

Case Report

Tourniquet-Free Knee Arthroscopy in a Patient with Clinical Features Suggestive of Klippel–Trénaunay Syndrome: A Case Report

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ABSTRACT

Klippel–Trénaunay syndrome (KTS) and related venous malformation disorders may complicate lower-extremity surgery because of abnormal venous circulation and the potential risks of bleeding and thromboembolic events. We report the case of a 43-year-old man with chronic left knee pain and lifelong enlargement and cyanotic discoloration of the affected lower extremity. Magnetic resonance imaging demonstrated a medial femoral condyle osteochondral lesion, a longitudinal tear of the posterior horn of the medial meniscus, a suprapatellar plica, and multiple dilated periarticular venous structures. Doppler ultrasonography showed a patent deep venous system without thrombosis but marked superficial venous dilatation and great saphenous vein reflux. Following vascular surgical evaluation, the clinical findings were considered suggestive of the KTS spectrum. Knee arthroscopy was therefore performed without pneumatic tourniquet inflation. Adequate visualization was maintained using gravity-assisted irrigation and meticulous radiofrequency hemostasis. The medial meniscal tear was repaired, the osteochondral lesion was treated with debridement and microfracture, and the suprapatellar plica was resected. No intraoperative or postoperative vascular or orthopedic complications occurred. At 6 months, the patient had regained full knee motion with substantial symptomatic improvement. This case suggests that tourniquet-free knee arthroscopy may be a feasible option for carefully selected patients with suspected venous malformations, provided appropriate preoperative vascular assessment and meticulous intraoperative hemostasis are employed.

Keywords: Klippel–Trénaunay syndrome, venous malformation, knee arthroscopy, tourniquet-free surgery, meniscal repair, osteochondral lesion.

INTRODUCTION

Knee arthroscopy is a minimally invasive orthopedic surgical procedure widely used for the diagnosis and treatment of various intra-articular knee pathologies, including meniscal tears, chondral lesions, and synovial disorders.^[1] Pneumatic tourniquets are frequently used during arthroscopic knee surgery to improve visualization and reduce intra-articular bleeding.^[2] However, tourniquet use has been associated with several potential risks, including venous stasis, muscle and nerve injury, and thromboembolic complications.^[3]

Chronic venous insufficiency and congenital vascular malformations are clinical conditions that may present with venous dilation, limb hypertrophy, and skin discoloration of the lower extremities.^[4] Among these conditions, Klippel–Trénaunay syndrome (KTS) is a rare congenital vascular malformation characterized by the triad of capillary malformations, venous varicosities,



Cite this article as:

Kaya O, Yavuz T. Tourniquet-Free Knee Arthroscopy in a Patient with Clinical Features Suggestive of Klippel–Trénaunay Syndrome: A Case Report. Sports Traumatol Arthrosc 2026;3(2):81–87.

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Submitted: 18.03.2026

Revised: 21.04.2026

Accepted: 24.04.2026

Available Online: 27.08.2026

Sports Traumatology & Arthroscopy –
Available online at www.stajournal.com

and soft tissue or bone hypertrophy of the affected limb.^[5] Owing to abnormal venous circulation and vascular structures, surgical procedures involving the lower extremities in these patients require careful preoperative planning and individualized surgical strategies.^[6]

In this report, we present a case of tourniquet-free knee arthroscopy performed in a patient with clinical findings suggestive of the Klippel–Trénaunay syndrome spectrum.

CASE REPORT

A 43-year-old male patient presented to our clinic with left knee pain that had persisted for approximately 1 year. His symptoms included limping while walking, difficulty with knee flexion, and pain during knee extension. The patient reported that discoloration and an increased circumference of the affected leg had been present since childhood. Additionally, he had undergone endovenous laser ablation for varicose veins approximately 2 years earlier. The patient was not receiving any regular medical treatment.

The patient had previously been evaluated at another center, where arthroscopic knee surgery had been recommended. However, the procedure was canceled intraoperatively after marked swelling and discoloration of the lower extremity were observed, and the patient was subsequently referred to our clinic for further evaluation.

Physical examination revealed no obvious deformity of the knee joint. However, the affected lower extremity demonstrated a noticeably larger circumference than the contralateral side, accompanied by cyanotic discoloration, particularly in the foot and crural regions (Fig. 1).

Circumference measurements obtained from standard anatomical landmarks showed:

- Mid-thigh: 57 cm (left) vs 50 cm (right)
- Knee level: 44 cm (left) vs 39 cm (right)
- Mid-calf: 39 cm (left) vs 34 cm (right)

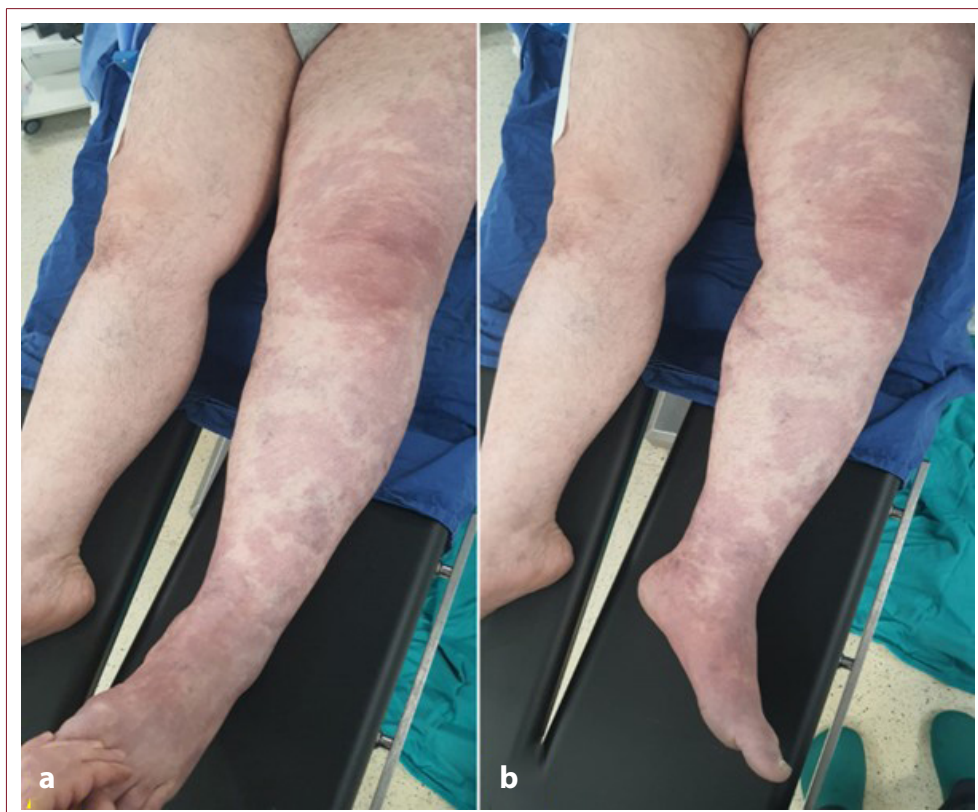


Figure 1. Preoperative clinical photographs of the affected lower extremity. **(a)** Anterior view of the left lower extremity demonstrating increased circumference, diffuse violaceous discoloration, and patchy vascular changes extending to the dorsum of the foot. **(b)** Bilateral comparison showing asymmetry in limb circumference and cutaneous vascular changes suggestive of a venous malformation spectrum.

Elevation of the limb resulted in a noticeable reduction in skin discoloration. No palpable venous masses were detected, and no limb-length discrepancy was observed.

Knee examination revealed a preserved range of motion, although pain was present, particularly during flexion. The suprapatellar ballottement test was positive. Medial joint-line tenderness was present, and the McMurray test was positive.

Plain radiographs of the knee demonstrated no osseous pathology (Fig. 2).

Magnetic resonance imaging (MRI) of the knee demonstrated cartilage irregularity compatible with an osteochondral lesion on the weight-bearing surface of the medial femoral condyle, accompanied by subchondral bone marrow edema. The lesion was estimated to measure approximately 1.5–2 cm in diameter. A band-like structure compatible with a suprapatellar synovial plica was also observed. Additionally, a longitudinal tear of the posterior horn of the medial meniscus was detected. Multiple dilated, serpiginous venous structures were noted within the subcutaneous tissues around the knee joint (Fig. 3).

Color Doppler ultrasonography performed to evaluate the venous system of the lower extremity demonstrated a patent deep venous system without evidence of thrombosis. Marked dilation of the superficial venous structures and reflux within the great saphenous vein were detected. These findings

were consistent with chronic superficial venous insufficiency. Following consultation with the vascular surgery department, the patient's clinical presentation was considered suspicious for the Klippel–Trénaunay syndrome spectrum. Advanced venous imaging was not performed because Doppler ultrasonography demonstrated a patent deep venous system, and the vascular surgery team did not recommend further investigation.

Based on the preoperative evaluation, arthroscopic knee surgery was planned.

Surgical Technique

The patient was placed in the supine position under spinal anesthesia. A pneumatic tourniquet was placed proximally on the lower extremity; however, owing to the existing venous pathology, the procedure was performed without inflating the tourniquet. The knee was positioned at approximately 90° of flexion, and a lateral post was used.

Arthroscopic evaluation was performed using a 30° arthroscope through standard anterolateral and anteromedial portals. Joint irrigation was performed using normal saline delivered via a gravity-flow system, with a total irrigation volume of approximately 6,000 mL. The total operative time, defined as the duration from the initial incision to wound closure, was 36 minutes. Despite the absence of tourniquet inflation, satisfactory visualization was maintained throughout



Figure 2. Preoperative knee radiographs of the affected limb. **(a)** Anteroposterior view demonstrating preserved joint alignment without apparent osseous abnormality. **(b)** Lateral view showing intact joint architecture without signs of fracture or advanced degenerative changes.

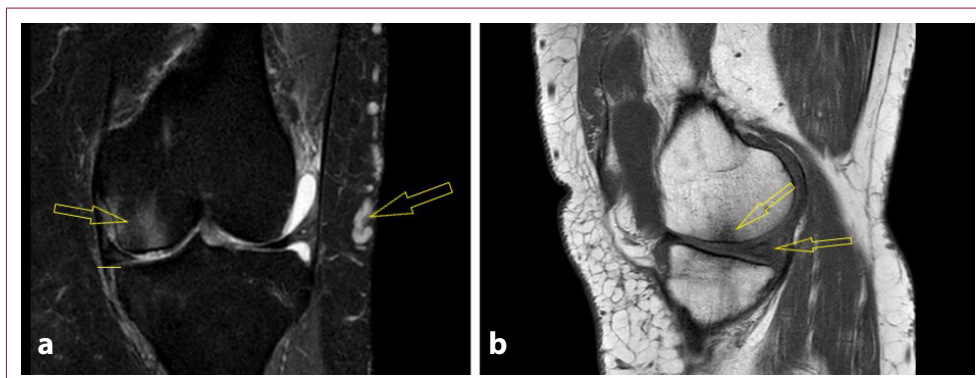


Figure 3. Magnetic resonance imaging of the knee. **(a)** Coronal fat-suppressed image demonstrating an osteochondral lesion with subchondral bone marrow edema on the weight-bearing surface of the medial femoral condyle (arrow), medial meniscal extrusion (line), and multiple dilated serpiginous venous structures within the periarticular soft tissues suggestive of a venous malformation (arrow). **(b)** Sagittal image demonstrating an osteochondral lesion of the medial femoral condyle (arrow) and a longitudinal tear of the posterior horn of the medial meniscus (arrow).

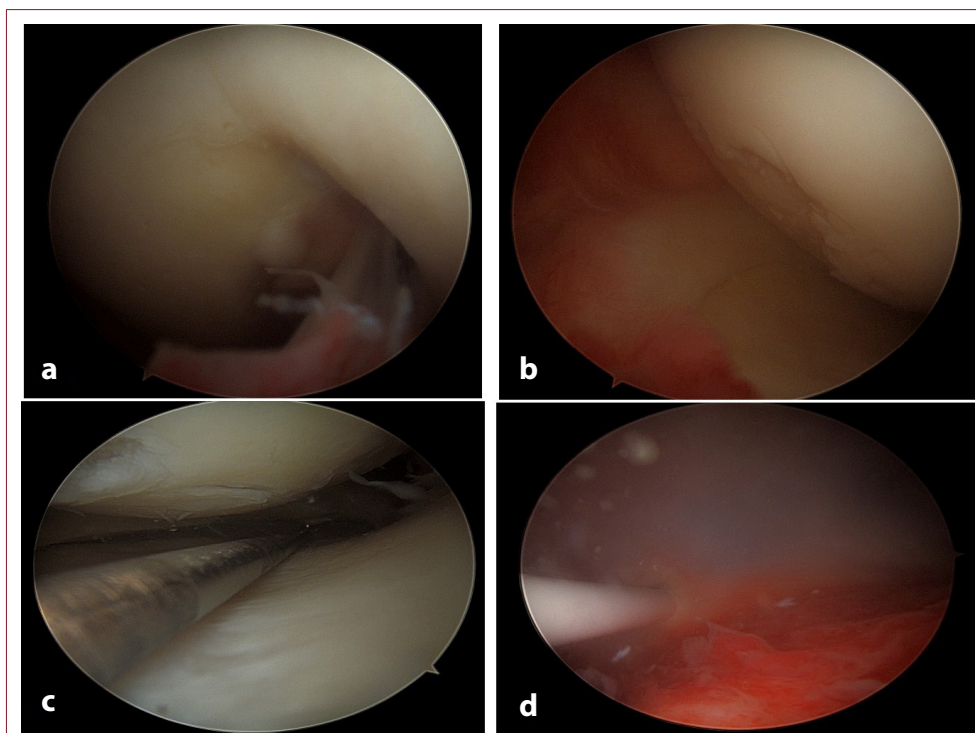


Figure 4. Arthroscopic findings during knee arthroscopy. **(a)** Initial diagnostic arthroscopic view demonstrating the ligamentum mucosum (infrapatellar plica). **(b)** Osteochondral lesion located on the weight-bearing surface of the medial femoral condyle. **(c)** Probe confirming a vertical longitudinal tear of the posterior horn of the medial meniscus in the red-red zone. **(d)** Arthroscopic appearance of a complete suprapatellar plica.

the procedure through continuous irrigation and meticulous hemostasis using radiofrequency coagulation when necessary.

Arthroscopic examination initially demonstrated the ligamentum mucosum (infrapatellar plica) (Fig. 4a). An Outerbridge grade III osteochondral lesion measuring approximately 2×2 cm was identified on the weight-bearing surface of the medial femoral condyle (Fig. 4b). Additionally, a vertical longitudinal tear of the posterior horn of the medial meniscus located in the red-red zone was observed (Fig. 4c), together with a complete suprapatellar plica (Fig. 4d).

The meniscal tear was first repaired using an all-inside technique (Fig. 5a). The osteochondral lesion was then debrided, and microfracture was performed by creating perforations approximately 3–4 mm apart in the subchondral bone using a microfracture awl (Fig. 5b). Following microfracture, bleeding and the release of bone marrow elements from the subchondral bone were observed. The suprapatellar plica was resected using a radiofrequency probe and shaver (Fig. 5c).

No intraoperative complications occurred.

Postoperative Follow-up

Postoperatively, the patient was mobilized using crutches without weight-bearing on the operated extremity for 4 weeks. Knee range-of-motion exercises were initiated early in the postoperative period. Partial weight-bearing was allowed in the fourth postoperative week, and full weight-bearing was permitted at approximately 6 weeks.

For deep vein thrombosis prophylaxis, low-molecular-weight heparin was administered for 4 weeks, and the patient was advised to wear anti-embolism stockings for 45 days.

At the 6-month follow-up, the patient demonstrated a full range of knee motion and reported a significant reduction in knee pain. No venous or orthopedic complications were observed during follow-up.

DISCUSSION

Lower extremity surgical procedures in patients with venous malformations or Klippel–Trénaunay syndrome (KTS) spectrum may present significant challenges in surgical planning.^[7] Abnormal venous circulation in these patients may increase

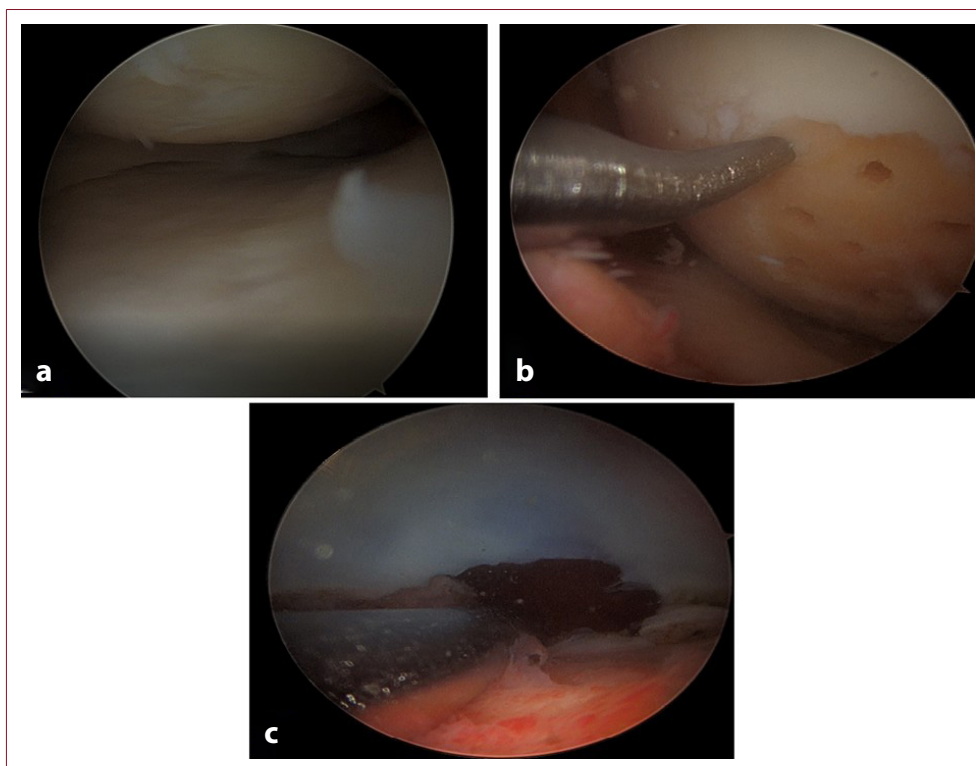


Figure 5. Arthroscopic images demonstrating the surgical procedures. **(a)** Medial meniscus after arthroscopic repair, showing restoration of the meniscal contour. **(b)** Microfracture of the osteochondral lesion using a microfracture awl. **(c)** Resection of the suprapatellar plica using a shaver.

the risks of intraoperative bleeding and thromboembolic complications.

Klippel–Trénaunay syndrome is a rare congenital vascular malformation characterized by the classic triad of capillary malformations, venous varicosities, and limb hypertrophy.^[8] However, the clinical presentation may vary considerably among patients, and the complete triad is not always present simultaneously.^[9] Therefore, the diagnosis is often established based on a comprehensive evaluation of clinical findings and imaging studies.

The use of a pneumatic tourniquet during arthroscopic knee surgery is commonly preferred to improve visualization and reduce intra-articular bleeding.^[2] However, tourniquet use has been associated with several potential complications, including venous stasis, muscle and nerve injury, and thromboembolic events.^[3] In patients with underlying venous circulation disorders, tourniquet inflation may theoretically exacerbate venous congestion and increase the risk of thromboembolic complications.^[10]

The management of patients with venous malformations or those within the KTS spectrum who undergo lower extremity surgery requires careful consideration of tourniquet use. Barbara et al.^[11] reviewed 136 anesthetic procedures in patients with KTS and reported that tourniquet application did not consistently prevent substantial intraoperative blood loss, highlighting the variability of hemostatic responses in this population. Gloviczki et al.^[12] emphasized that although tourniquet use may help reduce intraoperative bleeding in selected cases, the presence of abnormal venous anatomy and potential coagulation disturbances necessitates individualized surgical planning and a multidisciplinary approach. Furthermore, Catre et al.^[13] reported a case of total knee arthroplasty in a patient with KTS in which significant intraoperative challenges, including synovial hyperplasia, vascular engorgement, and increased bleeding, were encountered despite tourniquet use, although satisfactory hemostasis was ultimately achieved.

Several studies have suggested that knee arthroscopy can be performed without tourniquet inflation without compromising visualization or operative time. Kirkley et al.^[14] reported no significant differences in functional outcomes or operative time between the tourniquet and non-tourniquet groups in a prospective randomized trial of routine knee arthroscopy. Similarly, a meta-analysis by Zhang et al.^[15] involving 471 patients found no significant differences in visualization or operative time between the two groups, suggesting that routine tourniquet use may not be necessary in knee arthroscopy.

Taken together, these findings suggest that tourniquet use in patients with venous malformations or within the KTS spectrum may not always ensure optimal hemostatic control. Therefore, alternative strategies, such as a tourniquet-free approach, may be considered in carefully selected patients; however, further evidence is needed to support its routine use.

In the present case, arthroscopic knee surgery was successfully performed without tourniquet inflation, and intra-articular bleeding did not compromise surgical visualization. Adequate visualization was maintained through continuous irrigation and careful hemostasis. Although this observation suggests that tourniquet-free arthroscopic knee surgery may be feasible in selected patients with venous pathology, the findings should be interpreted with caution given the single-case design.

A further limitation of this report is the absence of an objective assessment of intraoperative visualization quality. Visualization was assessed subjectively by the operating surgeon, and no validated scoring system was used. The use of standardized and objective measures in future studies would allow for a more rigorous evaluation of the tourniquet-free approach.

In addition, the absence of advanced vascular imaging may limit the precise characterization of the underlying vascular anomaly. Furthermore, the findings of this report are based on a single case and therefore may not be generalizable to broader patient populations.

CONCLUSION

This case suggests that arthroscopic knee surgery may be performed without tourniquet inflation in a patient with a suspected venous malformation spectrum when careful preoperative evaluation and meticulous intraoperative hemostasis are ensured. However, these findings should be interpreted with caution given the single-case design and the absence of a definitive diagnosis of Klippel–Trénaunay syndrome. Tourniquet-free knee arthroscopy may represent a potential surgical option in carefully selected patients; however, its safety and feasibility require further validation in larger case series. Accordingly, the findings of this report should be considered hypothesis-generating, and further studies involving larger patient populations are needed to better define the clinical applicability of this approach.

DECLARATIONS

Ethics Committee Approval: This is a case report, and therefore ethics committee approval was not required in accordance with institutional policies.

Informed Consent: Informed consent was obtained from the patient for publication of this case report and accompanying clinical images.

Conflict of Interest: The authors declared no conflict of interest.

Financial Disclosure: The authors declared that they have no relevant or material financial interests that relate to the research described in this paper.

Funding Disclosure: No funding was received for this study.

Data Availability Statement: Data are available from the corresponding author upon reasonable request.

Use of AI for Writing Assistance: The authors declared that they did not use any generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

Author Contributions: Concept – OK; Design – OK; Supervision – OK; Resource – OK; Data Collection and/or Processing – OK, TY; Analysis and/or Interpretation – OK, TY; Literature Search – OK; Writing – OK, TY; Critical Reviews – OK. All authors have read and agreed to the published version of the manuscript.

Peer-review: Externally peer-reviewed.

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