

Case Report

Tourniquet-Induced Tibial Nerve Palsy Complicating Anterior Cruciate Ligament Reconstruction

Carlos A. Guanche, M.D.

Summary: In this case report, an unremarkable anterior cruciate ligament reconstruction is complicated by a tourniquet-induced tibial nerve palsy. The case underscores the necessity of being aware of the potential for complications associated with tourniquets, despite following recommended guidelines of tourniquet time and pressure. **Key Words:** Complications—Tourniquet palsy—Anterior cruciate ligament.

Neurological injuries may result from prolonged tourniquet use. These are well documented in the orthopaedic literature.¹⁻³ Exceeding recommended inflation time and pressure is known to be detrimental to both nerve function and the musculature below applied tourniquets. Specific injuries reported have included weakness and permanent electromyographic changes in the quadriceps musculature^{2,4,5} along with injuries to the sciatic nerve divisions.¹ However, no specific case report has addressed a palsy of the tibial nerve associated with tourniquet use. This report details a patient who underwent an uncomplicated anterior cruciate ligament reconstruction and awoke with a complete tibial nerve palsy in the operated extremity.

CASE REPORT

A 32-year-old, previously healthy woman underwent an anterior cruciate ligament reconstruction using a central one-third patellar tendon autograft. An all

endoscopic technique was employed for the reconstruction. The patient was of normal build, with a height of 169 cm and weight of 63 kg. During the procedure, a high thigh tourniquet was used. The tourniquet was a 9.5-cm circumference by 85-cm (34-in) length tourniquet, inflated at 300 mm Hg and maintained for a period of 110 minutes. The equipment was powered by a MediQuet tourniquet (Depuy Corp, Warsaw, IN), which was calibrated 10 days previously.

An arthroscopic fluid delivery pump was used during the procedure (Low-Pressure Irrigation System; Linvatec Corp, Largo, FL). The fluid pump was maintained at the 90 mm Hg level throughout the entire procedure. An arthroscopic leg holder was used (Arthroscopic Knee Platform; Linvatec Corp). No complications or unusual circumstances were encountered at the time of the surgery. No perforation of the posterior capsule occurred during the arthroscopic procedure.

On examination in the recovery room, a complete palsy of the tibial nerve was present in the operated extremity. The functions of foot inversion, plantar flexion, and toe flexion were 0/5. Sensory examination showed anesthesia of the plantar aspect of the foot and the medial aspect of the ankle. No deep tendon reflex of the tendoachilles could be elicited. No other neurological abnormalities were present in the involved extremity. Radiographic examination of the knee showed appropriate position of the femoral and tibial interference screws (Fig 1).

From the Department of Orthopaedic Surgery, Louisiana State University School of Medicine, New Orleans, Louisiana, U.S.A.

Address correspondence and reprint requests to Carlos A. Guanche, M.D., Department of Orthopaedic Surgery, Louisiana State University, 2025 Gravier St, Suite 400, New Orleans, LA 70112, U.S.A.

© 1995 by the Arthroscopy Association of North America
0749-8063/95/1105-1286\$3.00/0

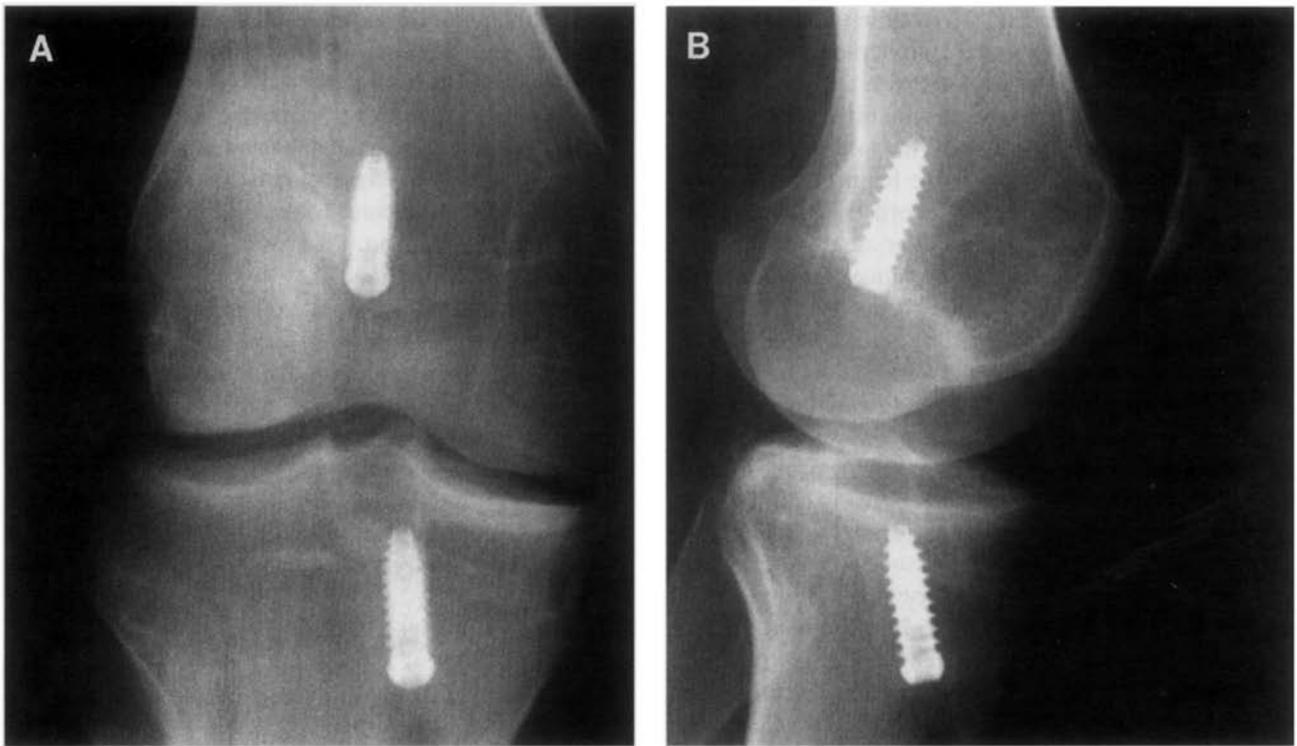


FIG 1. Postoperative radiographs following anterior cruciate ligament reconstruction. (A) Anteroposterior view, (B) lateral view.

Management consisted of observation for approximately 1 week. Examination 1 week later revealed a large ecchymotic area along the posterior mid-thigh, immediately below the previously applied tourniquet. Electromyography (EMG) and nerve conduction studies were performed 10 days postoperatively. The examination showed a conduction velocity in the tibial nerve of 23 m/s (normal 40 to 60 m/s) from the gluteal area to the popliteal fossa. A conduction velocity of 43.0 m/s was noted in the tibial nerve from the popliteal fossa to the ankle. Posterior tibial EMG revealed fibrillation potentials and positive F waves. The findings were consistent with a tibial neuropathy with evidence of mild axonal loss. No further intervention was recommended at this time other than a course of physical therapy to maintain passive foot and ankle range of motion.

Reevaluation at 6 months postoperatively revealed clinical improvement. There was approximately 2 cm of gastrocnemius atrophy compared with the normal extremity. Plantar flexion strength and foot inversion were graded 4\5, and toe flexion strength was graded 3\5. Sensation of the plantar aspect of the foot was subjectively decreased with pin-pricking eliciting pain. A positive Tinel's sign was present over the postero-

medial mid-leg. Overall, function of the tibial nerve was felt to be improving, with expected resolution of the neuropathy over the ensuing 6 to 8 months. Repeat electromyography will be performed 1 year after the injury.

DISCUSSION

The pathology of tourniquet-induced injuries is a basis for debate. Basic science studies have indicated that mechanical damage to the nerve is a source of injury.^{2,5,6} Others have proposed a vascular etiology.¹ Two studies evaluating tourniquet-induced EMG abnormalities have generated contradictory results. One showed more abnormalities in the group of patients using tourniquets,⁷ whereas another showed more abnormalities in those not using these devices.⁸

Whatever the cause of the injuries associated with their use, there is certainly no debate that prolonged tourniquet-induced ischemia caused by excessive application time, extreme pressure, or both, provoke significant complications.^{1-4,7,8} Two theories are available to explain what may occur with tourniquet application.¹

The first theory addresses leg shape. In most persons, the thigh is shaped more like a cone than a true

cylinder. Most commercially available tourniquets are made to fit perfectly around a cylinder and not a cone. It is conceivable that in persons with a slightly more cone-shaped thigh, the pressures are different over the proximal and distal aspects of the tourniquets. The thicker, more proximal part of the leg may experience higher pressure than is being recorded because more stress is concentrated over a smaller area. Conversely, the more distal aspect of the tourniquet may generate less pressure on the musculature beneath it.

The second theory espoused by Rorabeck and Kennedy¹ is that of calibration error. Evaluation of the pressure produced versus the reading obtained from the devices has shown as much as 40% variation. The older model tourniquet systems available at most hospitals do not calibrate themselves. Weekly calibrations of these instruments should be performed to assure that appropriate pressures are being used.¹

Finally, constant monitoring of the tourniquet devices is not routinely carried out. Intraoperative variation of the pressures experienced by the leg are difficult to account for and are usually not documented. No constant observation of the experienced pressures is routinely undertaken. This variability may cause excessive pressures for a portion of the operative procedure, leading to a tourniquet palsy.

In this case, the most unusual finding is that of the tibial nerve palsy as opposed to the peroneal nerve. In their study, Rorabeck and Kennedy found that the lateral division of the sciatic nerve was more likely to be injured with tourniquet use. In their five patients, all had injury to the lateral division of the sciatic and only one of the five had a significant tibial nerve deficit. The variability in this case is difficult to explain since no unusual steps were taken in the procedure to increase the likelihood of injury to the tibial nerve. Additionally, the cause of the tibial nerve palsy is not clear cut. In view of the large ecchymotic area that developed immediately distal to the tourniquet application site, and the EMG findings, the tourniquet must be implicated in the injury.

Of paramount importance in this case is that during a tourniquet time of only 100 minutes, and at a pressure of 300 mm Hg, such a devastating injury did occur. This points, perhaps, to a reconsideration of tourniquet use in general. One study, evaluating knee arthrotomies, found only a minimally increased operative time and no other significant difficulties in performing the arthrotomies with no tourniquet versus those performed with a tourniquet.³

A review of the literature, and this case in particular, points to the need to reevaluate the routine use of tourniquets. With regards to the knee, current technology using both fluid delivery pumps and hypotensive anesthesia may allow for the discontinuation of the use of these devices for most procedures.⁹ This may eliminate an additional variable from the equation of surgical complications, allowing a further refinement in arthroscopic surgical technique.

REFERENCES

1. Rorabeck CH, Kennedy JC. Tourniquet-induced nerve ischemia complicating knee ligament surgery. *Am J Sports Med* 1980;8:98-102.
2. Saunders KC, Louis DL, Weingarden SI, Waylonis GW. Effect of tourniquet time on postoperative quadriceps function. *Clin Orthop Rel Res* 1979;143:194-199.
3. Kieser C. A review of the complications of arthroscopic knee surgery. *Arthroscopy* 1992;8:79-83.
4. Ochoa J, Fowler TJ, Gilliatt RW. Anatomical changes in peripheral nerves compressed by a pneumatic tourniquet. *J Anat* 1972;113:433-455.
5. Gutin B, Warren RF, Wickiewicz T, O'Brien S, Altchek D, Kroll M. Does tourniquet use during anterior cruciate ligament surgery interfere with postsurgical recovery of function? A review of the literature. *Arthroscopy* 1991;7:52-56.
6. Nitz A, Matulionis D. Ultrastructural changes in rat peripheral nerve following pneumatic tourniquet compression. *J Neurosurg* 1982;57:660-666.
7. Dobner JJ, Nitz AJ. Postmeniscectomy tourniquet palsy and functional sequelae. *Am J Sports Med* 1982;10:211-214.
8. Thorblad J, Ekstrand J, Hamberg P, Gillquist J. Muscle rehabilitation after arthroscopic meniscectomy with or without tourniquet control. *Am J Sports Med* 1985;13:133-135.
9. Spindler KP, Bergfeld JA, Andrich JT. Intraoperative complications of ACL surgery: Avoidance and management. *Orthopedics* 1993;16:425-430.