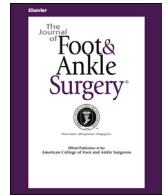




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Case Reports and Series

Custom-Made Total Talonavicular Replacement in a Professional Rock Climber

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ABSTRACT

Professional athletes are often eager to resume sporting activities at preinjury levels. When facing the challenge of restoring joint function after a complex articular fracture, innovative solutions must be explored. We describe the results of what we believe to be the first custom-made talonavicular prosthesis implanted in a professional rock climber who had developed post-traumatic ankle and talonavicular arthritis as sequelae of a complex talar and navicular fracture. Using computed tomography scan reconstruction of the contralateral healthy ankle and direct metal laser sintering, a custom-made talonavicular prosthesis was obtained and implanted using an anteromedial approach. The patient was clinically and radiographically evaluated every 6 months after surgery for 30 months. A 3-dimensional videofluoroscopic analysis was performed to assess the range of motion about the prosthesis. At the last follow-up visit, the functional scores were excellent (Tegner activity scale score of 9 of 10), and he had completely resumed his sporting activity. The American Orthopaedic Foot and Ankle Society score had increased from 36 to 81 points, and no signs of radiolucency were observed on the radiographs. The 3-dimensional videofluoroscopic analysis showed 15° of dorsiflexion and 4° of plantar flexion at the ankle. A customized solution is an option when the patient's expectations are not likely to be met by standard treatment, such as arthrodesis. A custom-made talonavicular prosthesis can be an effective solution for complex ankle injury sequelae in patients demanding high functionality.

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In recent years, the number of people taking up rock climbing has increased, including both professional and recreational athletes of different skills and ages (1,2). Despite progress in the development of safety devices and the increasing use of protective gear to safeguard climbers, every year about 50% to 80% of rock climbers incur injuries related to climbing (1,3). Investigators have analyzed the epidemiology and associated risk factors in rock climbing injuries. The current findings have shown that the distribution between the upper and lower extremity injuries is inconsistent (4). Overuse injuries account for approximately 75% to 93% of climbing injuries in elite climbers, who are particularly vulnerable in their fingers and wrists (2,5). Recreational athletes have shown a wider spectrum of injuries (1). Interestingly, 21% to 29% of fall-related injuries are fractures (2,3), and approximately 50% of these will affect the lower extremities and

about 43% are located in the foot and/or ankle (2,6). Talus fractures are usually the result of high-energy trauma and represent approximately 2% of all lower limb injuries, and about 45% of these are located in the neck of the talus (7,8).

Talar fractures are a challenge for surgeons owing to the relatively high incidence of poor treatment outcomes related to sequelae such as avascular necrosis, malunion, varus union, and decreased function combined with pain and deformity. The high incidence of post-reduction complications is generally related to the fracture location or exposure, the Hawkins classification (9,10), and the quality of the reduction and fixation (11). Although surgical options are controversial, especially in cases of severe injury in which healing complications are likely, immediate reduction and open or closed fixation is the recommended treatment. Talar body avascular necrosis is a complication of talar fractures that commonly results in pain and limitation of ankle motion. Talectomy and arthrodesis have been recommended for some cases of late arthritis or osteonecrosis (12), although these interventions can lead to functional limitations that are incompatible with high levels of physical or weightbearing activity. A potential solution to this condition is the custom-made

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talar prosthesis, which could help to preserve foot and ankle joint function (13).

In the present report, we describe the case of what we believe to be the first custom-made talonavicular prosthesis. This was implanted in a professional rock climber who had been experiencing talar avascular necrosis after talar and navicular fractures that were initially treated with open reduction and internal fixation. The patient signed an informed consent form before the surgical procedure and was also informed about our intent to publish a report of his case, in accordance with our institution's ethics committee guidelines.

Case Report

A 27-year-old male, a professional rock climber, came to us for care in January 2011. In September 2009, after falling while rock climbing, he had sustained talar and navicular fractures that were treated at another institution by open reduction and internal plate and screw fixation. In October 2010, the internal fixation devices were removed, and the patient started a rehabilitation program that included physical exercises, osteopathic manipulation therapy, and electrical stimulation of the skeletal muscles. After 4 months, a structural deformity involving supination and varus of the hindfoot and a 10° fixed equinus of the ankle became evident. This condition was combined with severe pain, loss of function, and marked limitation of ambulation.

Standard radiographic examinations performed 5 months after removal of the internal fixation devices, including anteroposterior and lateral weightbearing views of the ankle, showed severe osteoarthritis of both the ankle and the talonavicular joints, secondary to osteonecrosis of the talus (Figs. 1 and 2).

Before surgery, the patient subjectively rated his foot pain using a 10-cm visual analog scale (14–16), the short-form 36-item health survey (17), the American Orthopaedic Foot and Ankle Society ankle-hindfoot scale (18,19), and the Tegner activity level (20,21). The patient's preoperative scores were as follows: visual analog scale score for pain, 6.5; short-form 36-item health survey physical component score and mental component score, 35.4 and 36.0 points, respectively (below average); American Orthopaedic Foot and Ankle Society hindfoot-ankle scale score, 36; and Tegner activity level, 5. After considering the patient's expectations in terms of functional outcome, we decided to undertake surgical implantation of a custom-built total talonavicular replacement prosthesis to maintain the hindfoot and ankle structure and restore as much movement as possible. For this purpose, bilateral foot and ankle computed tomography scans were obtained and used to manufacture the prosthesis in 2 separate phases (Sintac srl, Biomedical Engineering, Trento, Italy). First, from the computed tomography scans of the contralateral foot and ankle, a volume rendering was obtained. The shape of the required prosthesis was then designed to reconstruct the missing bones to fit the



Fig. 1. Preoperative lateral weightbearing radiographs of the injured ankle.



Fig. 2. Preoperative anteroposterior weightbearing radiographs of the injured ankle.

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