University of Fribourg / Faculty of Science and Medicine / Department of Medical and Surgical Specialties

Investigating the vascular supply to medial and lateral femoral condyles and identifying arterial anastomoses

Fatos Ramadani

The Hoffa fracture represents an intra-articular distal femur fracture in the coronal plane. These fractures have been reported to lead to a high risk of developing non-union, malunion, or avascular necrosis. Several studies have proposed different treatment strategies to improve this fracture's healing. The central aspect of these studies has taken into consideration the pattern of the fracture, type of fracture fixation, and approach to the fracture. However, only a few have underlined the vascularity of the distal femur, a significant factor in the healing process of fractures. The aim of this study was to quantitatively determine the vascular intraosseous entry point and to develop a vascular casting technique to investigate the distal femoral blood supply.

In the first part of the study, 43 dried cadaver femora were taken. The distal condyles were subdivided into five areas (anterior and posterior supracondylar, lateral and medial condylar, and intercondylar), and the small vascular foramina of the distal femur were counted. In the second part, ten fresh frozen knees were selected to investigate the distal femur's vascularity. Industrial polyurethane (Soudal™ foam) diluted with acetone was used to fill the arteries of the knees. After the injection, the knees were corroded in a 10% NaOH solution, heated at 30°C. The corrosion process took 20 to 24 hours, and all the surrounding soft tissues subsided, leaving the polyurethane vascular architecture. The distribution of the different-sized arteries was analyzed to understand and improve the healing process of the Hoffa fractures.

The number of vascular entry points goes from 12 on average for the anterior supracondylar area to 24 for the medial condylar area. In the corrosion group, the vascular network around the knee was easily identified as underlying the relation of the vessels to the bone. This process permits distinguishing small arterioles less than 1 mm in diameter.

The main blood supply around the knees arises from the posterior part of the knee. The counting of holes confirms that the main entry points of arteries in the bone remain on the posterior and sides of the knees. The use of polyurethane in vascular casting remains an advantage in representing vascular trees. The properties of the polyurethane show good resistance to breakage, giving a solid vascular architecture around the condyles. The small vessels running into the bone arise from 2 main nutrient vessels, the descending genicular artery, and the superomedial genicular artery. The angles between the arteries and the fracture line may play an essential role in the development of osteonecrosis after a fracture. Furthermore, good knowledge of the vessel's distribution can prevent iatrogenic lesions in treating this fracture. The fixation of a Hoffa fracture is recommended due to the high instability. Using anteroposterior screws gives the least biomechanical stability, but remains the safest approach to the vessels. Posterior access to the fracture and fixation through plate or screws has a high biomechanical stability but puts at risk the vascularity and, in the case of a disruptor, can lead to osteonecrosis.

A better understanding of the 3D architecture of the vascular trees around the knees allows the development of better fixation strategy in Hoffa fracture. These strategies should be investigated in further studies.

Jury:
Prof. Dr. Med. Luis Filgueira (thesis supervisor)
Dr. Med. Hermes Miozzari (external co-examiner)
Dr. Med. Daniel Petek (internal co-examiner)
Prof. Dr. Michael Walch (president of the jury)