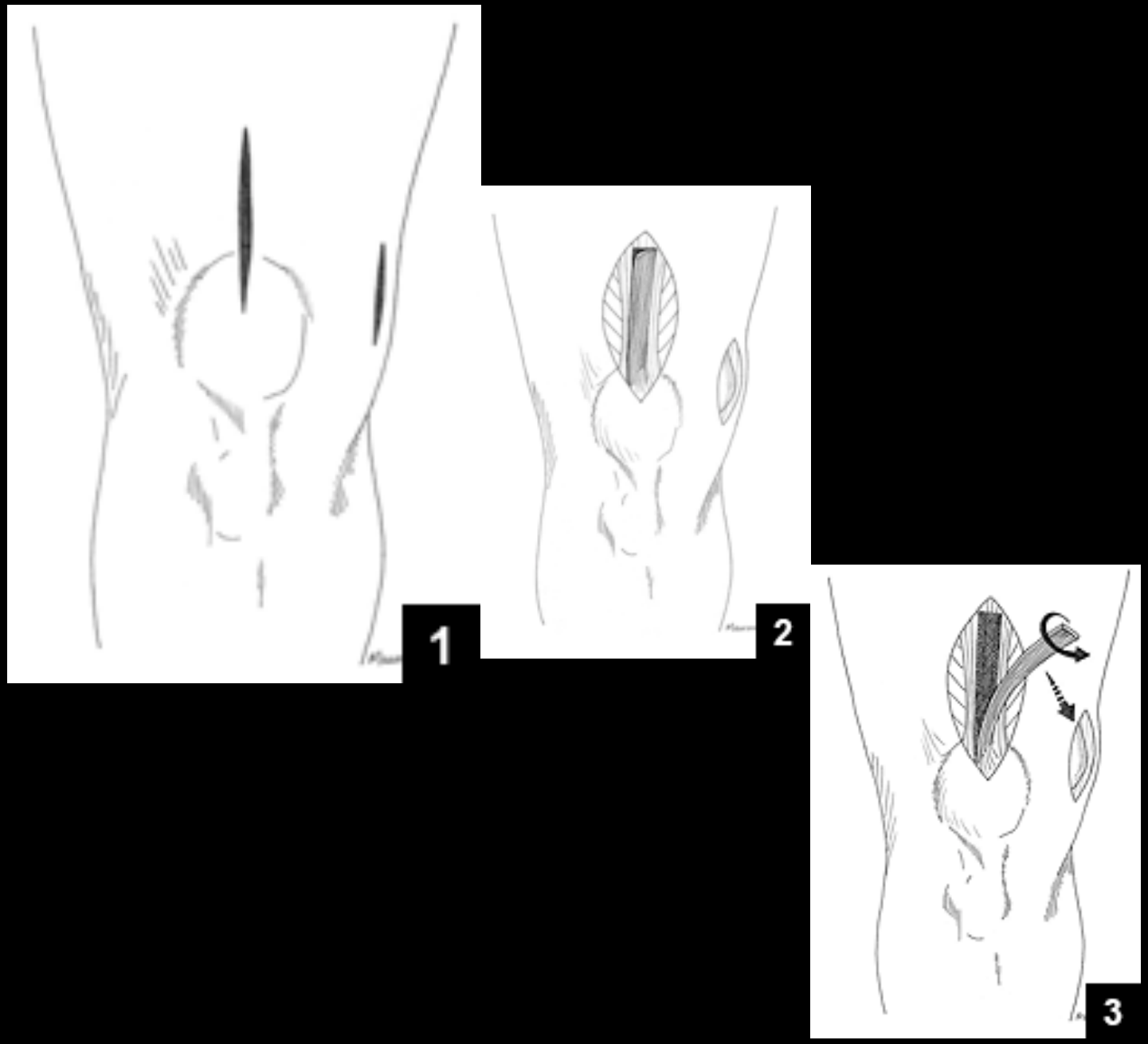



THE END



Importance of Strong Early Fixation

- Graft fixation is crucial in ACL reconstruction and is the weakest link in the initial 6- to 12-week period, during which healing of the graft to the host bone occurs.
- The graft must be able to withstand early rehabilitation, which can consist of forces as high as 450 to 500 N.
- Early Fixation failure usually occurs on tibial side.


1
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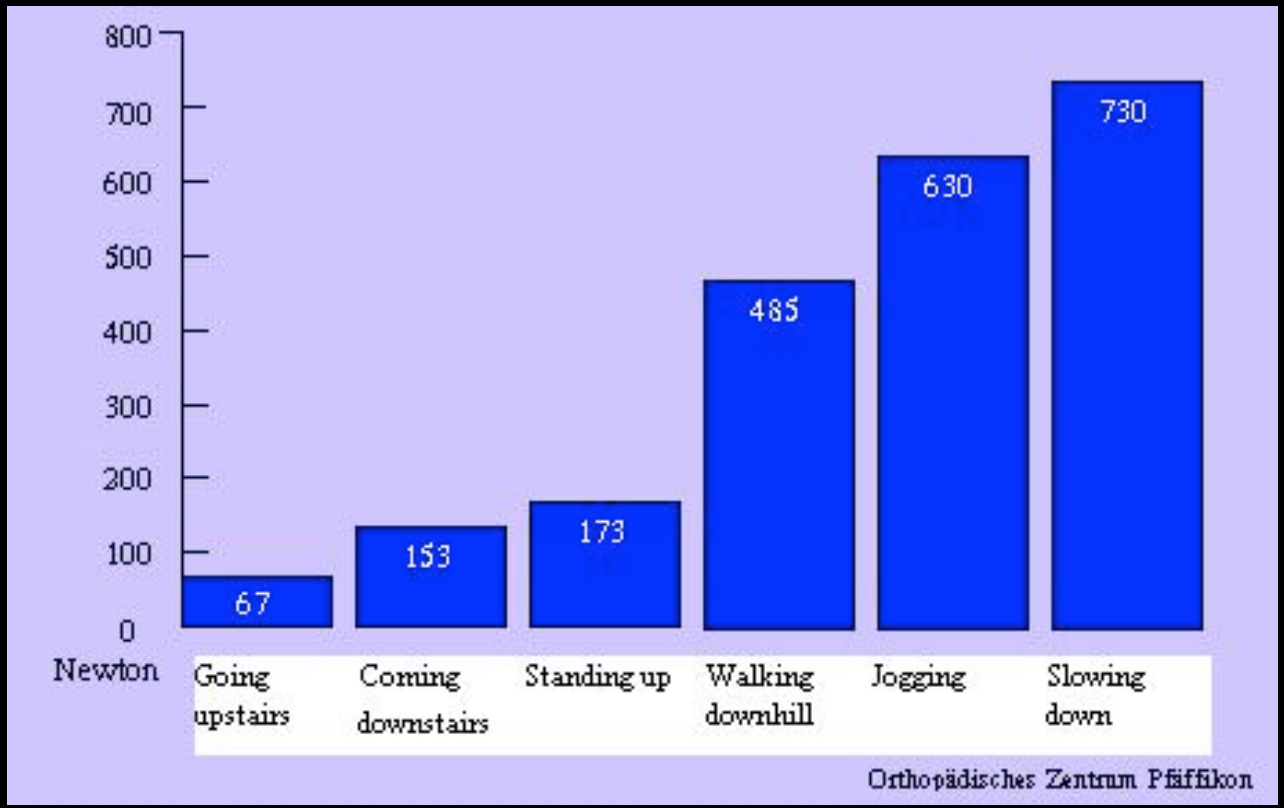
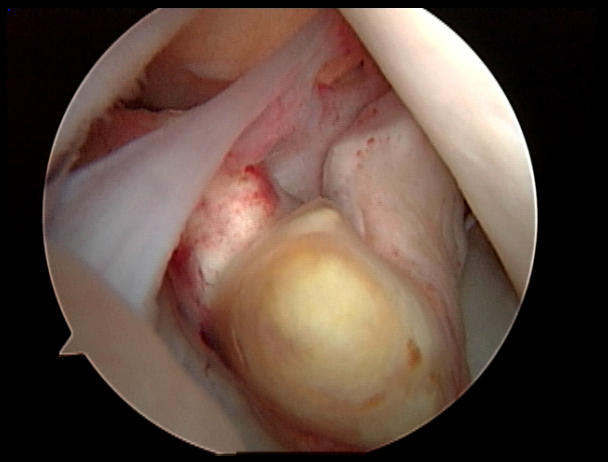
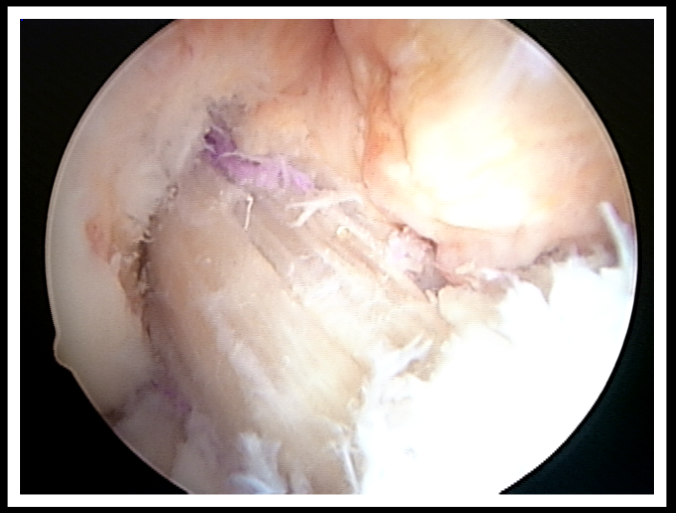
3

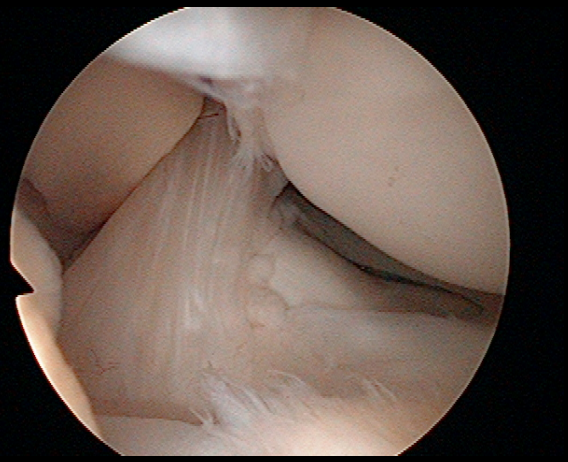
Forces on the anterior cruciate ligament
during normal daily activities

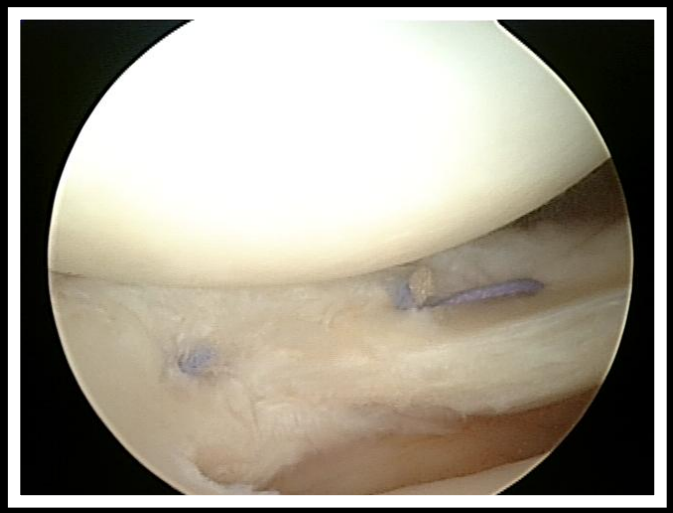


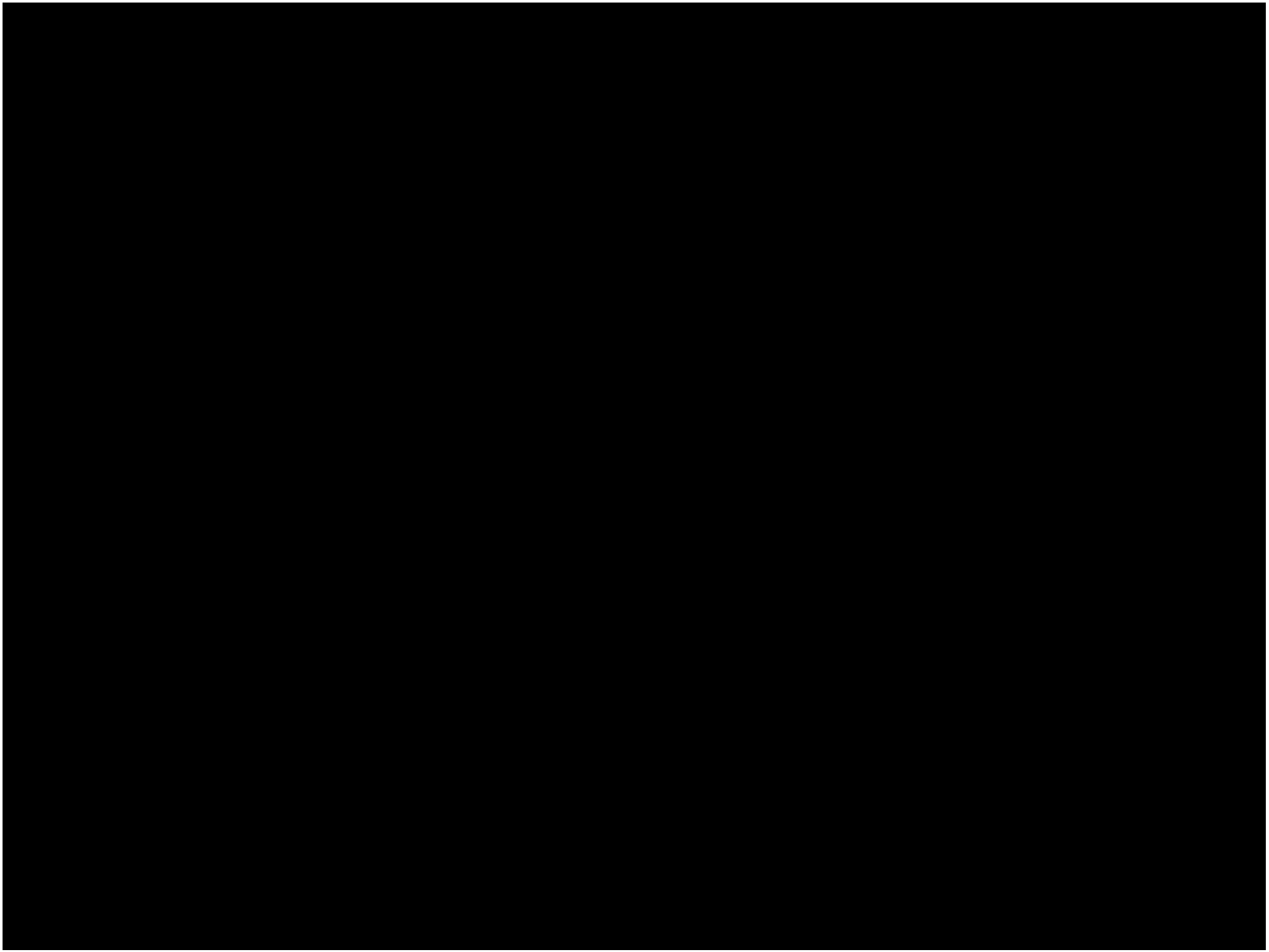

CYBEX











Tear resistance of the normal cruciate ligament and different grafts

Normal ACL	2160 to 2317 Newton
Ligamentum patellae (10 mm)	2376 to 2527 Newton
Quadruple hamstring	4108 to 4308 Newton
Quadriceps tendon (10 mm)	2352 to 2837 Newton

Graft Choice Issues

- Patellar tendon graft
  - Patellar surface irregularities
  - Patellar tendinitis
  - Patella infera/alta
  - Elasticity/stiffness
- Contralateral patellar tendon
  - Effects on 'good' knee
  - Delayed rehab versus loss of double injury

Graft Pretensioning

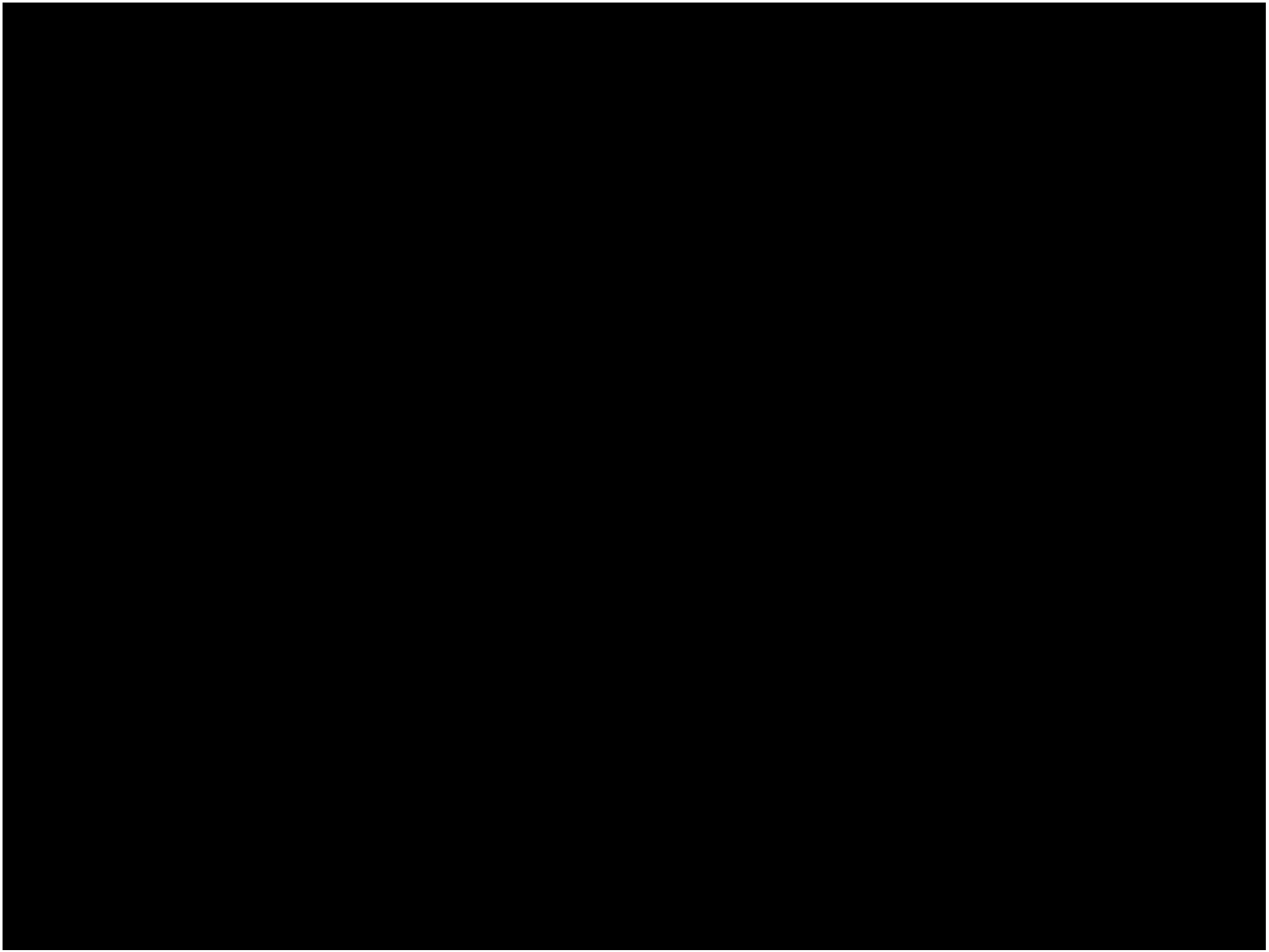
- May not be of benefit
- 75% viscoelasticityreturns to normal one minute after fixation for:

-5-10lbs tension at 150flexion BPTB
-4.5 kg –6.75 at 20 to 30 degrees flexion hamstring

Precise amount of tension has yet to be determined

Graft Choice

BPTB - ~40%
Hamstrings/G- ~40%
Allograft
Contralateral BPTB
Quadriceps Tendon



Ultimate tensile load of intact Human ACL and a few common replacement ACL grafts

Graft type	**Ultimate tensile load**
Intact ACL	2160±154
Bone-patellar tendon-bone	2376±151
Single-strand semitendinosus	1216±50
Quadruple hamstring	4108±200
Quadriceps tendon (10mm)	2352±495

Materiel and methods

- Prospective study
- 100 knees from 134 consecutive operations
- (1 surgeon, 1 technique)
- Chronic cases
- Accident to surgery interval : 4 ± 4.8 ys
- Mean age : 27.8 ± 9 years
- Males : 58 %
- Sport's trauma : 83 %
- Previous surgery in 32 cases :
  - 15 ACL reconstructions,
  - Meniscal resections : 18 med, 5 lat
- Follow-up : 11.7 ± 2 ys (10 to 16)

Methods

Function

- IKDC (International Knee Documentation Commitee)
- A.R.P.E.GE score

Anatomical value

- KT-1000 arthrometer
- Anterior radiological drawer

Methods

KT-1000 Arthrometer

(preop - post-op)

- KT 1 : 69 n
- KT 2 : 89 n
- KT 3 : maxi-manual

Stress radiography

(preop - post-op)

- 20° of flexion
- Load : 9 kg
- Translation of medial and lateral compartments

Per-operative findings

- Medial meniscus lesions : 30 %

  + 25 previous meniscectomies = 55 %

- Lateral meniscus lesions : 19 %

- Cartilages lesions : 19 %
  - Medial : 12
  - Lateral : 4
  - Both : 3

Complications

- 7 ematomas
- 2 DVT
- 1 temporary peroneal nerve palsy
- 2 SND
- 3 skin infections
- 1 infection

Results

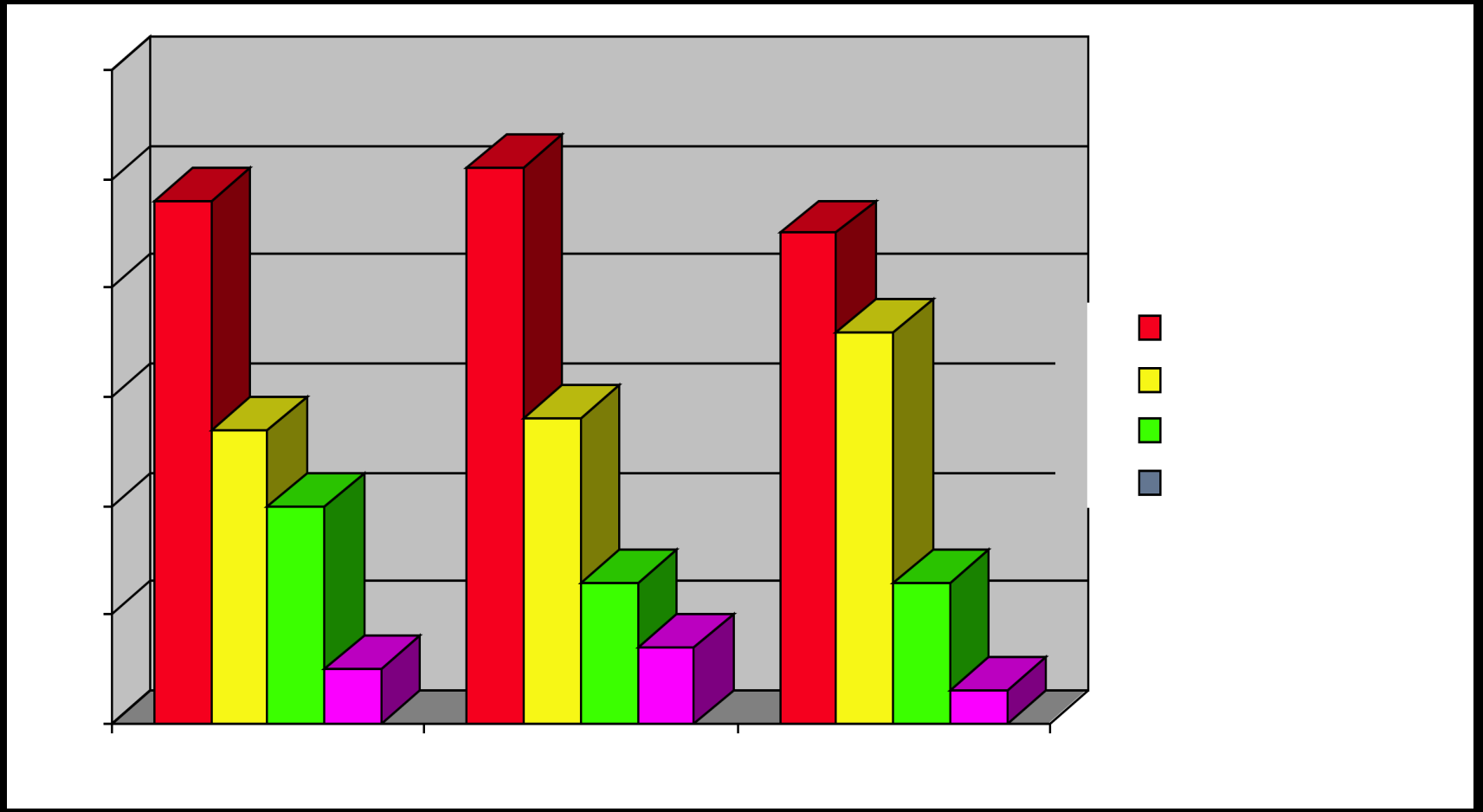
- Flexion : 143° ± 11
- Flexion contracture : 4.5° ± 7
- Amyotrophy : 1 cm ± 0.8 (28 having none)

- Recurrence of laxity : 9 cases
- Pivot-shift test

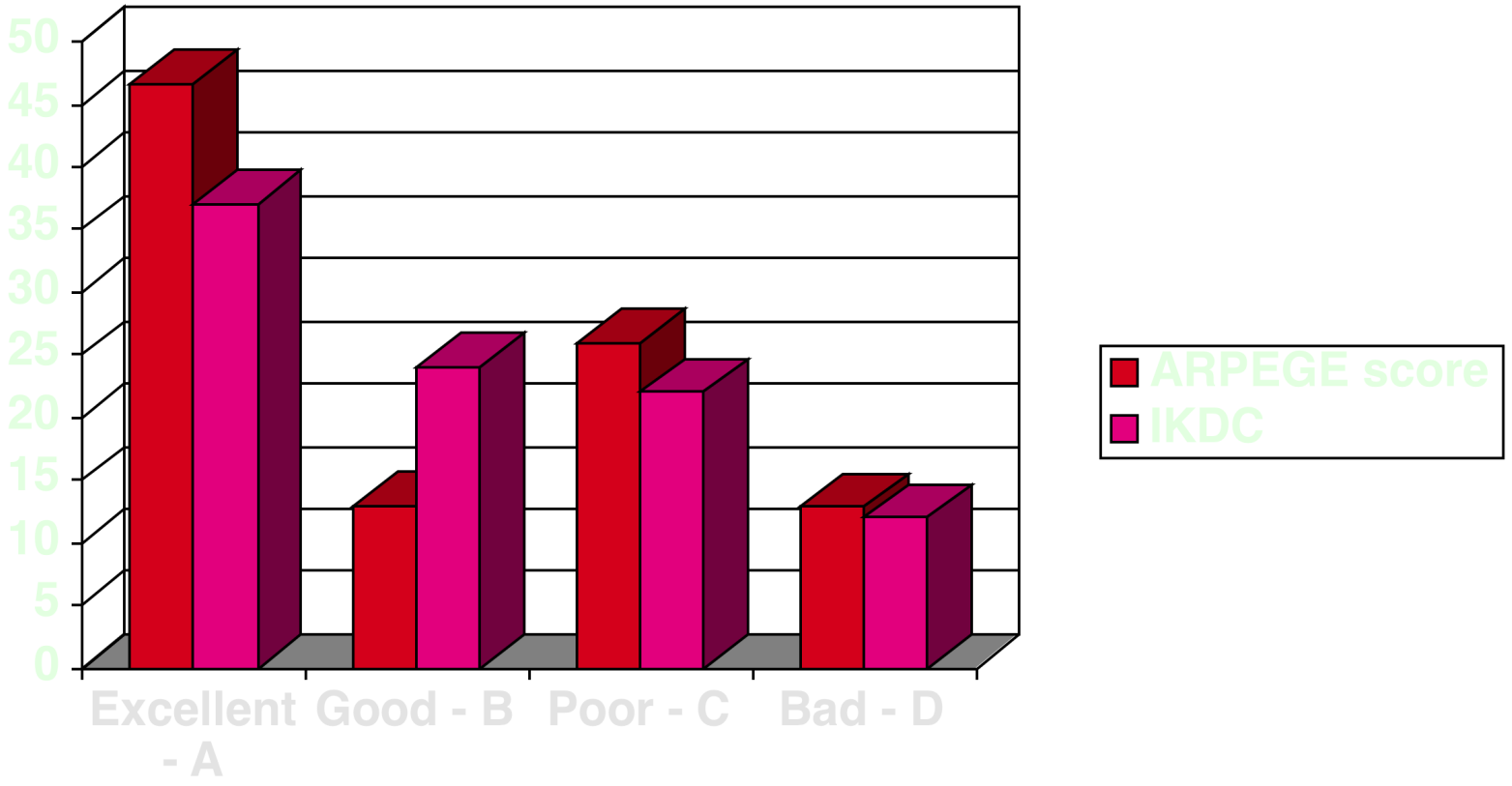
  ++ : 3 %

  + : 22 %

Symptoms according to activity level



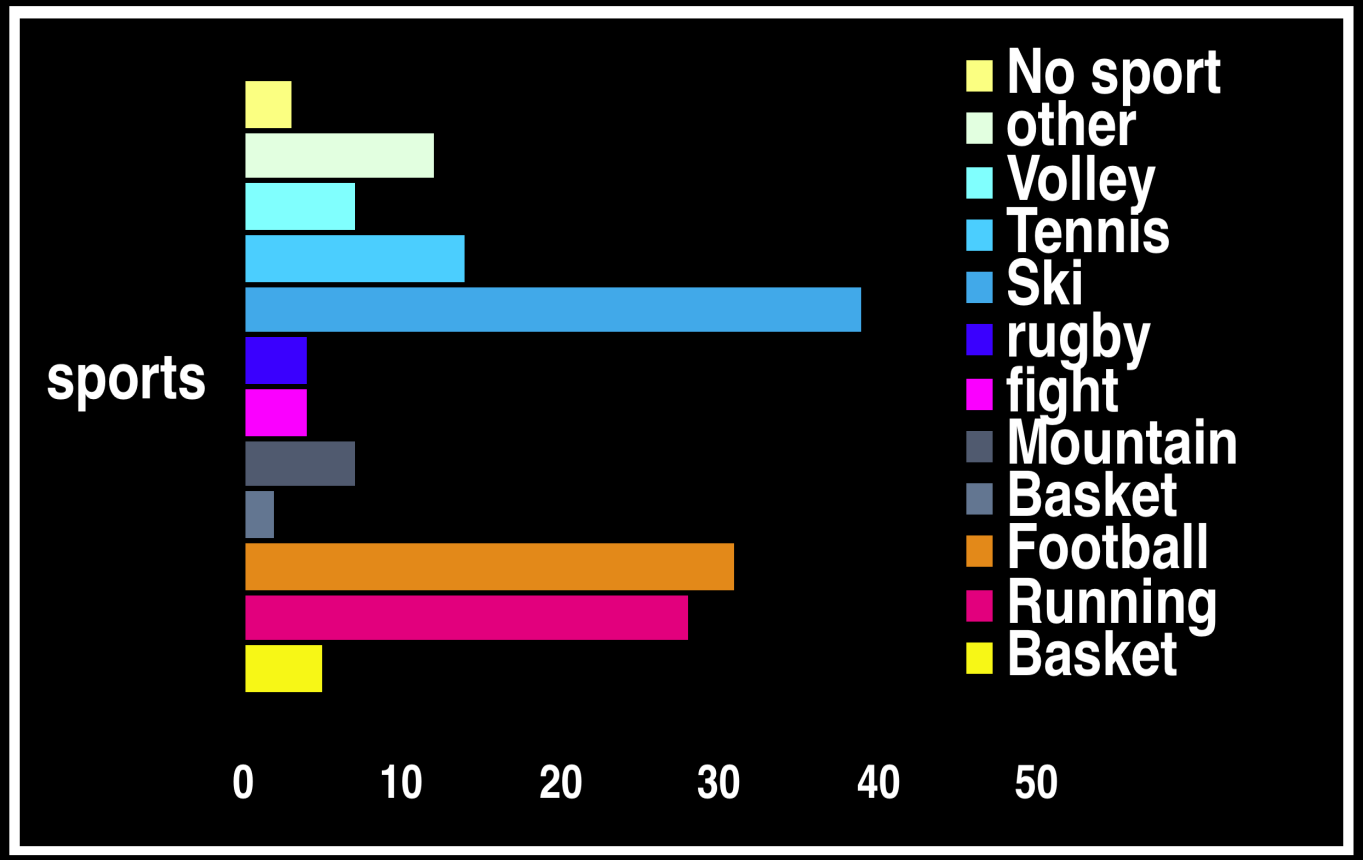
Functional results



IKDC score : 61 % excellent + good

A.R.P.E.GE : 60 % excellent + good

Sport before trauma

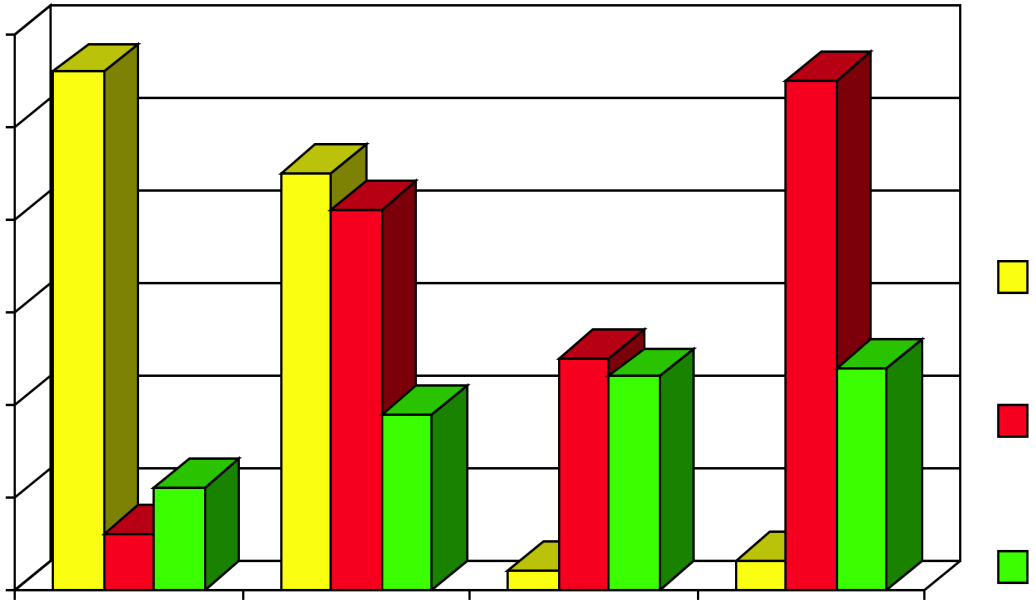


Competition : 58

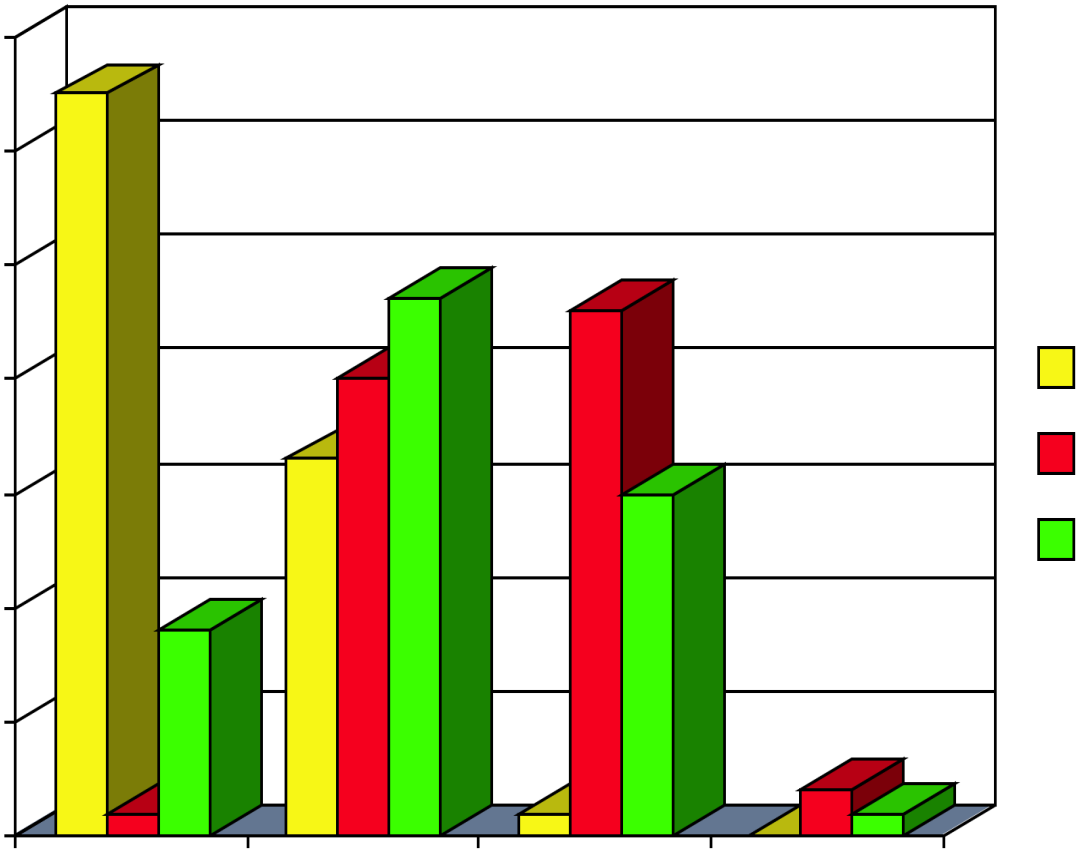
Recreative : 35

Sport activity

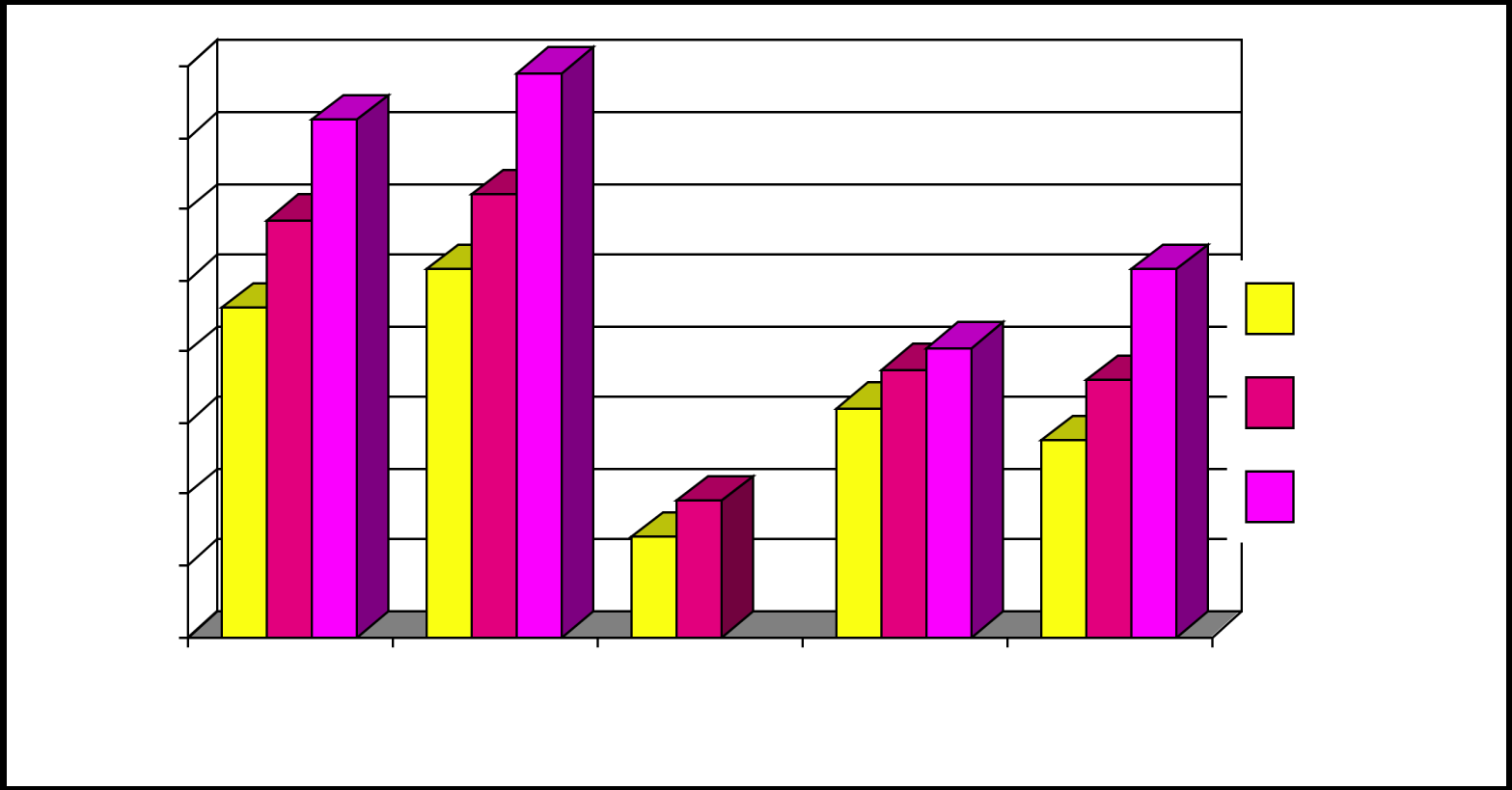
- Satisfaction expressed by the patients : 88 %
- 78 % of the patients return to sport activities
- Sport with pivot : 30 % (competition : 17 %)
- 14 patients stop sport for other reasons



Evolution of sport activity level



Arthrometric evolution



KT-1000 Arthrometer

KT 1 : 69 n

KT 2 : 89 n

KT 3 : maxi-manual

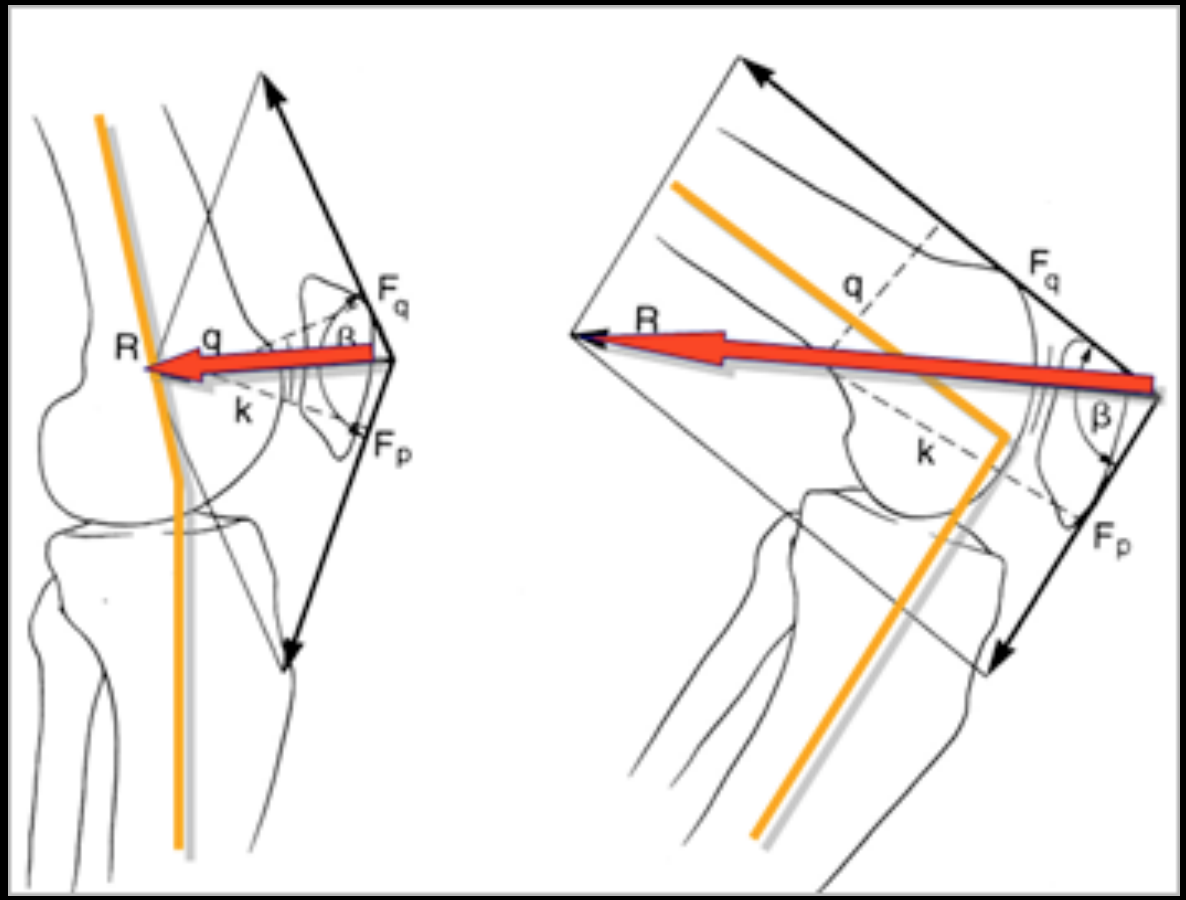
Patellar height modifications

Comparison of 3 different index

	Preop	Post-op	Difference
Blackburne	O.72 ± 0.17	0.69 ± 0.16	- O.028
Caton	0.87 ± 0.16	0.86 ± 0.15	- 0.01
Insall	1.11 ± 0.19	1.07 ± 0.20	- O.037

No significative modifications for patella

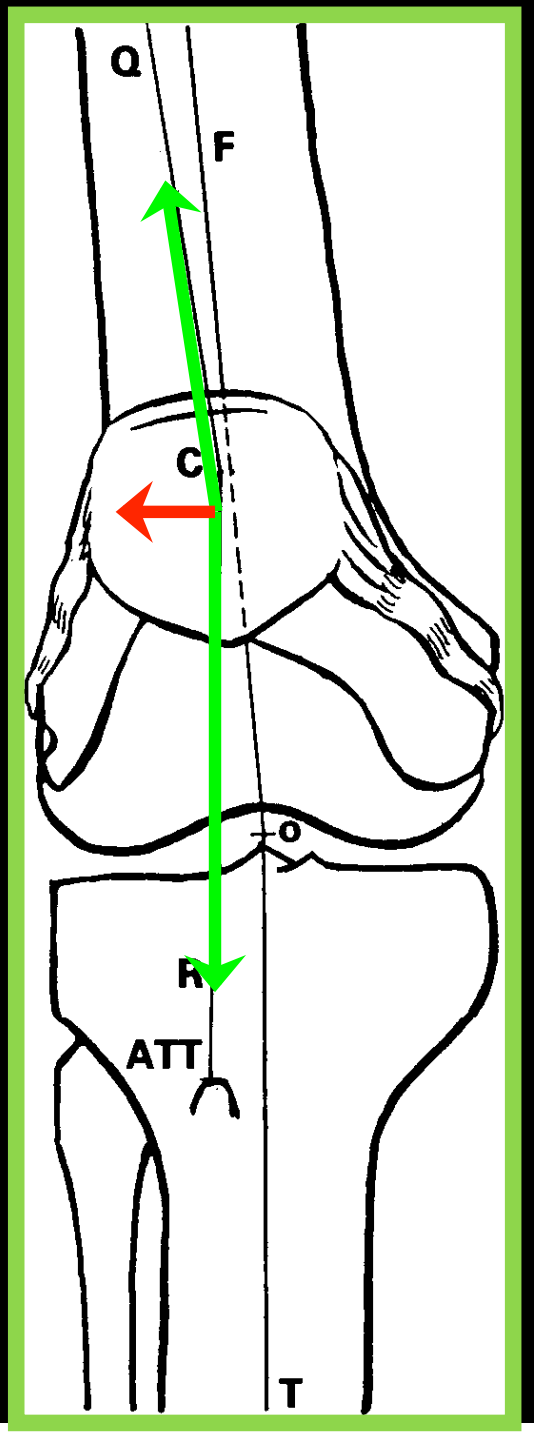
Fixation	Ultimate Failure Load (N)	Stiffness (N/m)
Patellar Tendon		
Metal interference screw19	558	—
Bioabsorbable interference screw19	552	—
Soft Tissue (Femoral)		
Bone Mulch Screw (Arthrotek, Warsaw, IN)24	1,112	115
EndoButton (Smith & Nephew Endoscopy, Andover, MA)24	1,086	79
RigidFix (Ethicon, Somerville, NJ)24	868	77
SmartScrew ACL (Linvatec, Largo, FL)24	794	96
BioScrew (Linvatec)24	589	66
RCI Screw (Smith & Nephew Endoscopy)24	546	68
Soft Tissue (Tibial)		
Intrafix (Ethicon)25	1,332	223
WasherLoc (Arthrotek)25	975	87
Tandem spiked washer25	769	69
SmartScrew ACL25	665	115
BioScrew25	612	91
SoftSilk (Acufex Microsurgical, Mansfield, MS)25	471	61



The quadriceps provides the greatest compressive force near extension when the contact area of the patellofemoral joint is smallest. Thus, a high force on a small area produces considerable patellofemoral joint reaction forces.

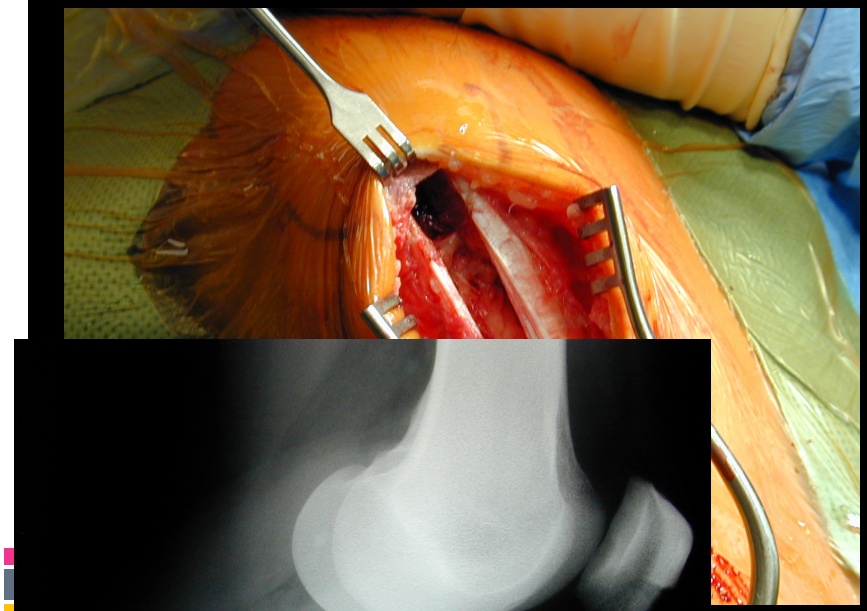
Frontal Plane PF Joint Mechanics: Quadriceps (Q) Angle

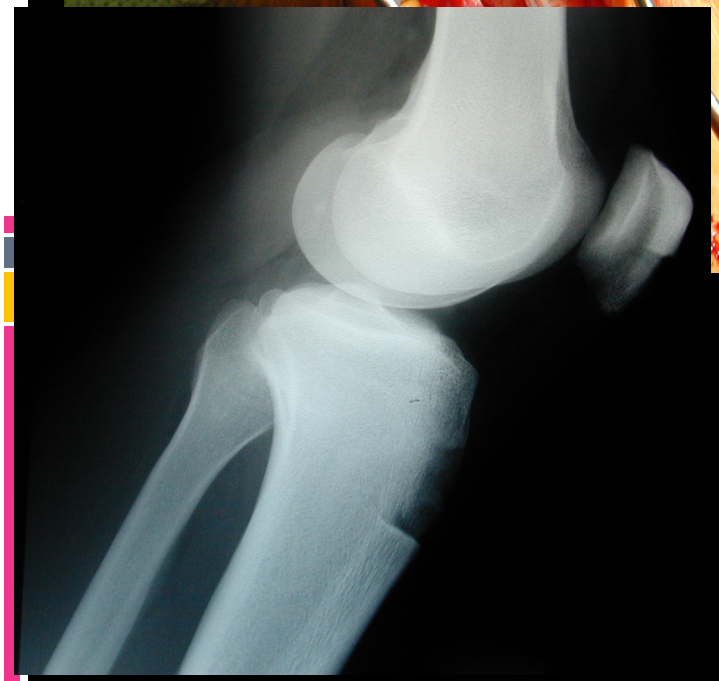
- Resultant force has a tendency to laterally translate the patella



Activity	Q-Force	% Body Weight
Walking	850 N	1/2 x BW
Bike	850 N	1/2 x BW
Stair Ascend	1500 N	3.3 x BW
Stair Descend	4000 N	5 x BW
Jogging	5000 N	7 x BW
Squatting	5000 N	7 x BW
Deep Squatting	15000 N	20 x BW

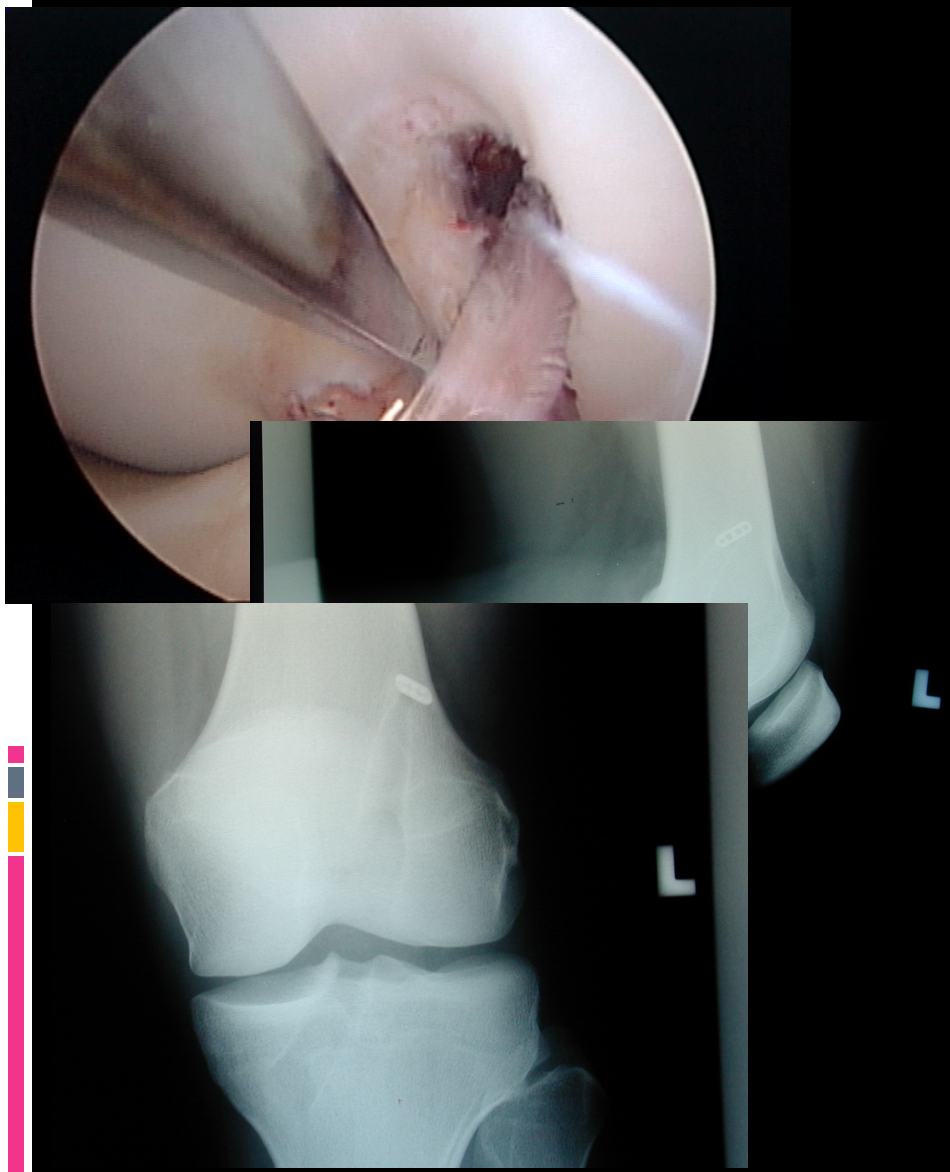
Bone-Patellar tendon-Bone





- Solid fixation – 700 N
  - Kurowsaka
- "Matched' stiffness to ACL
- Patient 'feel'

Hamstring tendons



- Fixation strength
  - Variable
  - Newer fixation better
  - Interference screws, posts, loops
- "Slippage'
- Loss of ACL agonist muscles
- Delayed healing potential

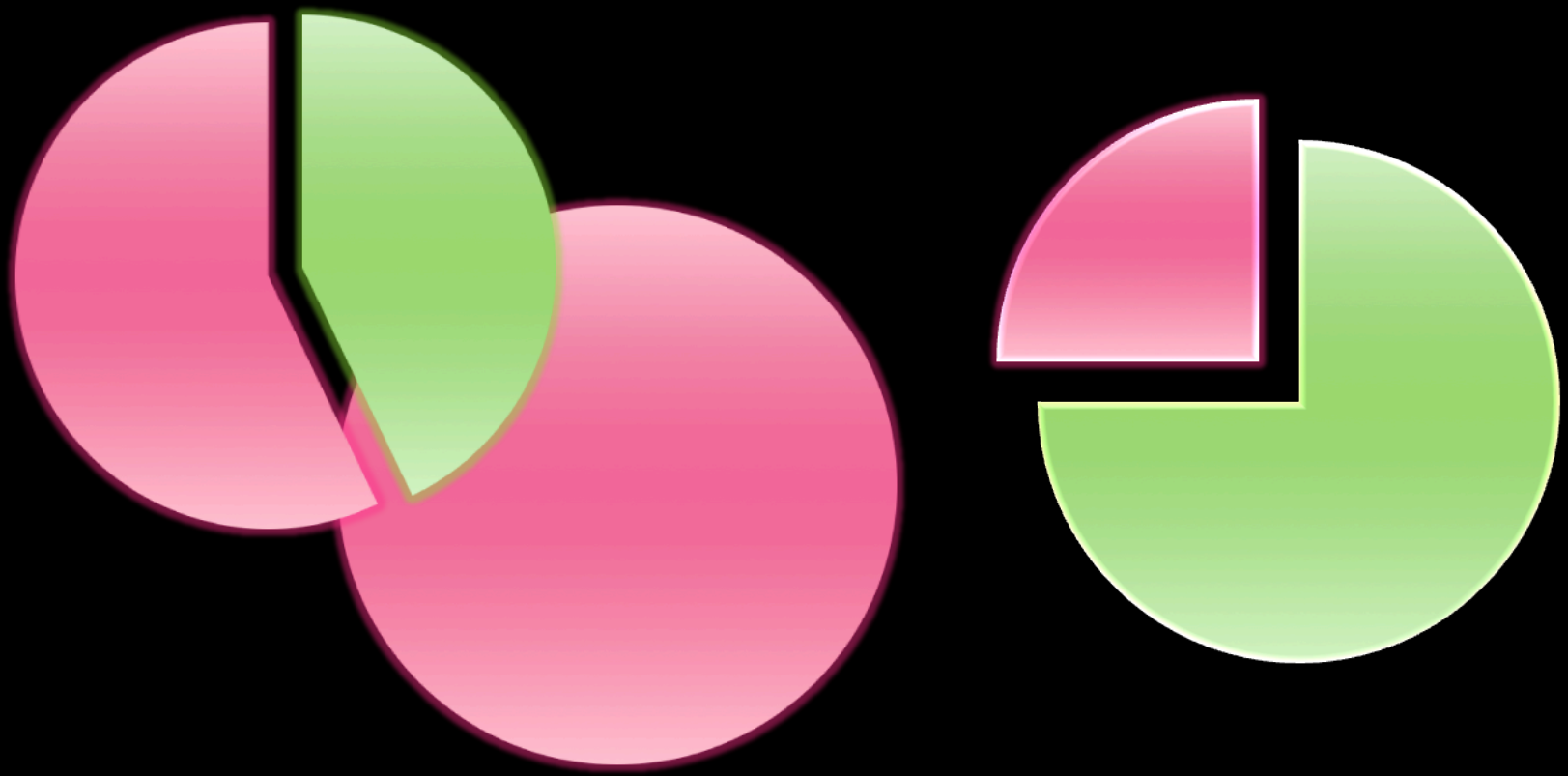
Allograft tendons

- Patellar tendon, Achilles tendon, anterior tibialis, hamstring tendons
  - Fixation
  - Host-graft reactions
  - "Friendly' environment for healing
  - Lack of donor site morbidity
  - No scar
  - Early failure rate?

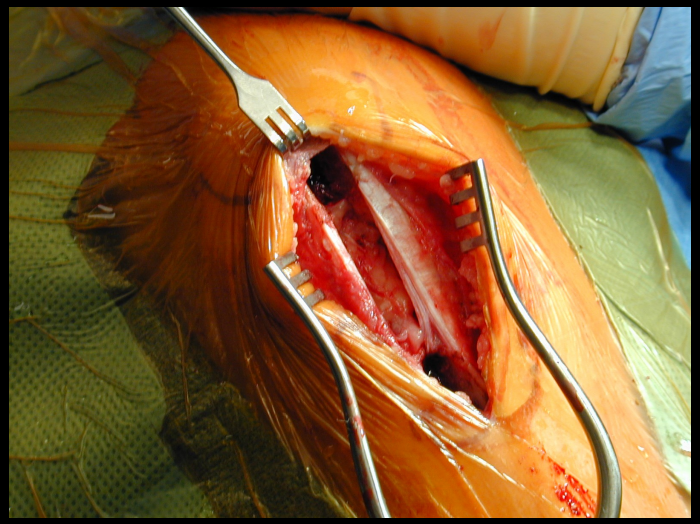
Patellar Tendon

Hamstrings

Quadriceps Tendon

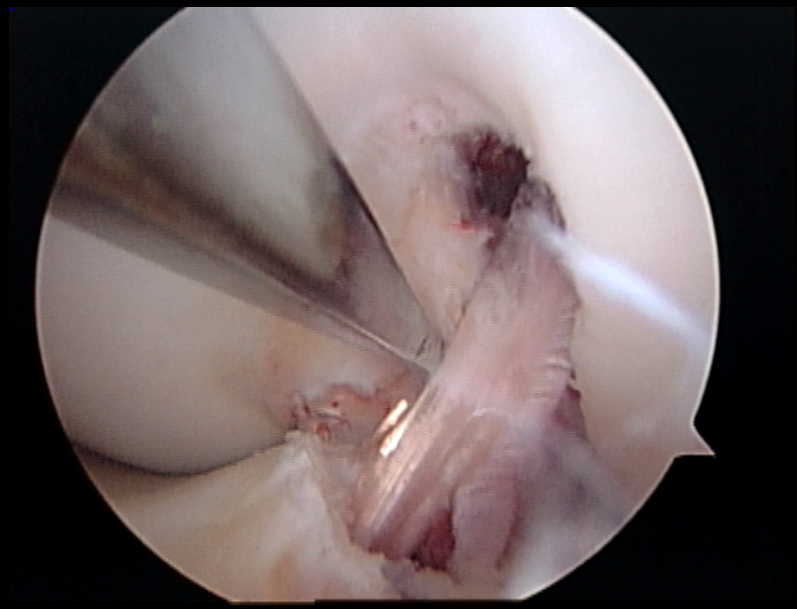


Graft Comparison



B-PT-B Autograft

- patellar pain, 4% -40%
- patellar baja may develop
- incidence patellar pain lower with immediate and aggressive rehab
- pain usually resolves after 3-6 months



Hamstring Tendon Autograft

- 3 years post ham. muscle strength about 95%
- evidence of post-harvest firm scar formation
- soreness harvest area noted up to 3 months, not major patient complaint
- saphenous neuralgia

Graft Comparison

Allografts

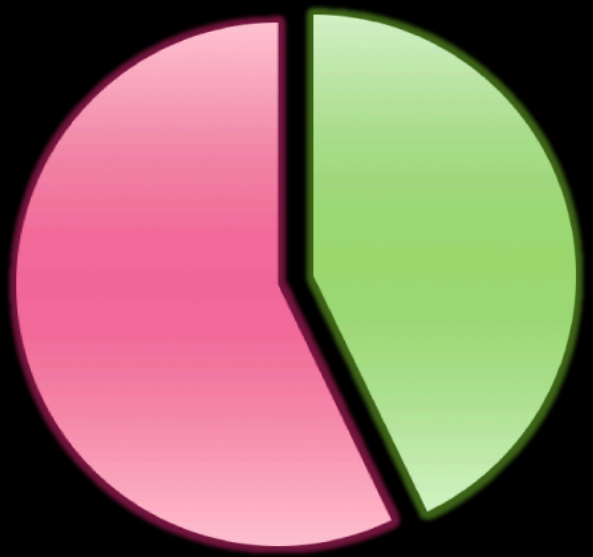
- lack of donor site morbidity
- fixation
- host-graft reactions
- no scar
- early failure rate?

Frequency

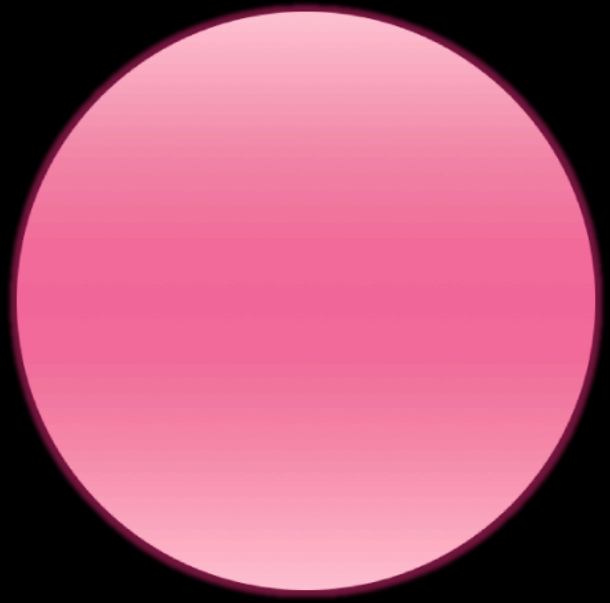
- It is currently one of the most common orthopedic procedures in the world

- 6th frequent orthopedic surgery in US
- 100.000 ACL tears each year
- 75.000 annually primary ACL reconstruction
- 3000-1000 revision

Patellar Tendon

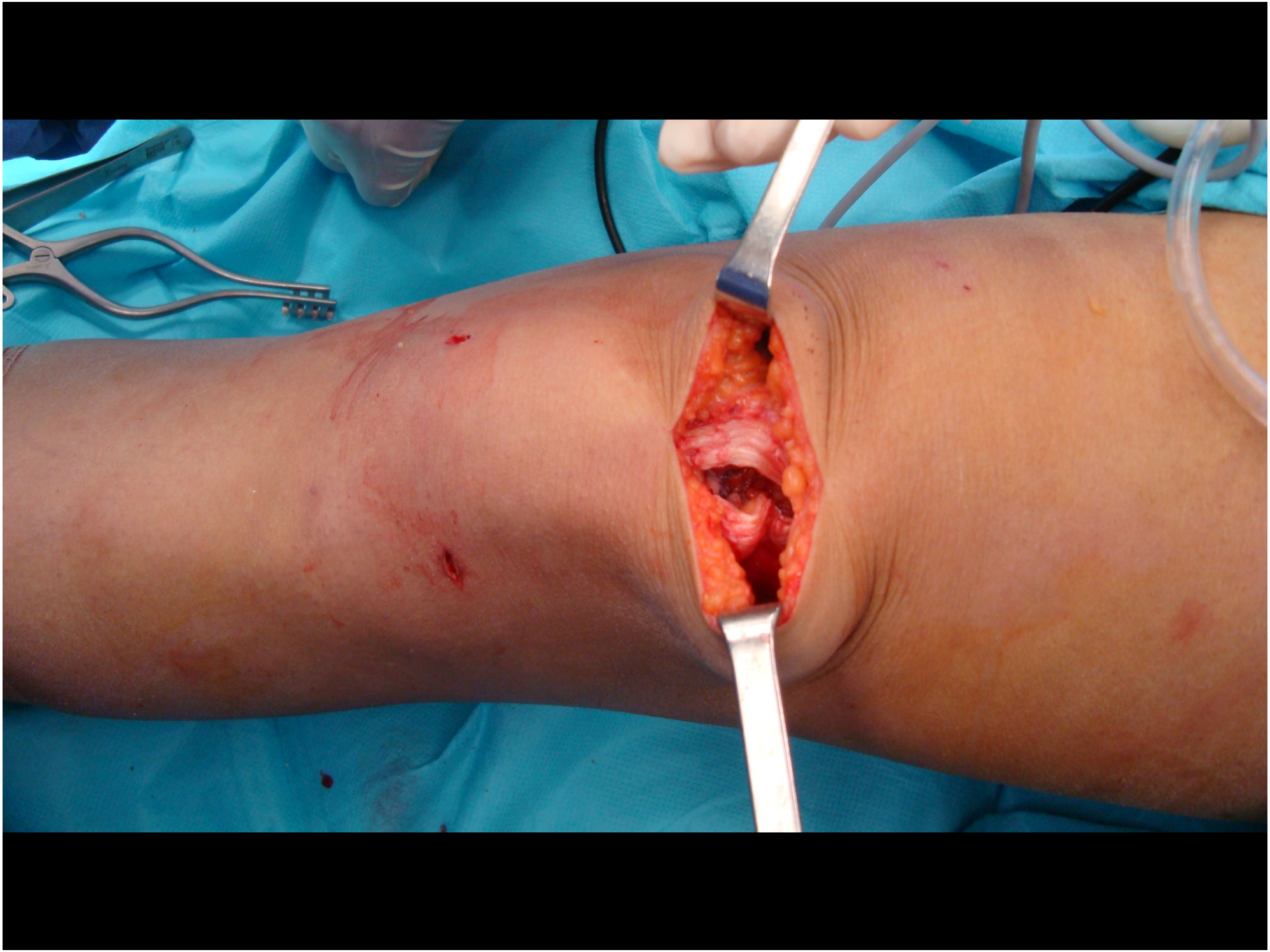


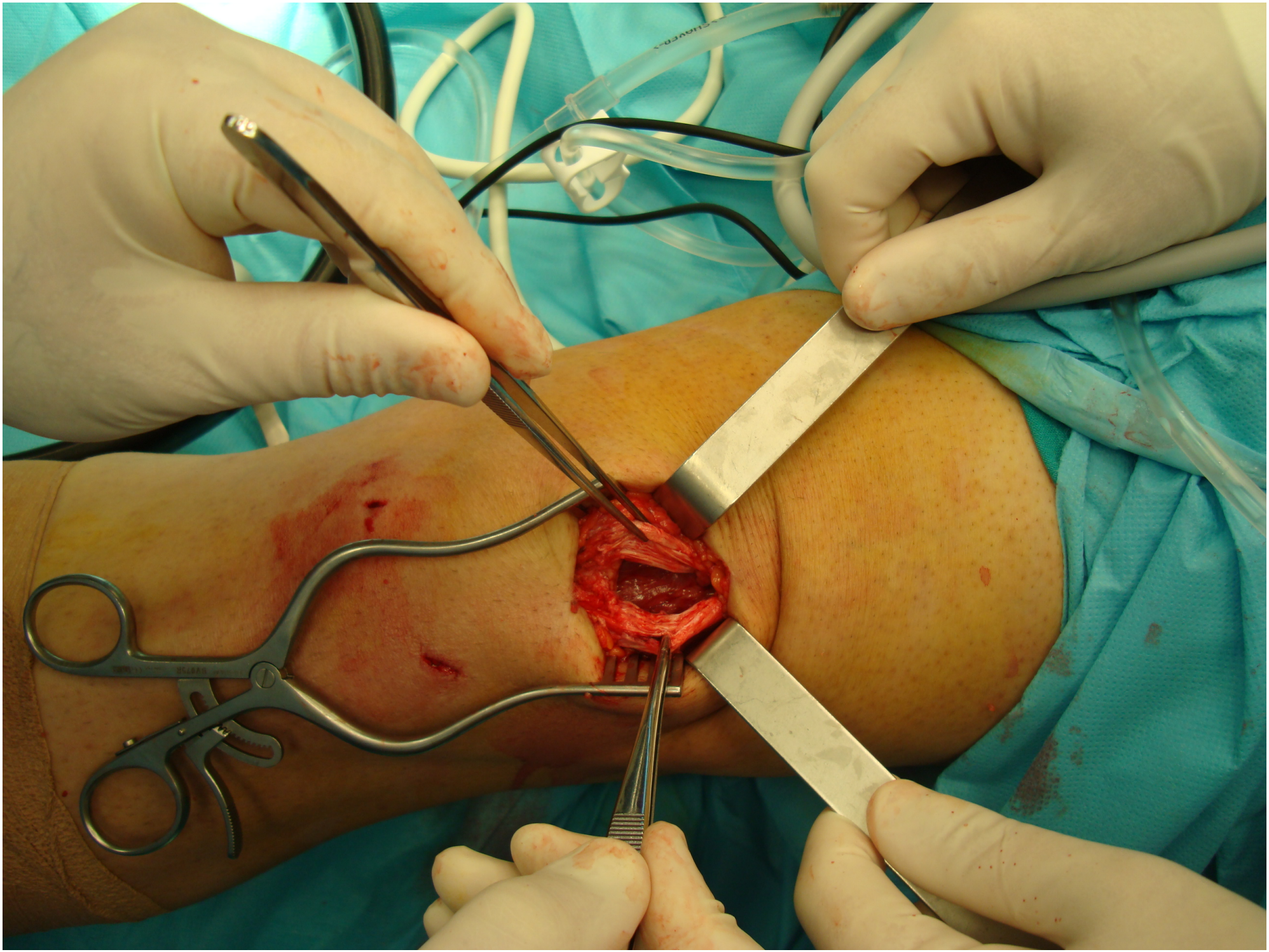
Hamstrings

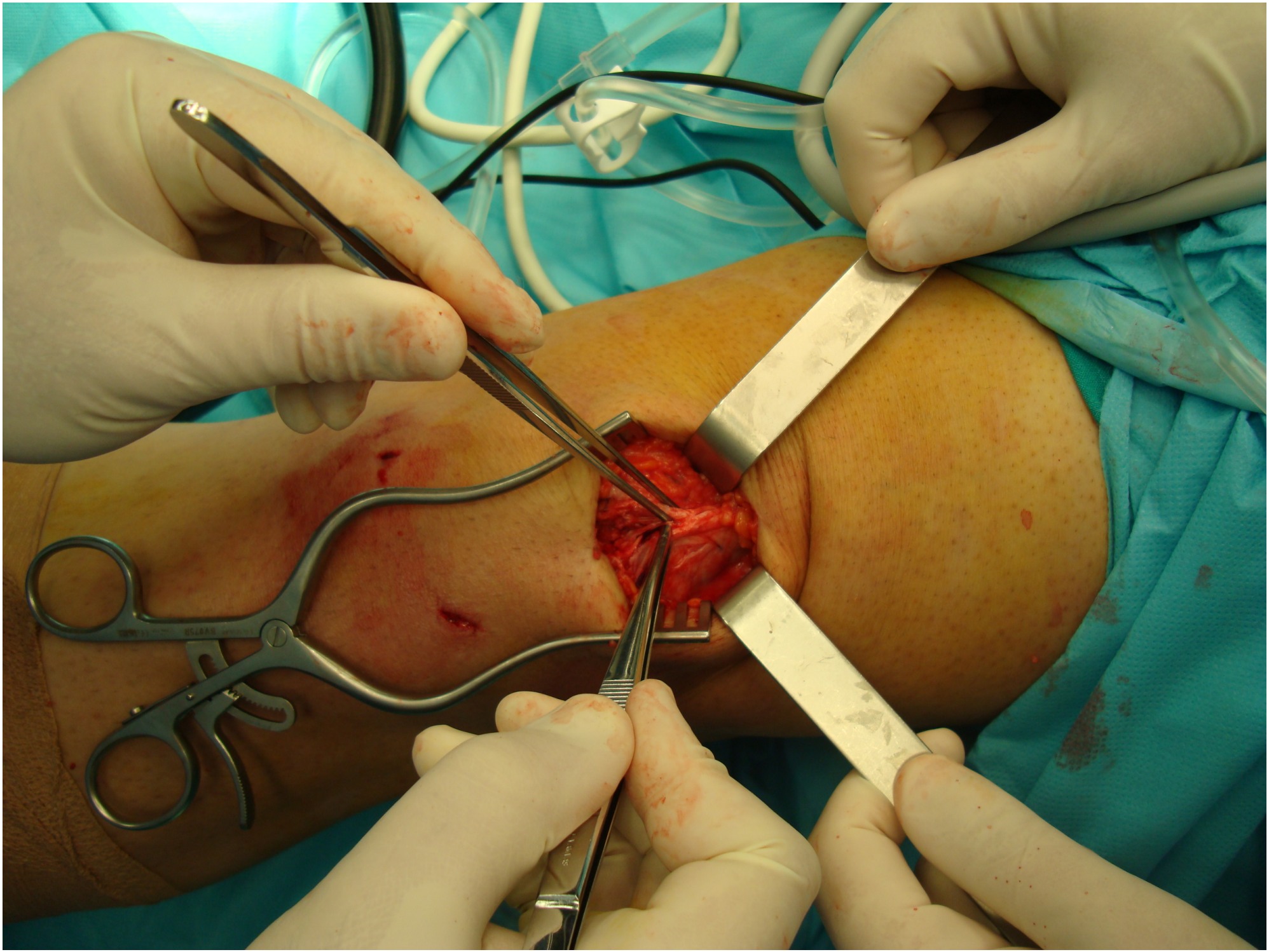


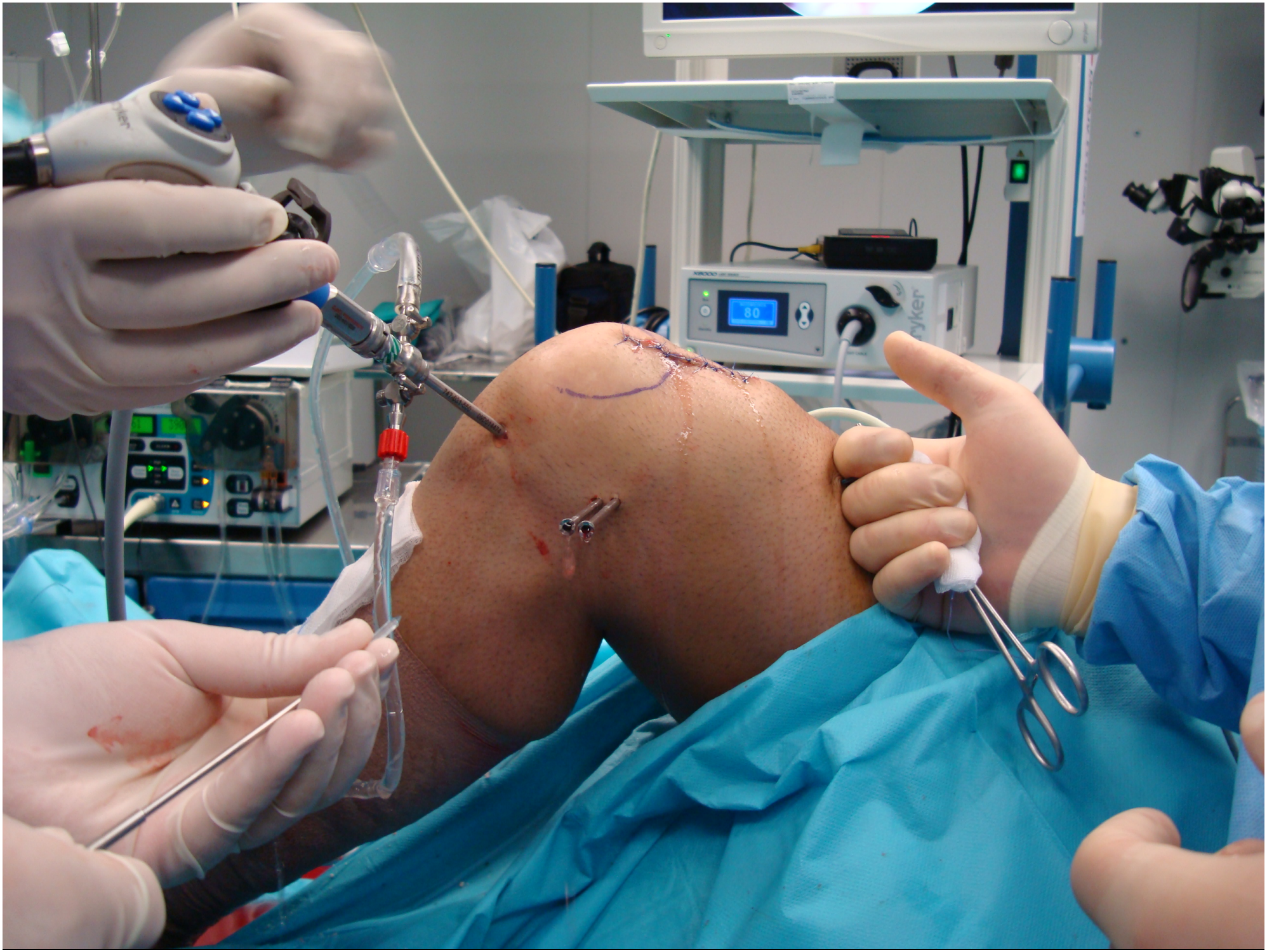
Quadriceps Tendon


fms duo
stryker
80





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