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### Inter-surgeon variation in skin incisions for tibial nailing in relation to the infrapatellar nerve

A.L.A. Kerver[b,*], M. Leliveld[a], H.P. Theeuwes[b], M.H.J. Verhofstad[a], G.J. Kleinrensink[b]

[a] *St. Elisabeth Hospital, Department of Surgery, Tilburg, The Netherlands*
[b] *Department of Neuroscience-Anatomy, Erasmus University Medical Center, Rotterdam, The Netherlands*

*Introduction:* Intramedullary nailing of the tibia has become the standard therapy for tibial shaft fractures. One of the most common complaints after this procedure is chronic anterior knee pain. This phenomenon is not yet elucidated, but might be associated with iatrogenic injury to the infrapatellar nerve. Damage of this nerve causes sensory disturbances in its area of distribution and also neuroma formation has been described. Although various surgical approaches of the entry point in the proximal tibia have been proposed, no consensus exists regarding the surgical-anatomical landmarks for a safe approach of the medullary canal.

*Objective:* To visualize the inter-surgeon variation in skin incisions for tibial nailing and to map the surgical anatomy of the infrapatellar nerve.

*Materials and methods:* Dutch trauma surgeons and residents ($n = 16$) were asked to draw an incision for tibial nailing on different embalmed human knees. Incision placement was expressed in relation to these anatomical landmarks: the upper and lower edge of the patella, the tibial tubercle and the medial and lateral edge of the proximal tibia (Fig. 1). Finally, the infrapatellar nerves of ten different cadaver knees were dissected and marked. All knees were digitally photographed and analysed using Computer Assisted Surgical Anatomy Mapping (CASAM), a new software tool that is able to depict all drawn incisions and all dissected infrapatellar nerves on real cadaver legs into one computed leg with standard dimensions.

*Results:* On average trauma surgeons performed 5 (0–15) tibial nailing procedures per year and had 4.7 (0–16) years of experience. Form and place of the incisions were highly variable. Surgeons that performed five or more procedures per year mainly made a central incision whilst surgeons that performed less than five approaches per year showed more variation in incision placement (Fig. 1.1). The variation in the topographic anatomy of the infrapatellar nerve was high, but it was mainly located medial of the patella and patellar tendon. Branching of the nerve occurred caudal to the patella and far most branches crossed the patellar tendon. Of 16 incisions drawn, only the lateral incision ($n = 1$) would not have damaged an infrapatellar nerve branch. In the central incisions ($n = 10$) and mainly in the medial incisions ($n = 5$) the dissected infrapatellar nerves would have been at risk for transsection (Fig. 1.2).

*Conclusions*: The variation between surgeons of the skin incision for tibial nailing appears highly variable. The infrapatellar nerve is at risk for iatrogenic damage in all vertical incisions except if performed lateral to the patella tendon. Oblique or horizontal approaches seem good alternatives to prevent iatrogenic nerve injury.

doi:10.1016/j.injury.2010.07.456

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### Infrapatellar nerve damage, a possible cause for chronic anterior knee pain after tibial nailing?

M. Leliveld*, M. Verhofstad

*Department of Surgery, St. Elisabeth Hospital Tilburg, The Netherlands*

*Introduction*: Intramedullary nailing of the tibia has become the conventional therapy for tibial shaft fractures. One of the most common complaints associated with this procedure is chronic anterior knee pain. Surgical damage to the infrapatellar nerve is one possible causative factor for post-nailing knee pain. The infrapatellar nerve is exclusively sensory and runs subcutaneously almost perpendicular to the patellar tendon. The purpose of this study was to determine the prevalence of chronic knee pain after tibial nailing in our institute and its relation with sensory disturbances at the nail entry site.

*Material and methods*: A chart review was conducted. All patients between 15 and 65 years with healed traumatic tibial shaft fractures treated with an intramedullary nail between 1998 and 2008 were included. Exclusion criteria were: fracture lines extending into the knee or ankle joint, any other fracture in the affected leg,

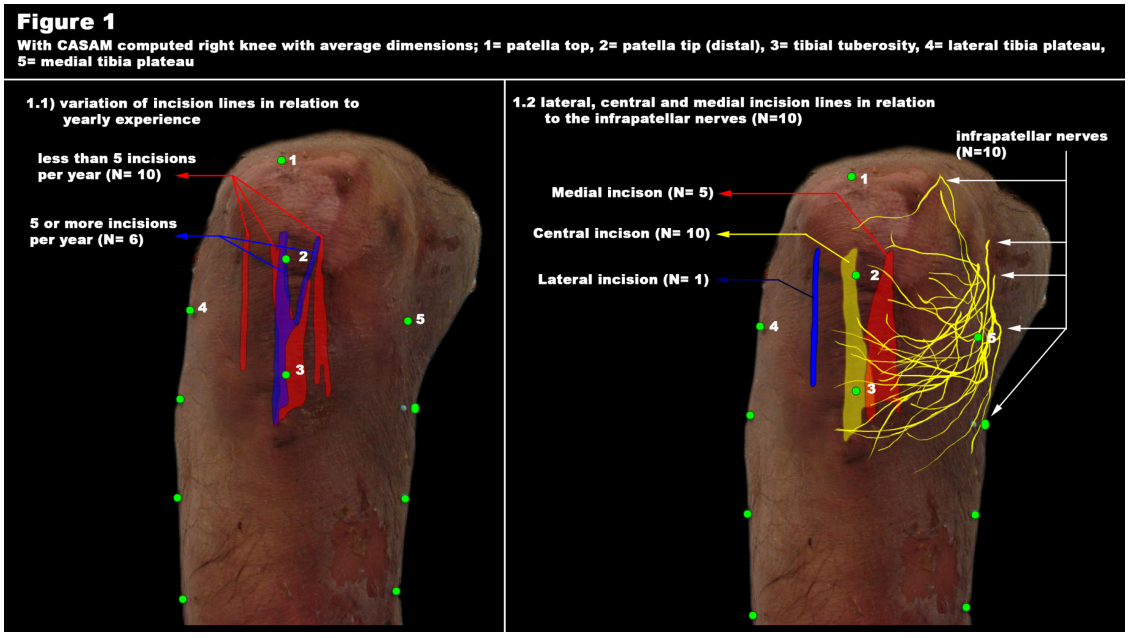


**Fig. 1.**

lacerations in the knee area, pre-operatively existing knee pain and loss of follow-up. Chronic knee pain was defined as persisting pain in the knee area 6 months after tibial nailing. Sensory disturbances were defined as hyperesthesia or anesthesia at the nail entry site.

*Results*: 97 patients (99 fractures) were included. 29 patients mentioned knee pain >6 months after initial surgery. Patients with chronic knee pain were compared with patients without chronic knee pain. A significant number of patients with chronic knee pain experienced sensory disturbances at the nail entry site prior to developing chronic knee pain ($p < 0.05$). Follow up of the chronic knee pain group was significantly longer ($p < 0.05$) and more tibial nails were removed in this group ($p < 0.05$). Odds to develop chronic knee pain were found to be 4.3 times higher for patients with sensory disturbances compared with those without sensory disturbances (95% CI 1.1–16.5, $p < 0.05$).

*Conclusion*: 29.3% of the patients in our study population experienced chronic knee pain. Due to the retrospective character of this study the possibility exists more patients suffered from chronic knee pain than noted. Because sensory loss in the knee area might not be of much concern to some patients, the percentage of patients with sensory disturbances might be higher in both groups. However, the data as presented here, indicate sensory disturbances as predictive factor for chronic knee pain. These sensory disturbances may suggest damage of the infrapatellar nerve which is at great risk to be transsected during tibial nail placement. Based on the current results, a prospective study on infrapatellar nerve damage after tibial nailing is conducted.

doi:10.1016/j.injury.2010.07.457

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## Evaluation of delay in operative fixation and outcome of closed ankle fractures

Michelle Spiteri*, Massimo Abela

*Mater Dei Hospital, Malta*

*Aim*: To evaluate the relationship between delay in operative fixation and outcome of closed ankle fractures.

*Method*: Retrospective study of patients admitted acutely with closed ankle fractures requiring internal fracture fixation in 2008. Data collection including age, co-morbidities, mechanism of injury, timing of surgery and complications were obtained. Radiographs were reviewed for fracture classification.

*Results*: 88 patients underwent surgery between January and December 2008. 11 patients were excluded from the study due to unavailable records. The average age of injury was 38.5 years (range: 12–86 years), with a 1:1 male to female ratio. 12.6% of patients were diabetic, and 23% were smokers. The mechanism of injury varied from slipping whilst walking (30%) to road traffic accidents. Bimalleolar fractures were the commonest type of fracture. All fracture dislocations were reduced on site or on entering the accident and emergency department. 70% of patients underwent surgery within 48 h of the injury (range 4–300 h). 8.7% of operations were postponed due to blistering secondary to severe soft tissue swelling or medical problems. Logistic problems, such as lack of theatre time, accounted for the rest. All fractures healed and patients returned to work by 3 months. Stiffness was the most common complication, affecting 15% of patients. These had either bi or trimalleolar fractures and a triplane fracture. Symptoms improved within 3–6 months. Other complications included infection (2.6%), PE and pain.

*Discussion*: 70% of patients underwent surgery within 48 h. All the operations were performed by or under direct supervision of experienced surgeons. Ankle stiffness occurred in patients with bi or trimalleolar fractures and 75% of these were operated within 24 h of the injury. 33% of patients with ankle stiffness had sustained a high energy injury, such as a fall from height, sports injury or road traffic accident. The relationship between joint stiffness and type of fracture and severity of injury is stronger than that with surgical delay. All ankle fractures have an element of swelling. This did not preclude surgery, unless there were blisters. Despite this, only 2 patients developed infection. Both had significant soft tissue trauma; and underwent surgery at 6 and 38 h from the injury. The outcome could be due to the fact that the surgeons or supervising surgeons had years of experience and therefore carefully handled the soft tissues. Thus, surgery does not need to be delayed due to swelling unless this is severe enough to cause blistering.*Conclusion*: Ankle stiffness is mainly associated with the type of fracture and severity of injury. Delay in surgery does not significantly affect complication rate and function. With regards to infection rates, proper and careful soft tissue handling during surgery is more important than delaying surgery due to ankle swelling.

doi:10.1016/j.injury.2010.07.458

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## Complications associated with the use of ilio-sacral screw fixation in posterior pelvic ring injuries

A.J.B. Tasker*, A. Odutola, R. Fox, C. Morrey, A.J. Ward, T.J.S. Chesser

*Pelvic and Acetabular Reconstruction Unit, Frenchay Hospital, North Bristol NHS Trust, Bristol BS16 1LE, United Kingdom*

*Aims*: To assess the complications associated with the use of ilio-sacral screw fixation in posterior pelvic ring injuries.

*Methods*: A retrospective case note review of consecutive patients treated between 1993 and November 2008 was performed. All patients had pre- and post-operative radiograph and CT imaging. Fractures were classified according to the system described by Young and Burgess. Sacral injuries were classified as ilio-sacral joint disruptions or fractures according to Denis (I–III). Percutaneous ilio-sacral screw fixation was performed under C-arm image intensifier guidance. All patients were followed up at yearly intervals with inlet and outlet radiographs.

*Results*: There were 189 patients who underwent percutaneous ilio-sacral joint fixation, with a mean age of 36.7 years (range 13–80). Follow up was achieved in 175 patients (92%) with a mean of 36 months (range 2–113 months). Of the remainder three died, one was repatriated and 10 discharged out of region or failed to return. Mean time from injury to operation was 7 days (range 1–50). 28% of sacral injuries were bilateral and 20% were associated with a concomitant acetabular fracture. 80% sacral injuries were reduced closed. Bilateral fixation was performed in 22% of cases and S2 screws placed in 18% (the remainder having solely S1 fixation). The re-operation rate was 18% (32) due to local complications. Indications included haematoma (1), loss of reduction (3), malreduction (2), S1 nerve root impingement (2), non-union (9) and removal of screws (15) for pain, loosening or infection. One further patient had CT confirmed breach of the S1 foramen but was asymptomatic. In 75% of cases reoperation was within a year of the index procedure.

*Conclusions*: Percutaneous ilio-sacral screw fixation can be technically demanding. Serious complications requiring reoperation are uncommon and iatrogenic nerve injury is rare in experienced hands.

doi:10.1016/j.injury.2010.07.459