BTB harvesting
Minimal invasive for minimal pain

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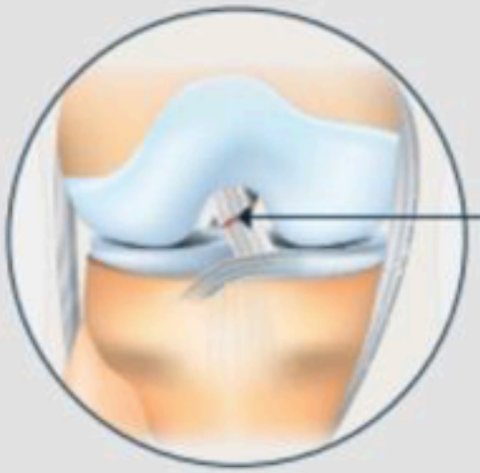
Advantages of BTB

- Bone integration
- Reproducible diameter
- Strength and Stiffness
- **No weakness of Hamstrings**
- **Low re-rupture rate**



Comparison of Five-Year Outcomes Following Three ACL Reconstruction Techniques



Study evaluated the 5-year outcomes of 315 patients treated for complete ACL ruptures using...



Patellar tendon (PT)



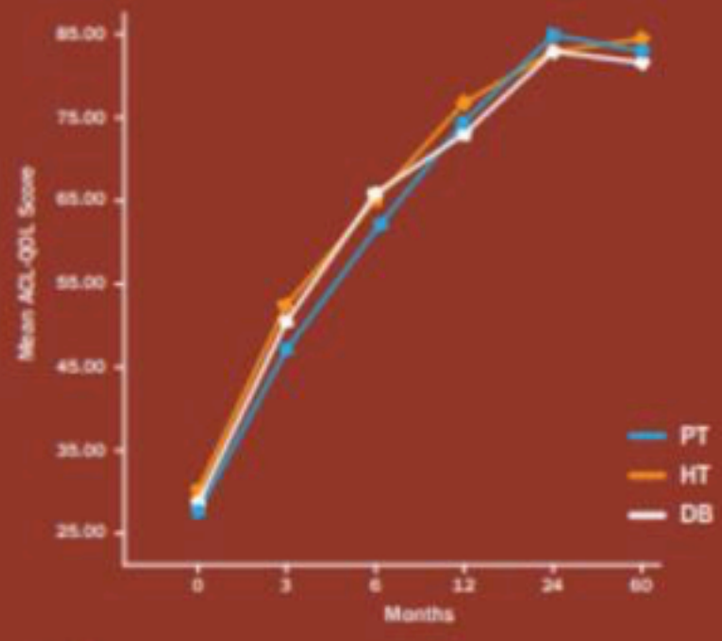
Single-bundle hamstring tendon (HT)



Double-bundle hamstring tendon (DB)

Primary outcome: Anterior Cruciate Ligament-Quality of Life (ACL-QOL) score

All three groups showed improved 5-year ACL-QOL scores, but no differences between groups at 5 years



PT group reported more moderate to severe kneeling pain, while more traumatic ACL reinjuries occurred in the HT and DB groups

Secondary outcomes	PT	HT	DB
% of patients with a normal or nearly normal IKDC grade	87%	82%	75%
Pivot shift (of ≥2)	12%	16%	22%
Kneeling pain	10%	4%	2%
Traumatic reinjury	4%	15%	16%

Disease-specific quality of life at 5 years is not different, but PT reconstruction is recommended for younger patients with a high risk of reinjury

A Randomized Clinical Trial Comparing Patellar Tendon, Hamstring Tendon, and Double-Bundle ACL Reconstructions. Patient-Reported and Clinical Outcomes at 5-Year Follow-up
Mohtadi et al. (2019) DOI: 10.2106/JBJS.18.01322
www.jbjs.org | theJBJS | @JBJS JB&JS

Low re-rupture rate

- "While the HT remains a common choice for ACLR, the current aggregate data indicate that **BPTB and QT demonstrated significantly lower failure rates than HT ACLR in adolescent athletes 18 years old."**

Scoping Review

Graft Failure in Pediatric Patients After Bone–Patellar Tendon–Bone, Hamstring Tendon, or Quadriceps Tendon Autograft ACLR

A Systematic Review and Meta-analysis

Camryn B. Petit,*†‡§ BS, Zaamin B. Hussain,‡ MD, EdM, April McPherson,*†‡‖ PhD, Erich J. Petushek,¶ PhD, Alicia M. Montalvo,*# PhD, MPH, ATC, Mia S. White,** MILS, AHIP, Harris S. Slone,†† MD, Joseph D. Lamplot,*‡‡ MD, John W. Xerogeanes,*†‡ MD, and Gregory D. Myer,*†‡§‖¶¶##a PhD
Investigation performed at Department of Orthopaedics, Emory University School of Medicine, Atlanta, Georgia, USA

Background: Anterior cruciate ligament (ACL) reinjury risk is high in young athletes, with graft failure rates as high as 23%. The optimal autograft choice to minimize reinjury risk in this population is unclear.

Purpose: To compare graft failure rates between bone–patellar tendon–bone (BPTB), hamstring tendon (HT), and quadriceps tendon (QT) autografts in patients aged ≤18 years with a minimum follow-up (FU) of 24 months.

Study Design: Systematic review; Level of evidence, 4.

Methods: A systematic review of the literature between database inception and March 2022 encompassed PubMed/MEDLINE, Cochrane CENTRAL, Embase, and Web of Science Core Collection databases. Studies on autograft ACL reconstruction (ACLR) using HT, QT, or BPTB autograft in patients ≤18 years old with a minimum FU of 2 years were included. Graft failure rates were pooled and estimated using random-effects models via the inverse variance method and logit transformations. Meta-analyses were used to estimate failure rates and pairwise comparisons were conducted by autograft type when appropriate.

Results: A total of 24 studies comprising 2299 patients (HT: n = 1237, 44.8% female, 59.1-month mean FU; BPTB: n = 913, 67.3% female, 79.9-month mean FU; QT: n = 149, 36.4% female, 35.3-month mean FU) were included. HT exhibited the highest failure rate at 11.8% (95% CI, 9.0%-15.4%); failure rates for BPTB and QT were 7.9% (95% CI, 6.2%-10.0%) and 2.7% (95% CI, 1.0%-7.5%), respectively. HT had a significantly higher failure rate than both BPTB (Q = 5.01; *P* = .025) and QT (Q = 7.70; *P* = .006); BPTB had a significantly higher failure rate than QT (Q = 4.01; *P* = .045). Male patients were less likely than their female counterparts to experience graft failure after HT ACLR (odds ratio, 0.48; 95% CI, 0.25-0.95).

Conclusion: While the HT remains a common choice for ACLR, the current aggregate data indicate that BPTB and QT demonstrated significantly lower failure rates than HT ACLR in adolescent athletes ≤18 years old. The QT demonstrated the lowest failure rate in adolescents but also the lowest proportion of patients represented due to a paucity of published QT data, indicating a need for future studies with larger sample sizes that include QT autografts, reduced risk of bias, and consistent reporting on skeletal maturity and surgical technique to better determine the ideal autograft for active athletic populations ≤18 years old.

Keywords: knee; ACL; adolescent; athlete; graft failure

The Orthopaedic Journal of Sports Medicine, 12(11), 23259671241289140
DOI: 10.1177/23259671241289140
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In the United States alone, an estimated 100,000 to 200,000 anterior cruciate ligament (ACL) injuries occur each year, corresponding to an estimated 64,000 to 100,000 ACL reconstructions (ACLRs).[8,9,40] ACL injury

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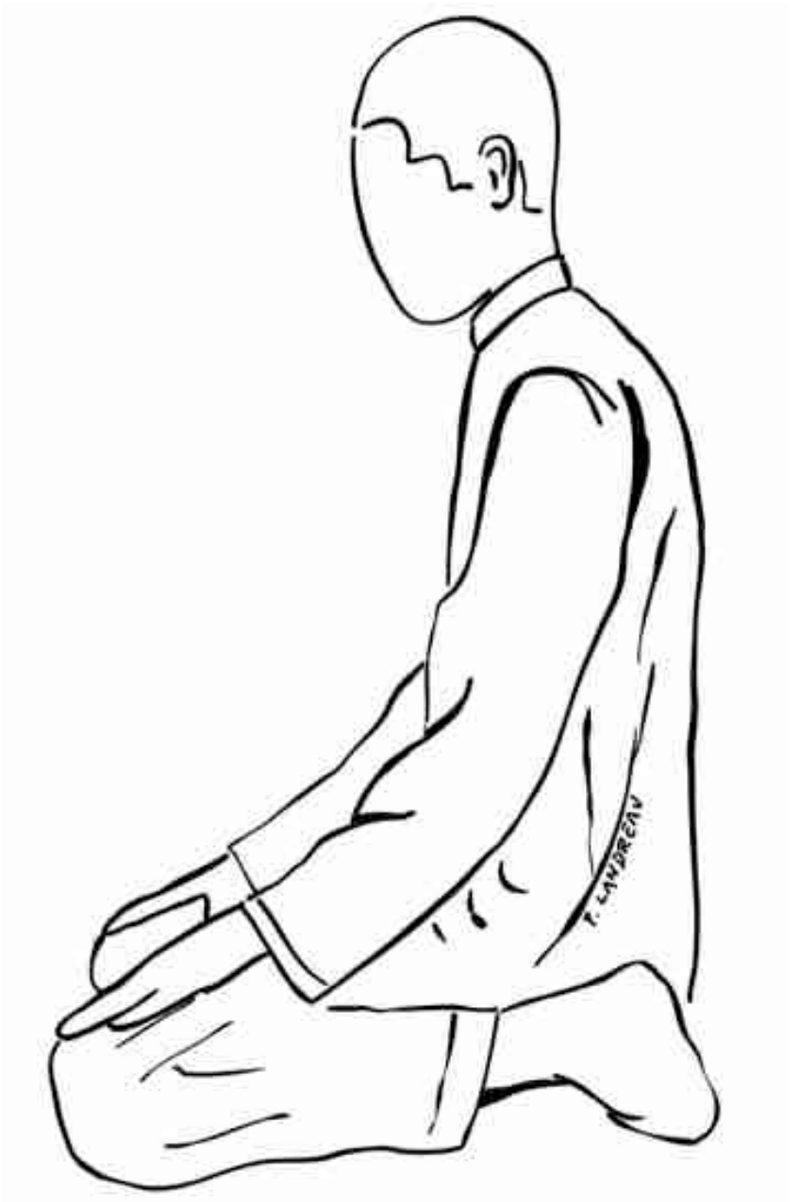
Low re-rupture rate

Disadvantages

- Quadriceps weakness
- Flessum
- **Anterior knee pain**
- Length not adaptable



Anterior Knee Pain

- incidence: **4 to 60%** of anterior knee pain in literature
- **Causes of the pain: multifactorial**
  - Knee dysfunction
  - related to bone-patellar tendon-bone graft techniques:
    - **Inflammatory response related to the donor site healing process (tendinopathy)**
    - **Injury to the infrapatellar branches of the saphenous nerve (IBSN)**

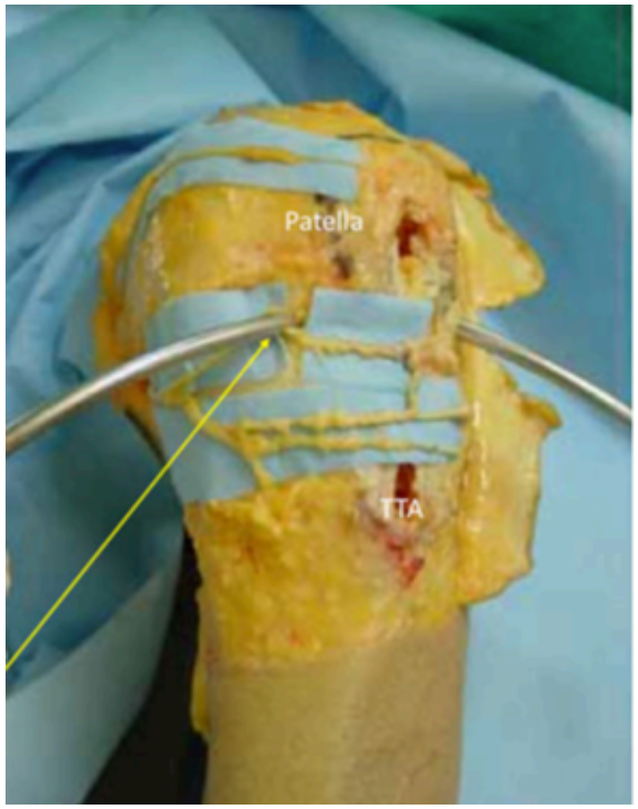
Dilemma in Athletes

Better results in Athletic population ⟷ Higher Extensor morbidity

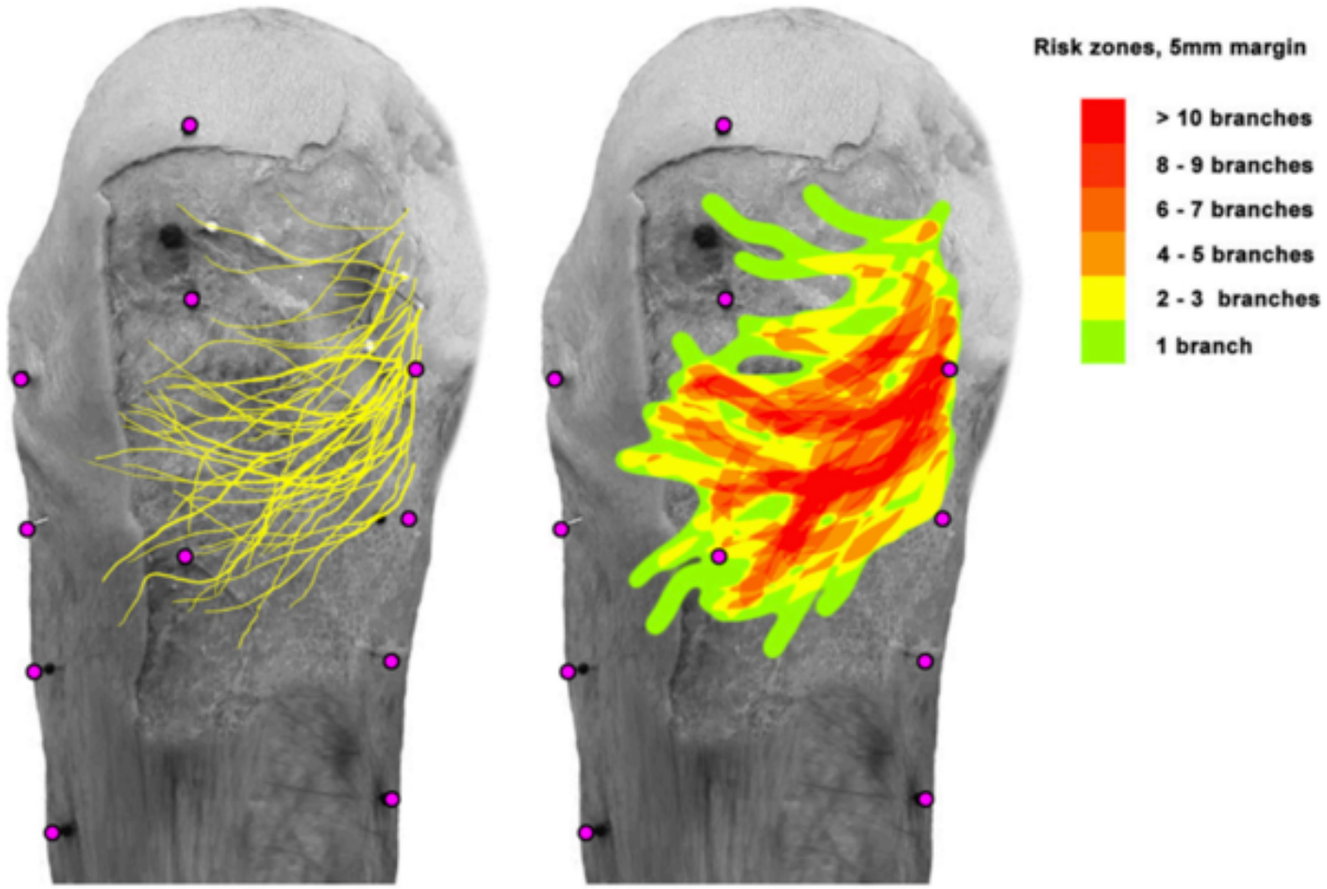
- **One option: other graft choices** with less donor site morbidity: but what about the revision?

- **Another option: mini invasive technique in order to preserve IBSN and the peritenon.**

What says anatomy?



Gaudot et al. OTSR 2009

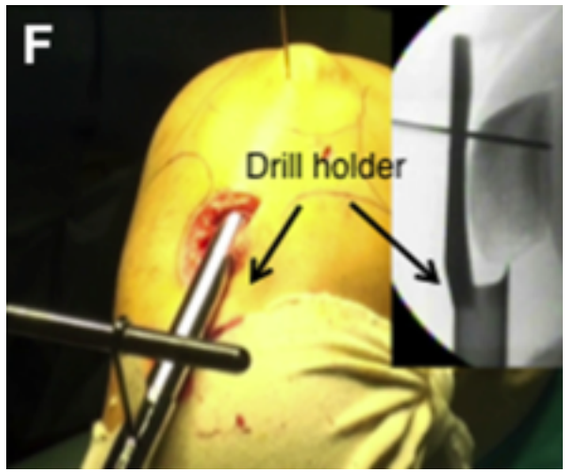


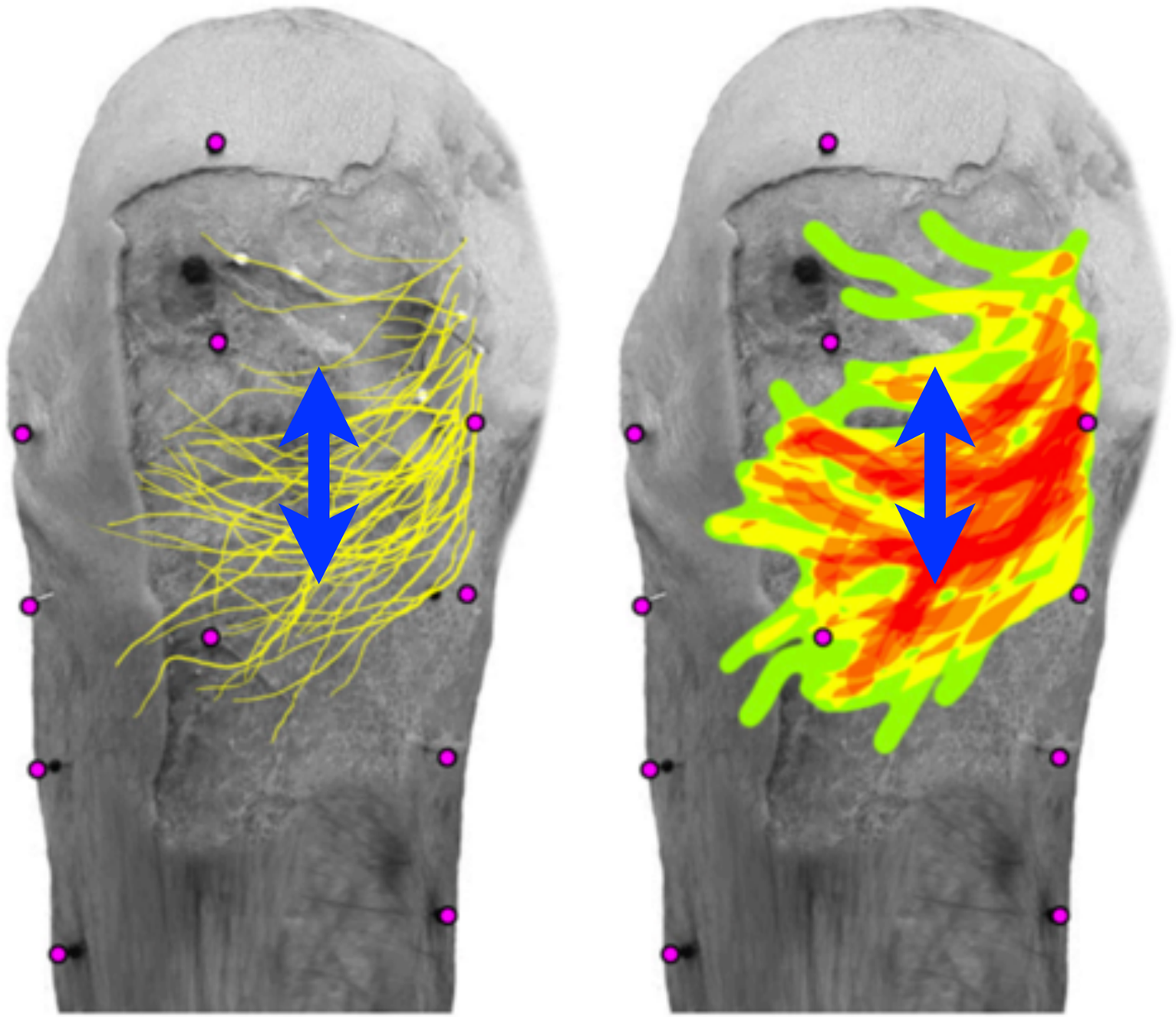
The Surgical Anatomy of the Infrapatellar Branch of the Saphenous Nerve in Relation to Incisions for Anteromedial Knee Surgery
Kerver et al. JBJS 2013

Computer-assisted surgical anatomy mapping tool



Options?

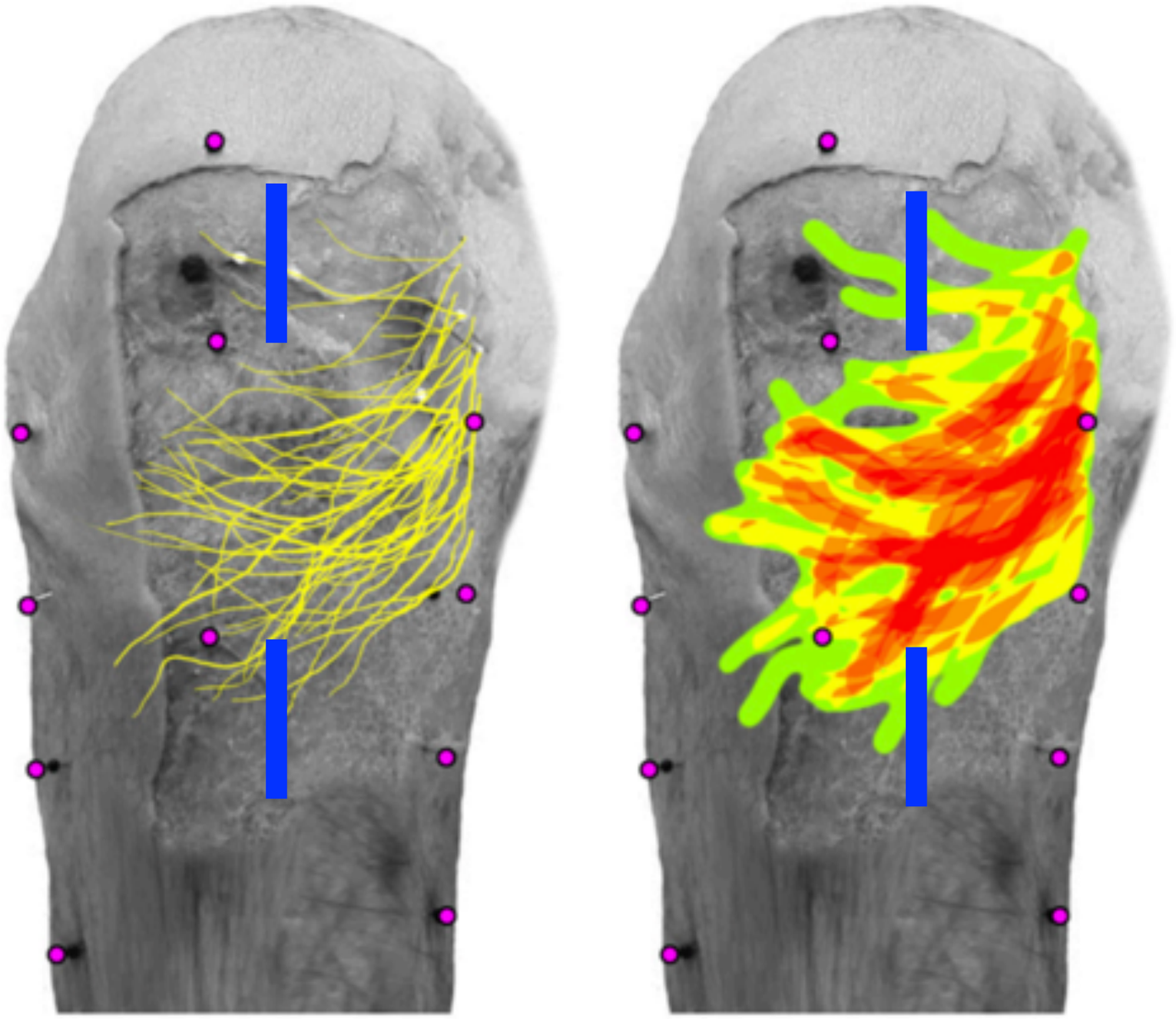


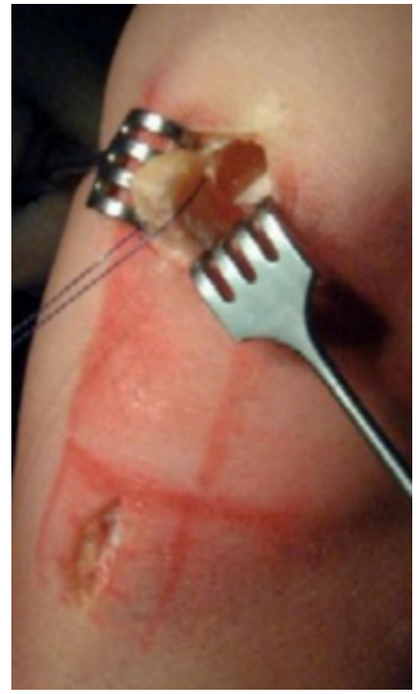


Koh et al.

Option 1:
One mini incision

Options?



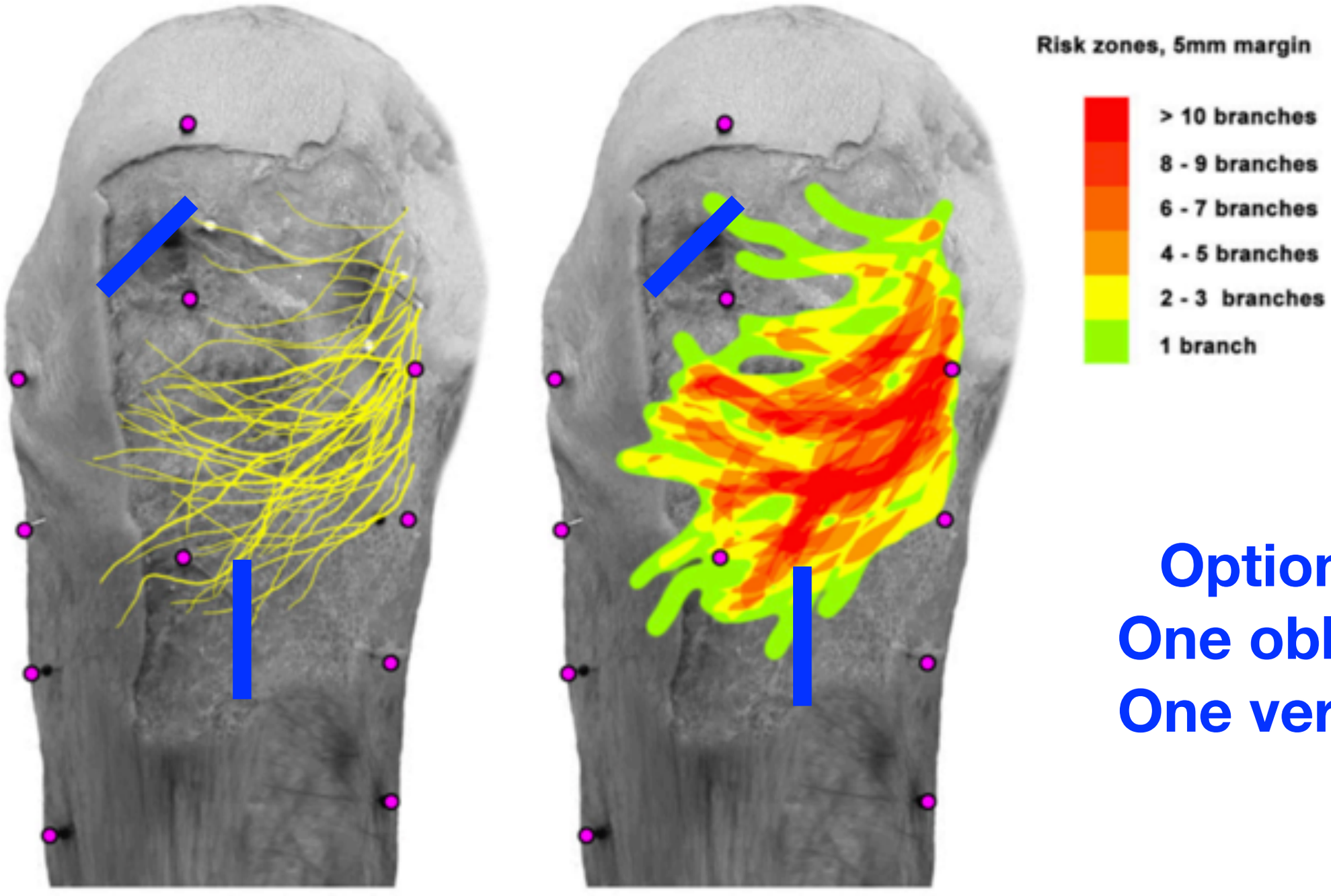


Beaufils et al.

Option 2:
Two small vertical incisions

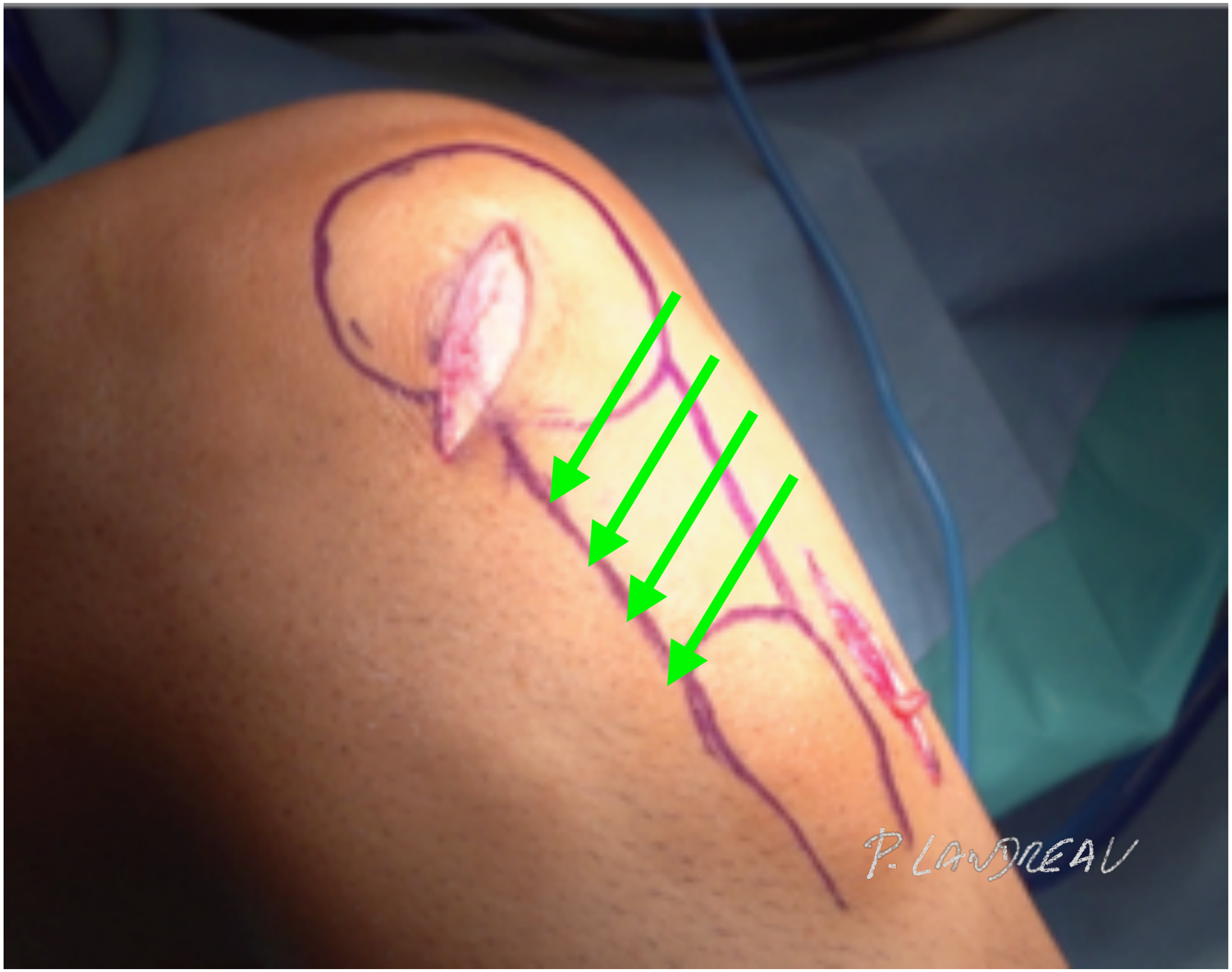
Options?

Martens



Option 3:
One oblique
One vertical

2 incisions:
One proximal lateral oblique
One distal medial vertical



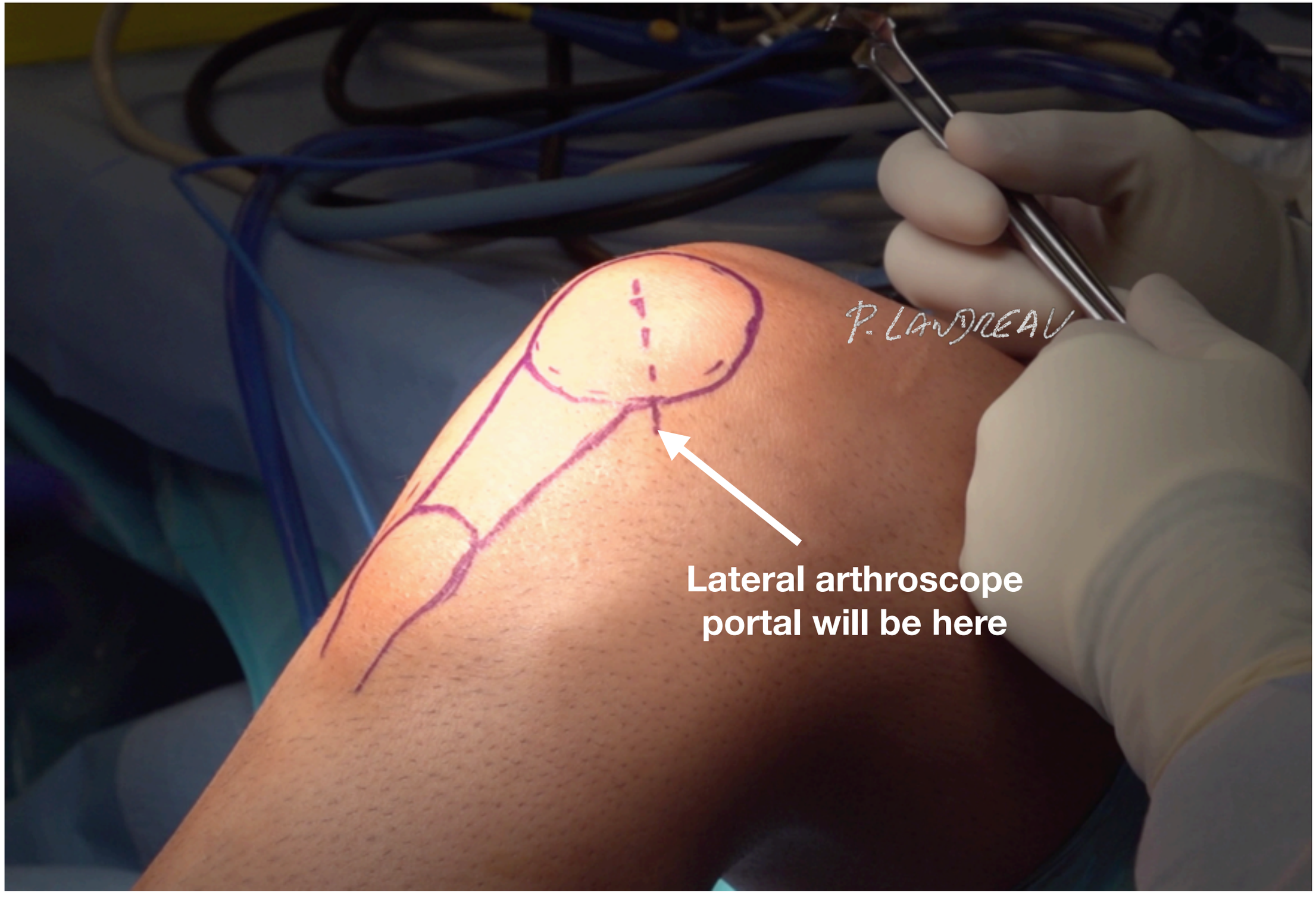
Technique

- **No specific instrumentation**

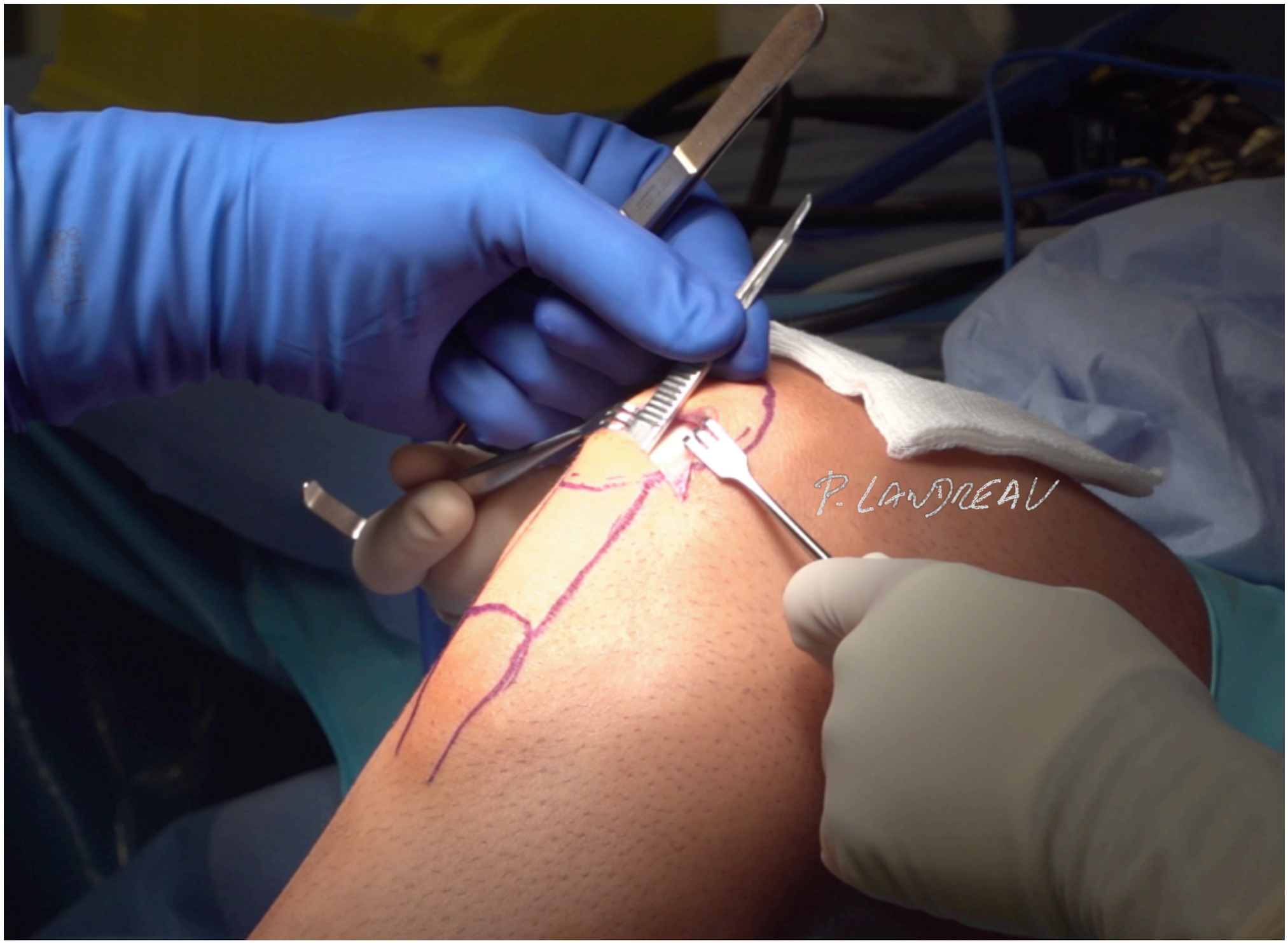


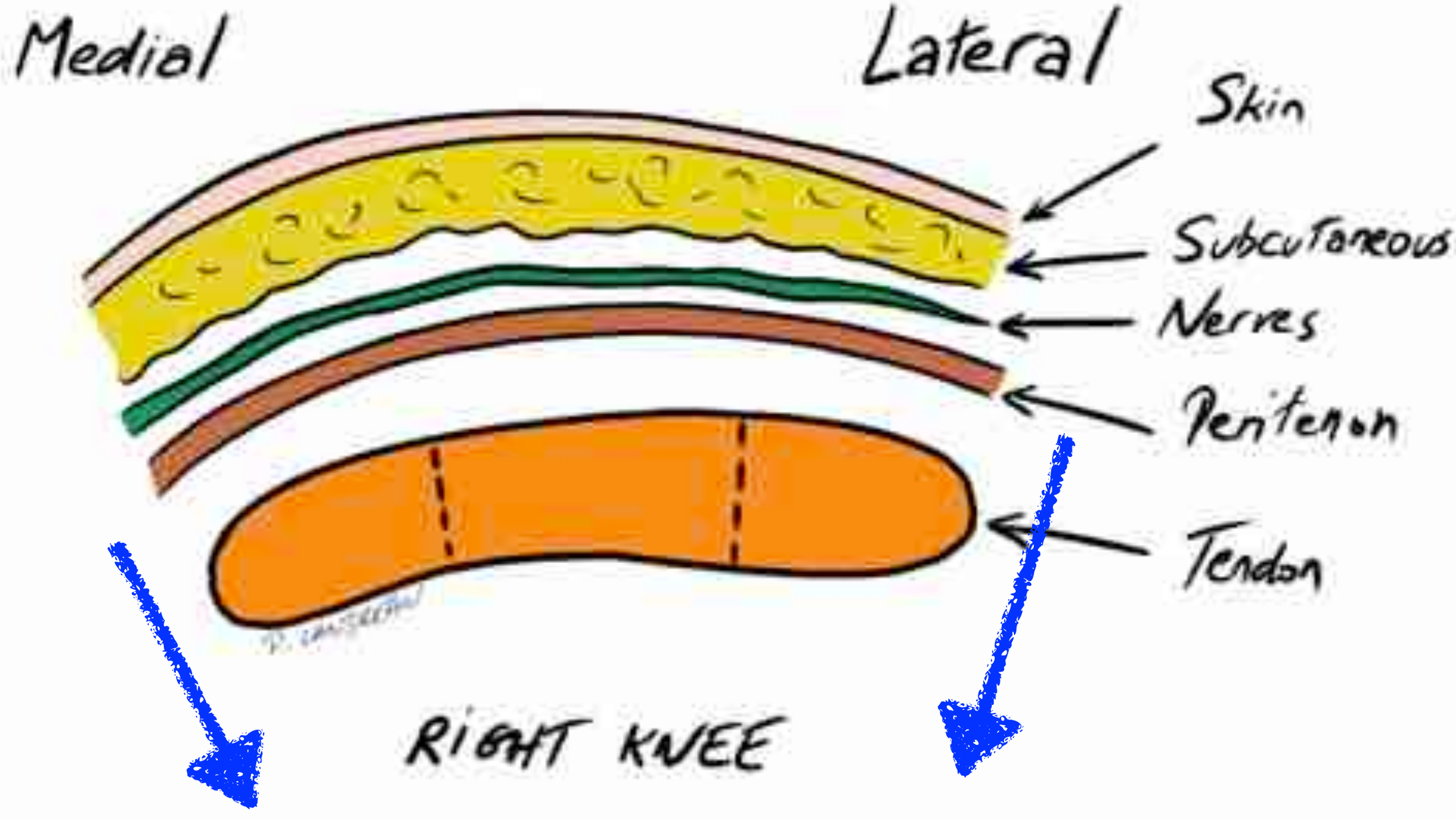
Left knee

Oblique from center of patella



Go behind the peritenon





Safe zone behind the peritenon

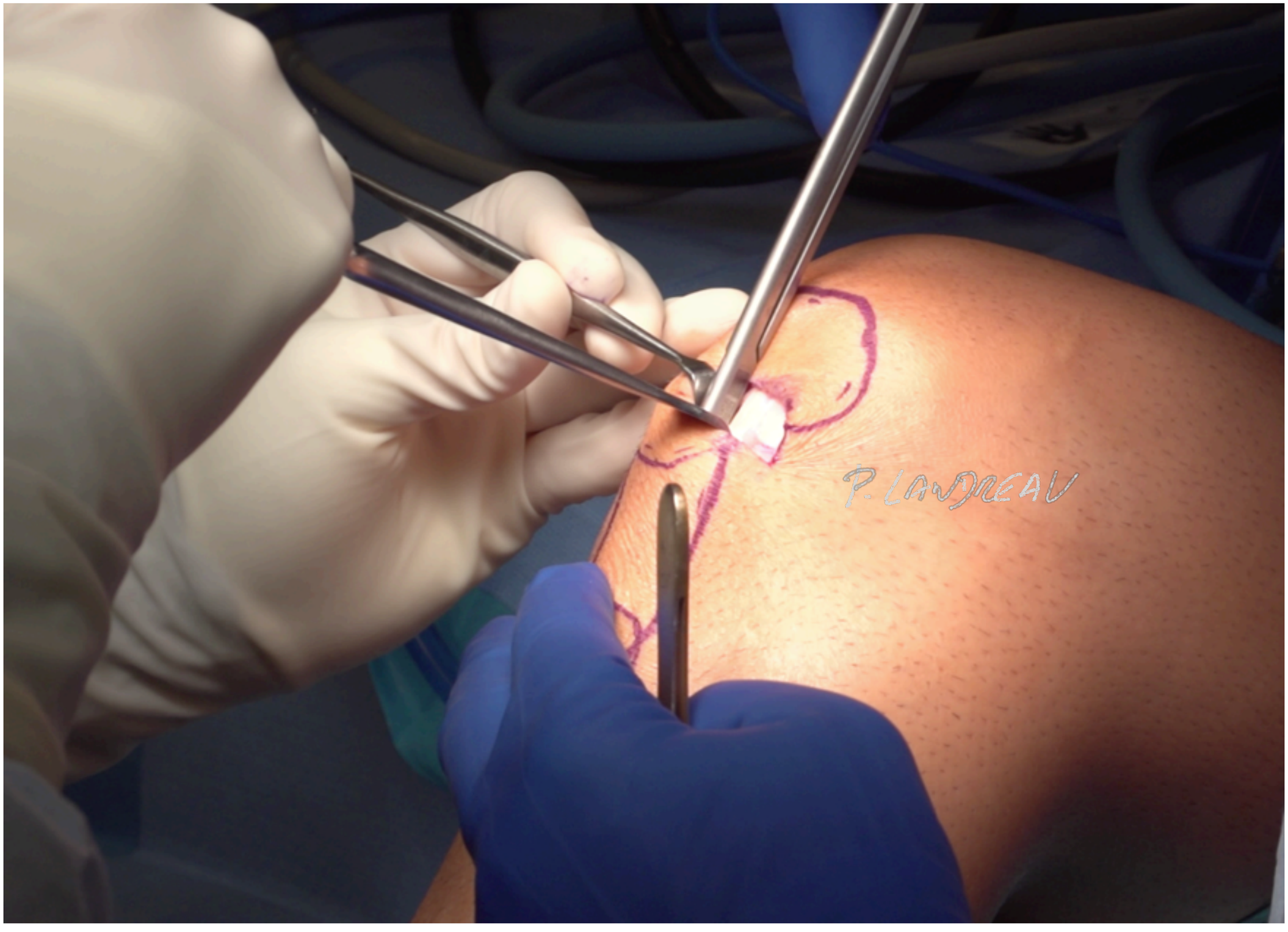
Straight scissors



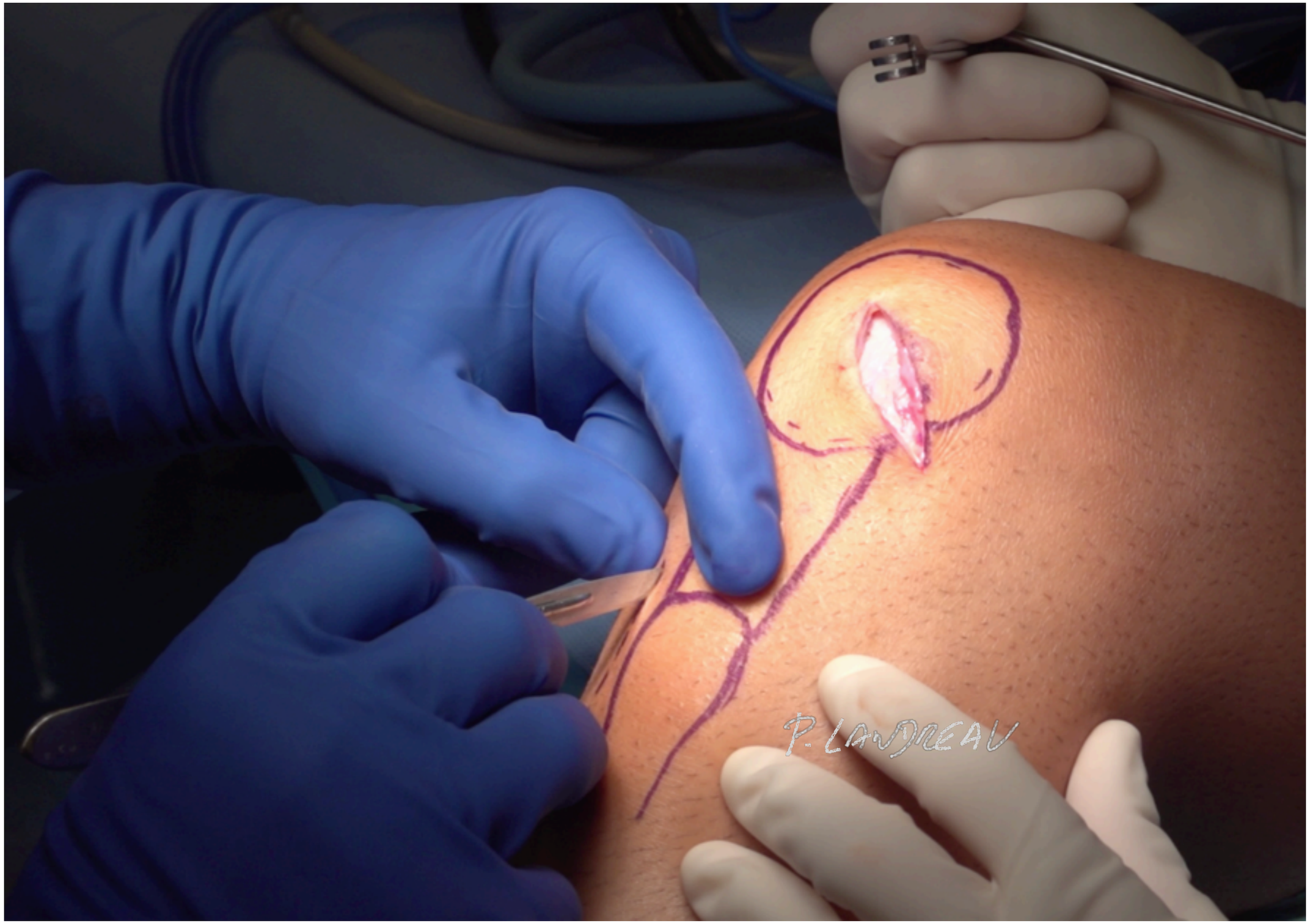
Don’t cut, separate



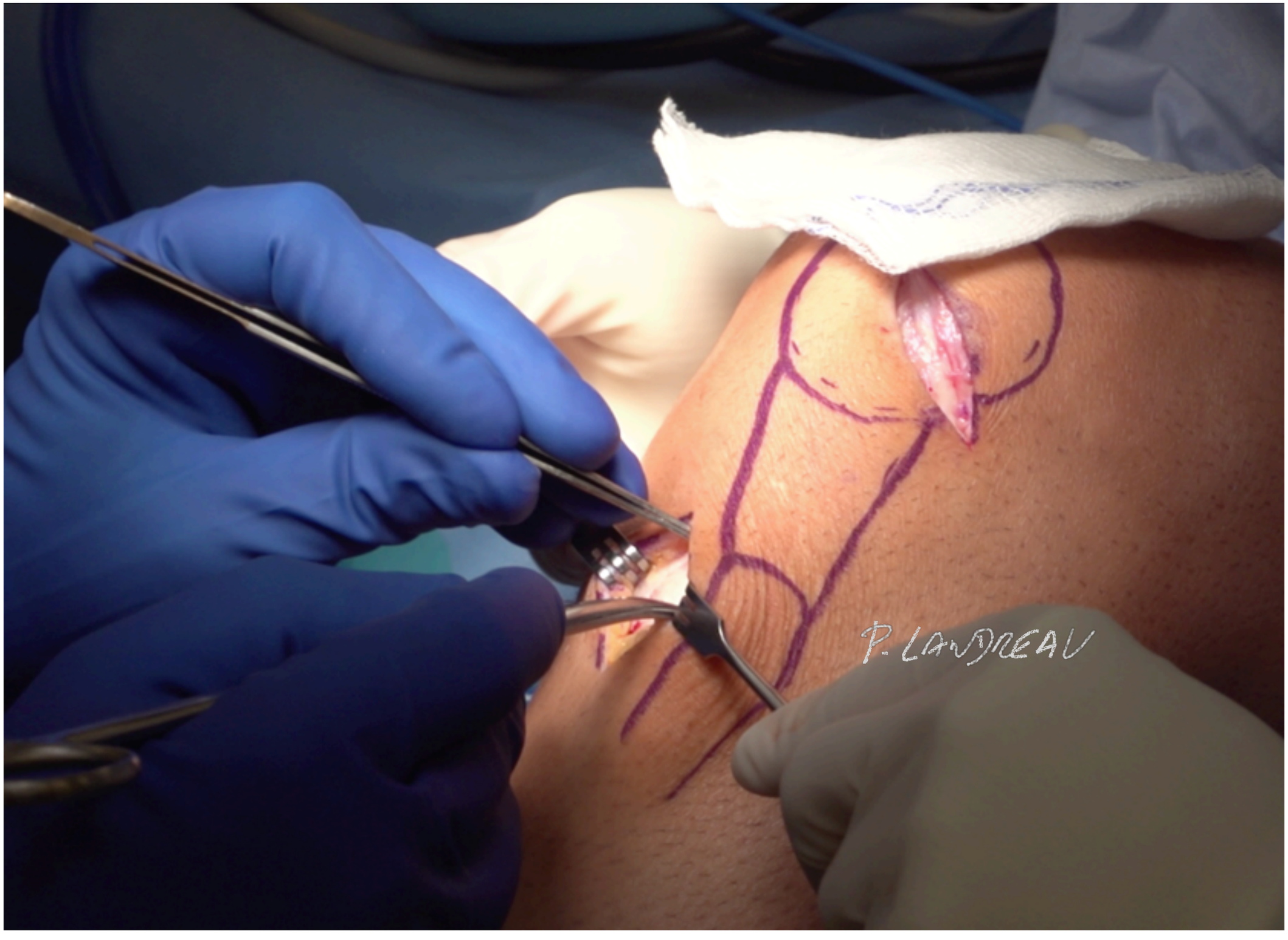
Until the tibial tuberosity



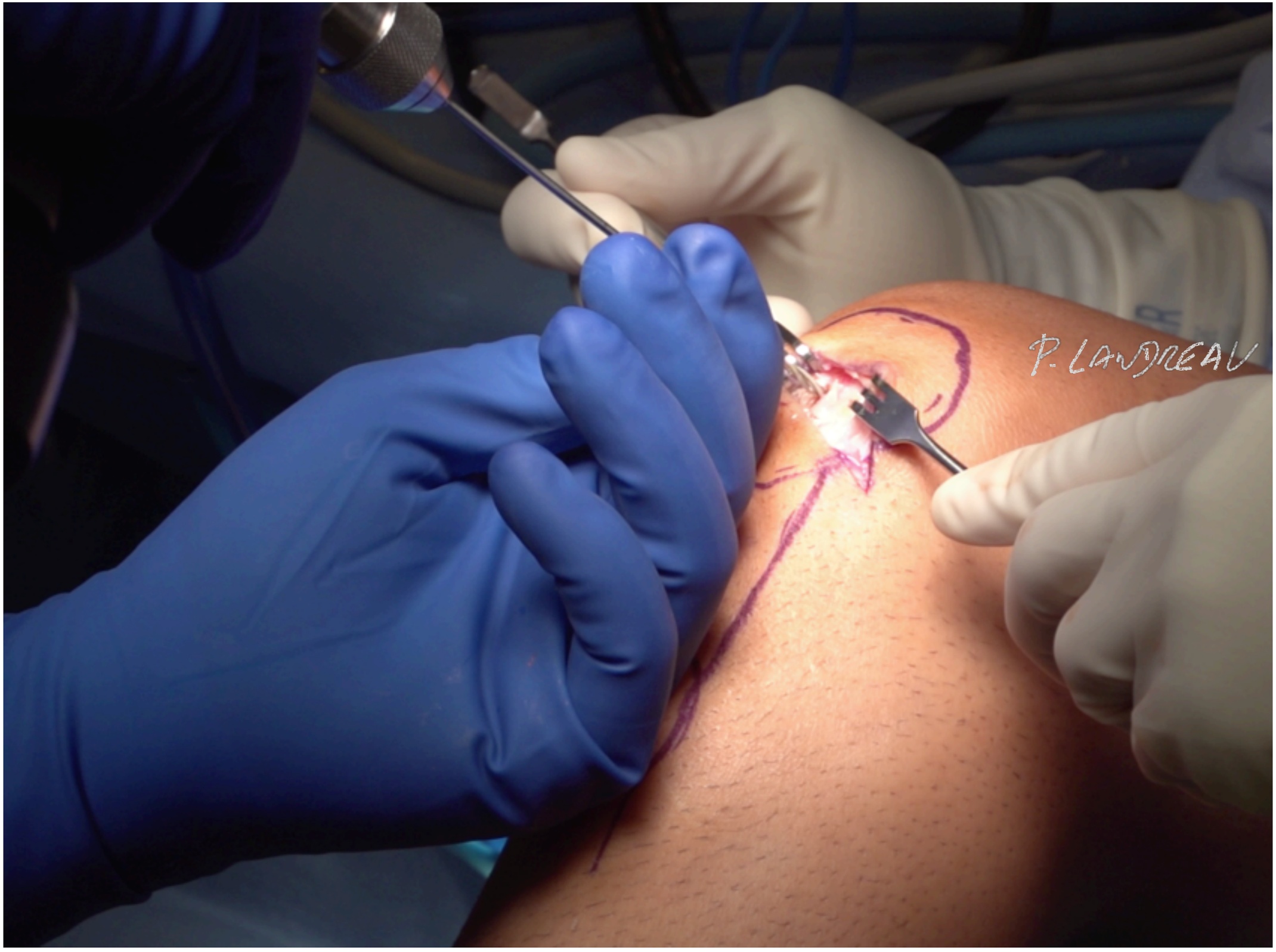
Small paramedial approach



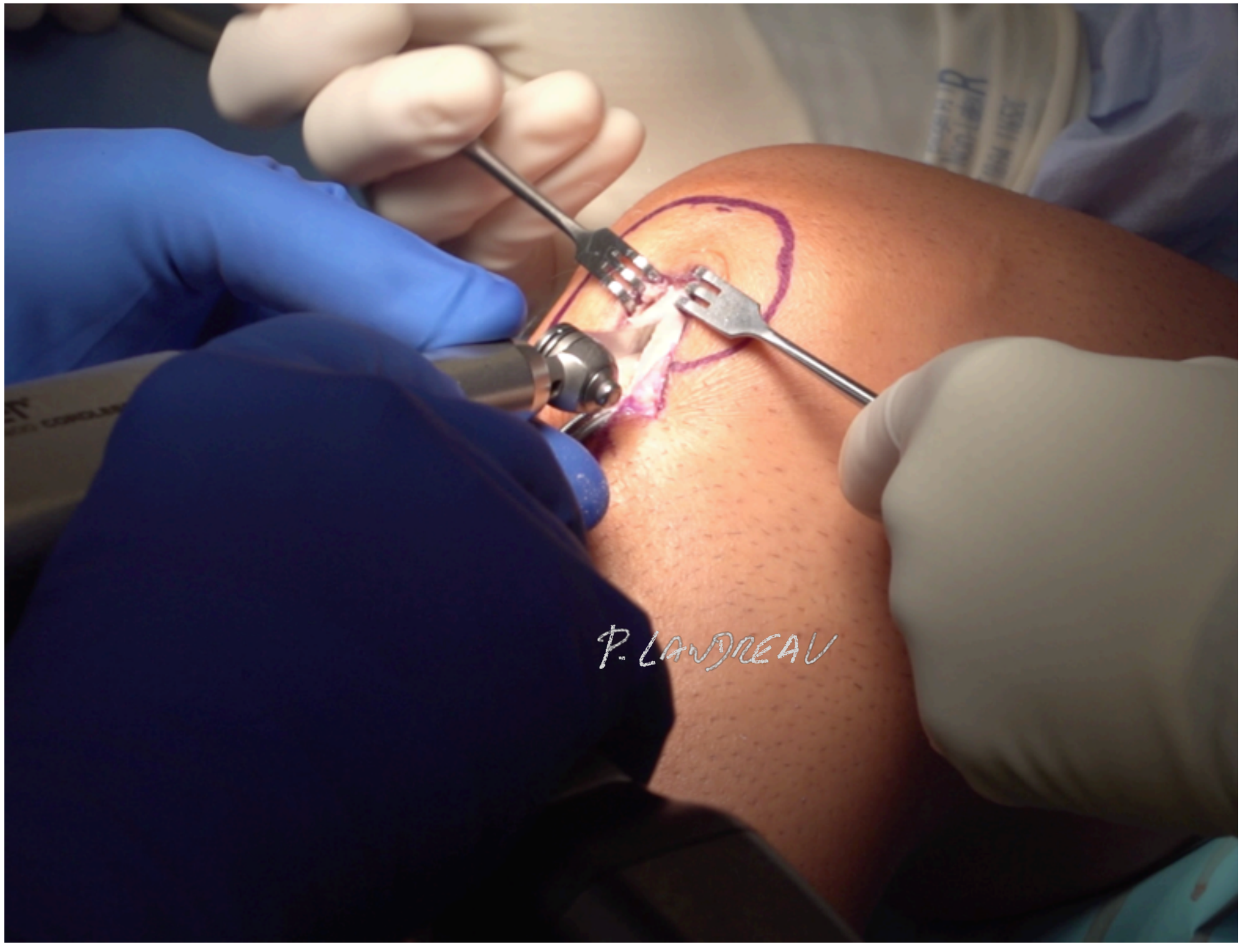
Approach the TT



Usual bone patellar harvest



Usual bone patellar harvest



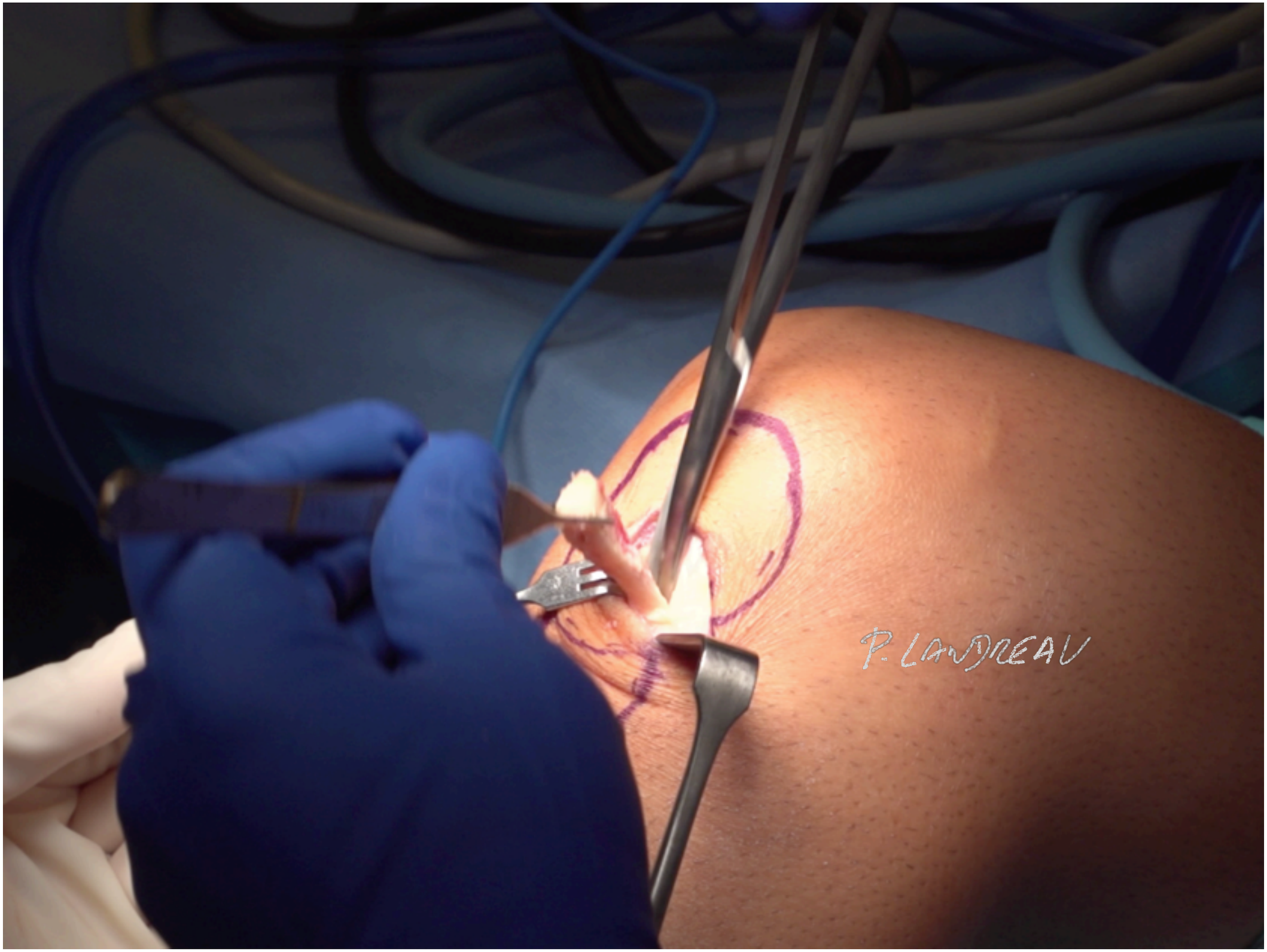
Usual bone patellar harvest



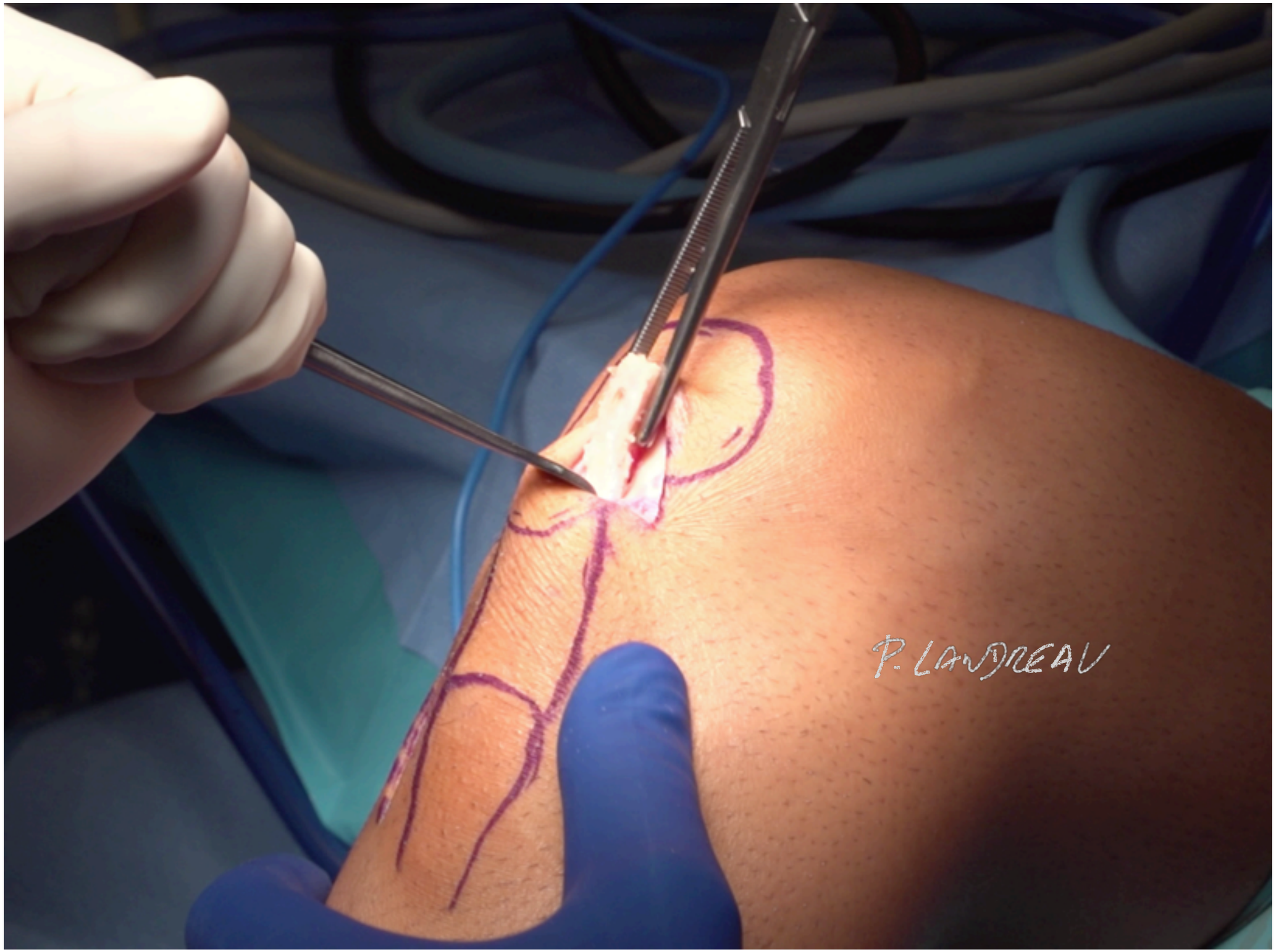
Usual bone patellar harvest



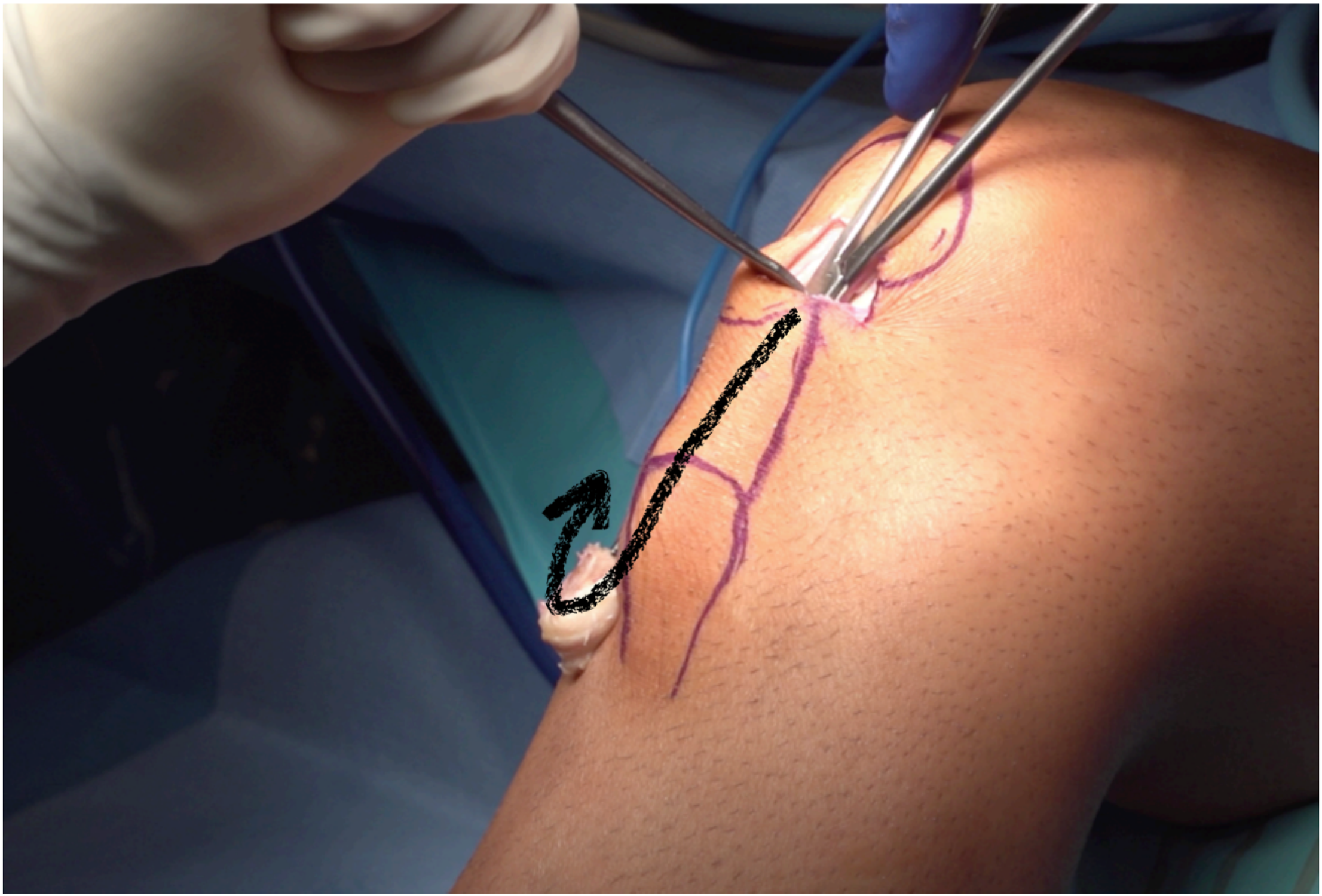
Release the tendon



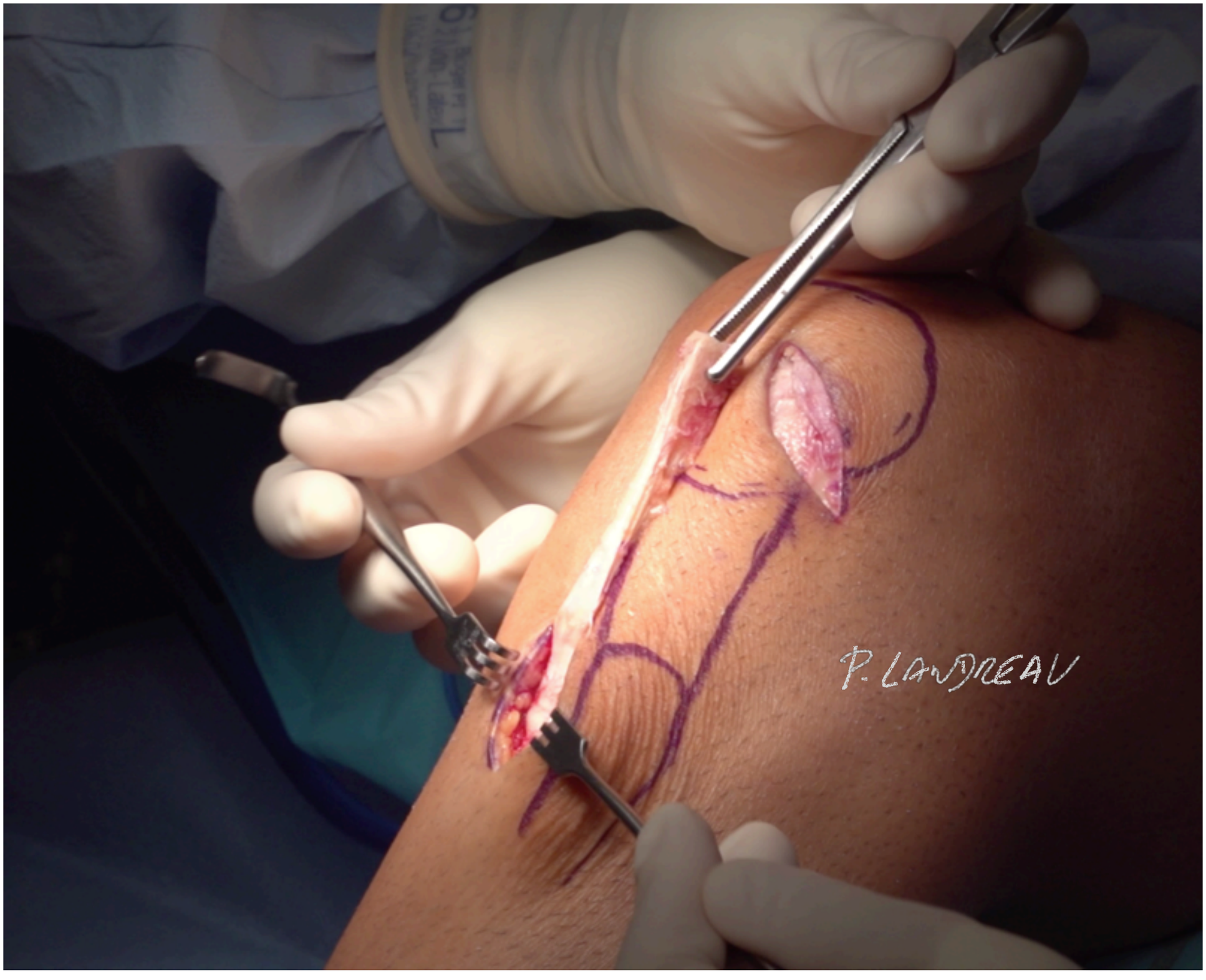
Move the tendon down



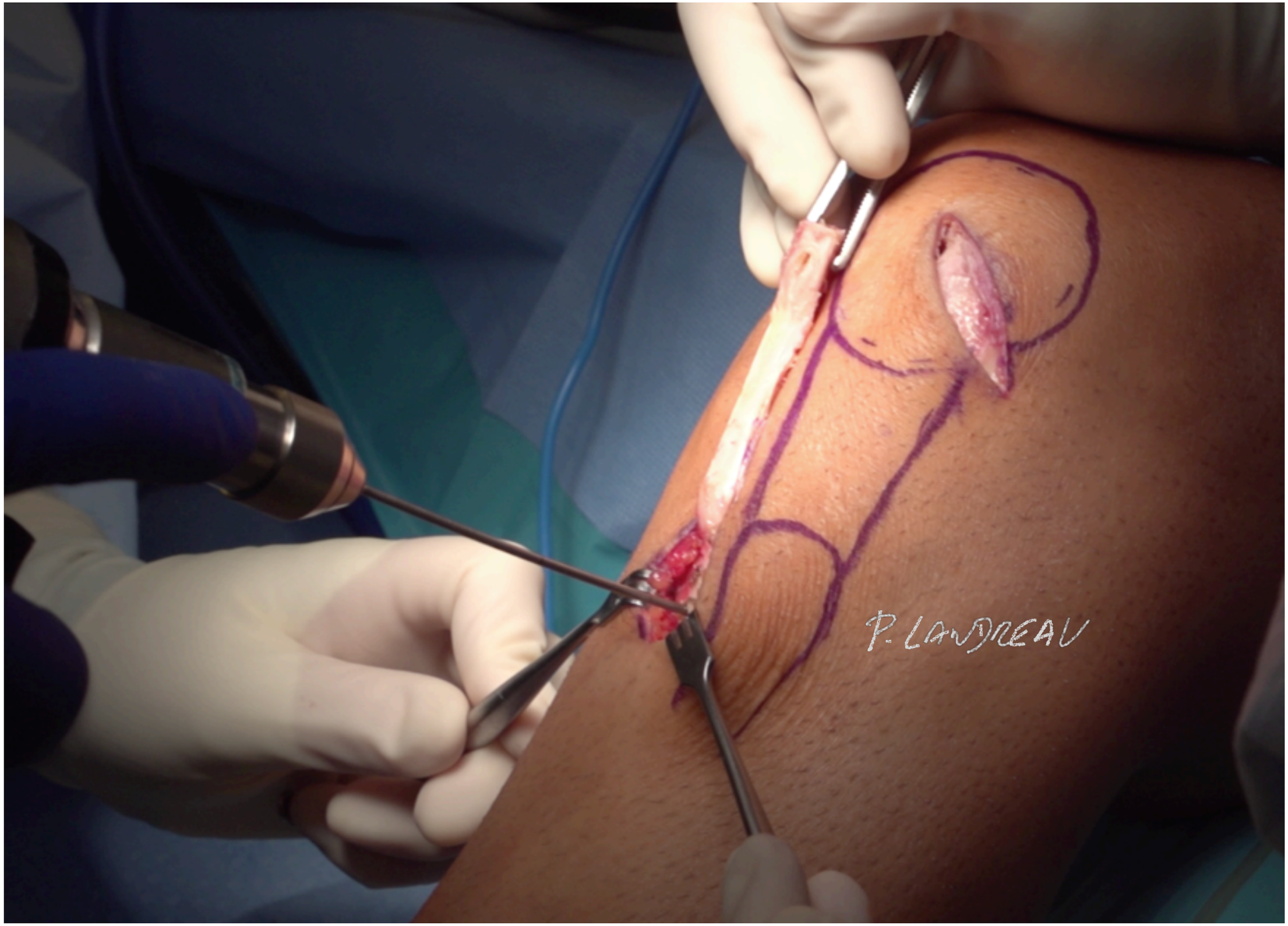
Move the tendon down



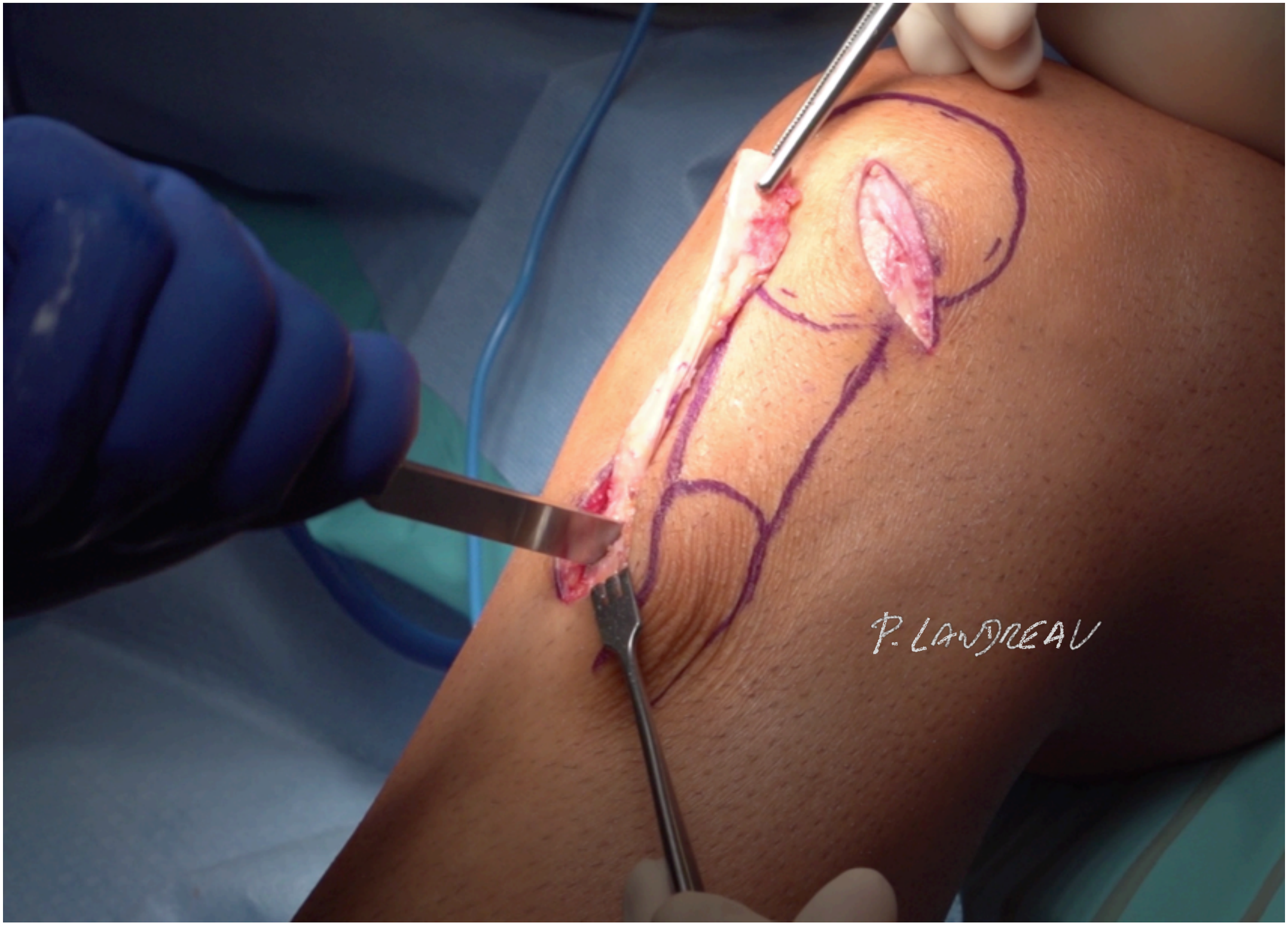
Pass the tendon anterior

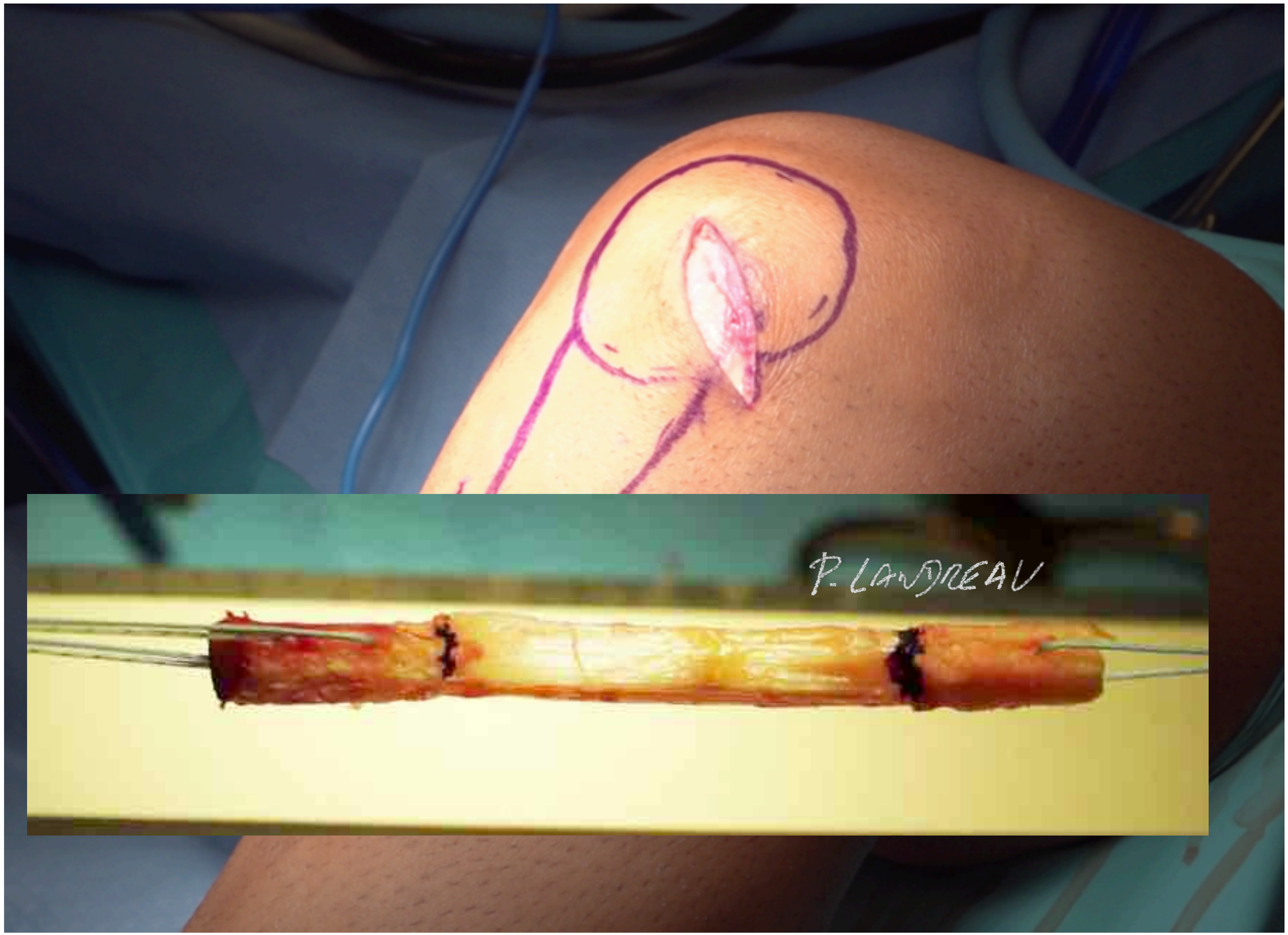


Usual tibial bone harvest



Usual tibial bone harvest



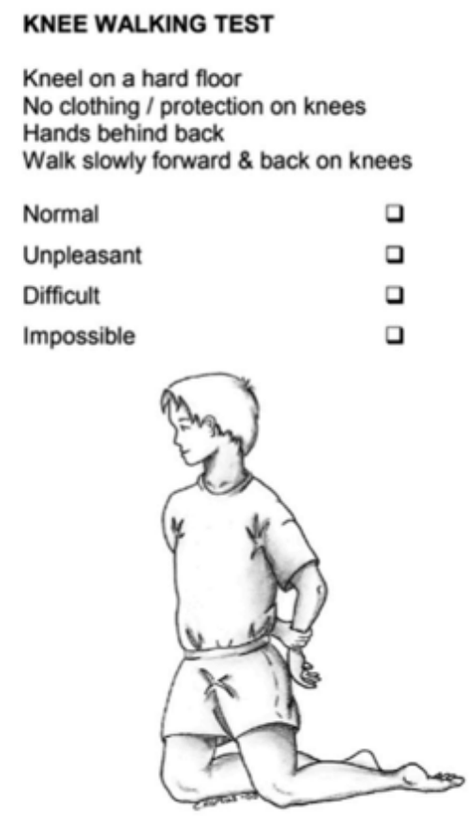

P. LANDREAU


P. LANDREAU

Evidence?

- The double-incision approach significantly **reduces the mid-term incidence of anterior knee pain** after ACL-reconstruction.

- Less disturbance in anterior knee sensitivity and **less discomfort during walking on one's knees** than the traditional one-incision technique.



Kartus et al.

Beaufils et al.

Orthopaedics & Traumatology: Surgery & Research (2012) **98**, 426–431

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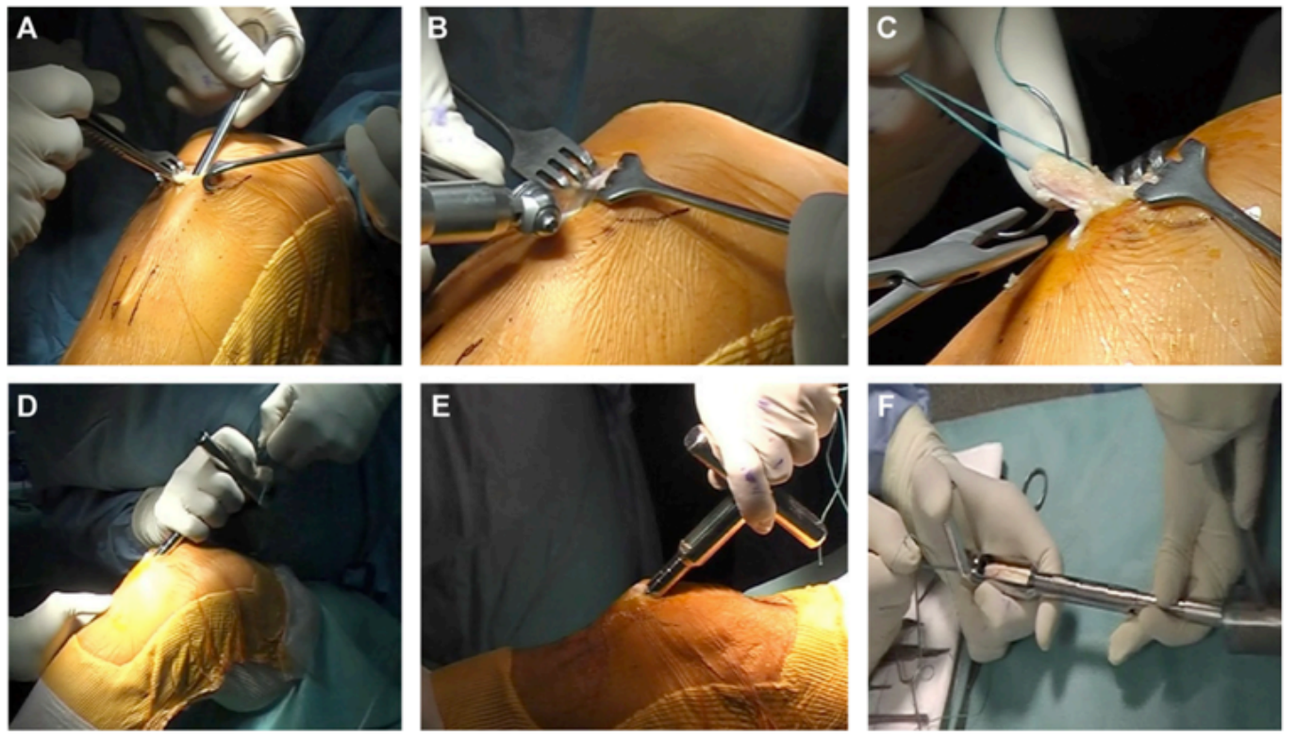
ORIGINAL ARTICLE

Bone-patellar tendon-bone graft via a single minimally-invasive approach versus a classical approach in anterior cruciate ligament reconstruction: A prospective study

A. Ioncu[a], R. Mader[b,*], N. Bonin[c], P.-J. Ternamian[d], D. Dejour[c]



The minimally-invasive technique reduces the risk of cutaneous hypoesthesia. It does not prevent anterior pain related to harvesting the patellar tendon

Arthroscopy, Sports Medicine, and Rehabilitation, Vol 5, No 4 (August), 2023

Minimally Invasive Bone-Patellar Tendon-Bone Graft Harvest Is Associated With Less Frequent Anterior Knee Pain at Rest Than Hamstring Graft Harvest After Anterior Cruciate Ligament Reconstruction at the 1-Year Follow-Up

Panagiotis Sgardelis, M.R.C.S., Gohar Naqvi, F.R.C.S., (Tr&Orth), and Christopher Servant, F.R.C.S. (Tr&Orth)

Purpose: To compare the incidence of postoperative anterior knee pain at rest and during "knee walking" in patients who had anterior cruciate ligament reconstruction (ACLR) surgery with hamstring tendon (HT) grafts versus bone-patellar tendon-bone (BPTB) grafts harvested using a minimally invasive double-incision technique with autografting of the bone harvest defects. **Methods:** Adult patients who had undergone an ACLR and had completed a questionnaire enquiring about anterior knee symptoms at a minimum of 1 year postoperatively were identified. Two groups were compared: 1) patients who had received a BPTB graft harvested using a minimally invasive double-incision technique with autografting of the bone harvest defects, and 2) patients who had received a HT graft. **Results:** A total of 142 adult patients were included: 88 had a BPTB graft and 54 had a HT graft. The prevalence of anterior knee pain at rest was 10% in the BPTB group and 28% in the HT group ($P = .006$). Overall, knee walking scores were worse in the BPTB group when compared to the HG group, but the difference in the proportions of patients who found it impossible to knee-walk was not statistically significant (17% vs 6%; $P = .069$). **Conclusions:** Our results showed that pain at rest was less in the BTPB group compared to the HT group contradicting historic literature. In addition, there was no statistically significant difference between the 2 grafts when comparing the proportion of patients who found it "impossible" to knee-walk. **Level of Evidence:** Level III, retrospective comparative study.

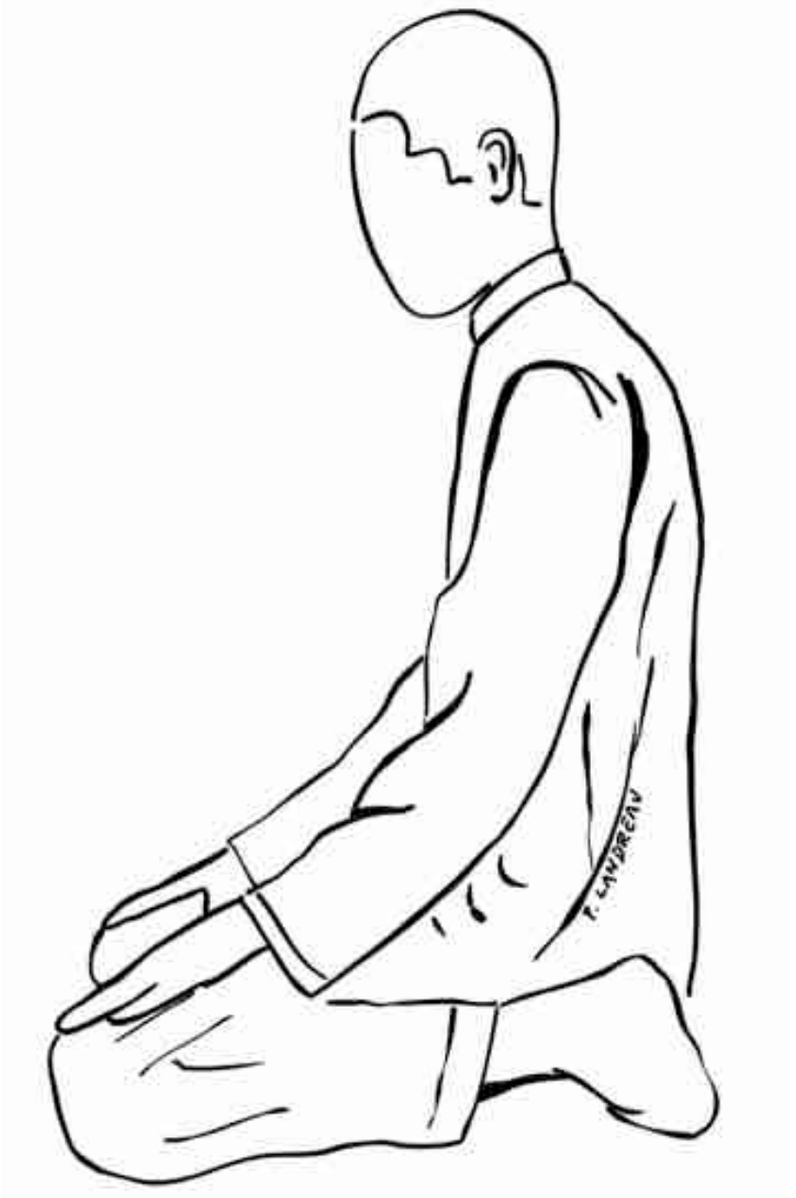


1. "No statistically significant difference between the 2 grafts when comparing the proportion of patients who found it"impossible" to knee-walk"

2. "Pain at rest was less in the BTPB group compared to the HT group contradicting historic literature"

Experience?

- 50 BTB / 50 Hamstrings grafts
- No difference in return to prayer between the two techniques: 4 to 6 months



Personal unpublished data

Conclusion

- The **BTB graft should not be excluded** due to the potential risk of anterior knee pain.

- There are **minimally invasive solutions available to reduce this risk**.

- Therefore, the BTB graft should remain **one of the graft options**, both for **primary** reconstructions and in the context of ACL **revision** techniques.

BTB is still a very good graft!

