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Partial Replacement of the Talus with a Titanium Augment in a Patient with Osteochondral Defect

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Summary. *A case of replacement of an osteochondral defect of the talus in an 18-year-old patient using a 3D-printed titanium alloy augment is presented. The follow-up period was 2 years. The clinical and radiological outcomes were good. The function of the operated foot was comparable to that of the contralateral healthy foot.*

Keywords: *foot; talus; osteochondral defect; 3D printing.*

Osteochondral lesions of the talus (OLT) are a relatively common consequence of ankle injuries. According to Kessler J.I. et al. [1], the incidence of OLT is 4.6 cases per 100,000 population aged 6 – 19 years. The incidence of OLT following ankle ligament injuries is approximately 6.5 % [2].

There are medial, lateral, and central localizations of OLT. The most common medial localization is associated with a higher frequency of inversion injuries of the foot. Conservative treatment can be effective if OLT is diagnosed early and if the damaged area is small. Fragmentation of the articular surface and an osteochondral defect (OCD) require surgical intervention; in some cases, treatment may involve replacement techniques (osteoplasty or osteochondroplasty), endoprosthesis, or even ankle arthrodesis. The most challenging localization of an OCD is the medial edge of the talar block. The unique anatomical shape of this area makes plastic replacement techniques impossible, while total ankle replacement may be premature. In 2023, Cui Y. et al. [3] reported the results of a partial replacement (endoprosthesis) of the medial part of the talar dome in a patient with an OCD using a titanium alloy augment printed on a 3D-printer. The long-term clinical and radiological outcomes were good. This was the first case of partial talar replacement described in the literature. We performed a similar surgery on a patient with an OCD two months before the publication of the report by Cui Y. et al. The purpose of this article is to report the long-term outcome of using a 3D-printed titanium augment for the replacement of a part of the talar dome in a patient with an OCD.

Written informed consent for the publication of photographic materials was obtained from the patient. Ethical standards comply with the principles of the Declaration of Helsinki on human rights and the requirements of the local bioethics committee.

Case description. An 18-year-old patient presented to the clinic complaining of pain and swelling in her right ankle joint, which significantly worsened after overload. At the age of 13, she sustained an inversion injury to the right foot. After a standard X-ray examination, a diagnosis of lateral ligament injury was made. Treatment involved immobilization with an orthosis. Approximately three months after the injury, she began to experience sporadic pain accompanied by hydrarthrosis. MRI revealed a transchondral fracture of the medial edge of the talus (stage III according to the Berndt and Harty classification). Arthroscopic debridement and tunneling of the right talus were performed on September 11, 2019. However, the clinical and radiological dynamics of the disease showed no significant changes.

At the time of the examination, the patient complained of pain in the medial side of the ankle joint, which tended to worsen with prolonged loading. Periodic «blokages» of the right ankle joint are accompanied by transient synovitis. Active extension of the right foot was reduced. MRI scans showed destruction and collapse of the medial talus (Fig. 1). The significant defect in the articular surface of the talus required replacement, but the location of the defect made osteochondroplasty impossible. After consultations with the patient and her family, a decision was made to replace the defective part of the talus with an augment based on a titanium alloy.

Using appropriate technical support, an augment with two locking screws was fabricated. The articular surface of the augment was mirror-polished, while the opposing surfaces for contact with bone tissue were processed for osseointegration (Fig. 2).

The surgery was performed under general anesthesia on February 8, 2023, and included segmental resection of the medial part of the talar dome and replacement of the defect with an individual titanium 3D-augment.

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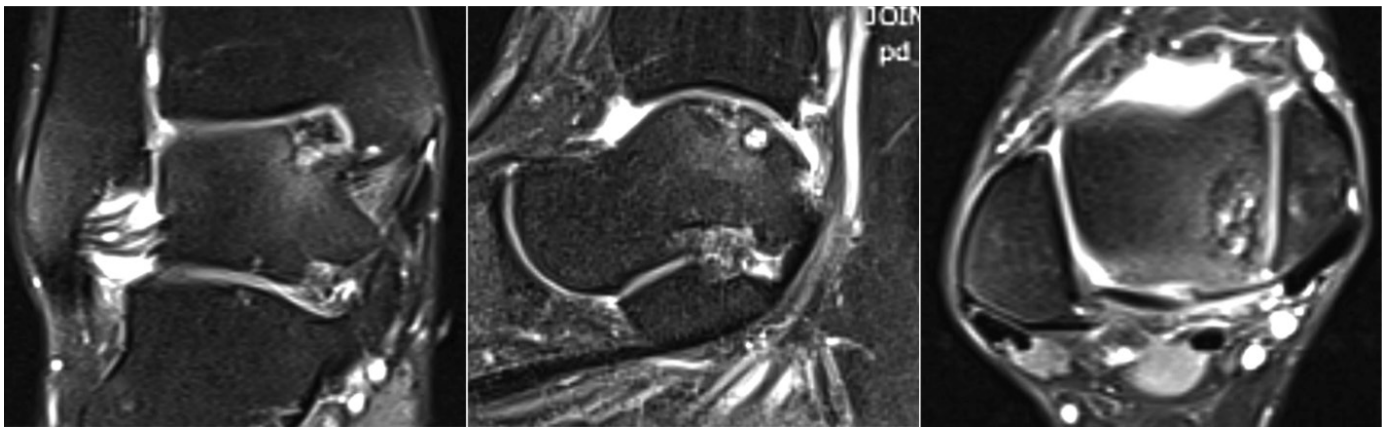

Fig. 1. MRI scans of the right ankle joint. Appearance and localization of the osteochondral defect of the talus.

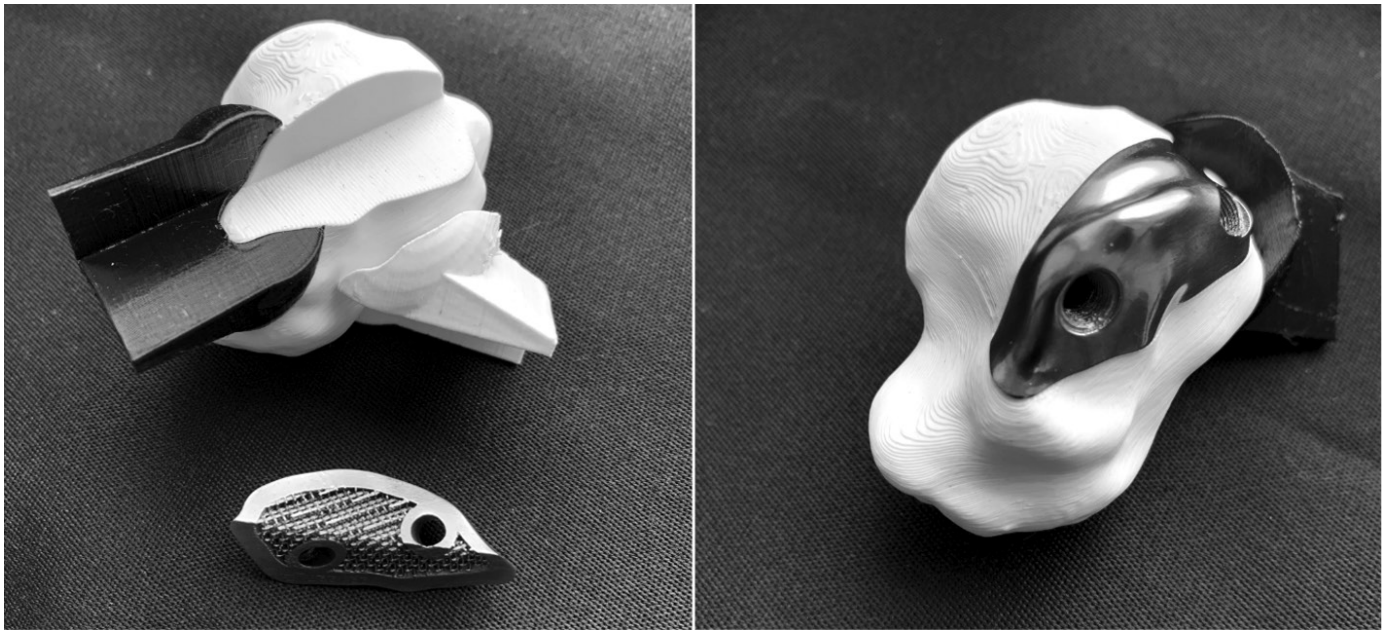

Fig. 2. Plastic prototype of the right talus, a template for resection of the osteochondral defect area, and a titanium augment.

A medial osteoplastic approach was performed to access the resection area. Resection of the talus was performed using a template. The accuracy of the augment position was checked radiographically, and fixation was performed with 4.5 mm locking screws. Osteosynthesis of the medial malleolus was performed with a 4.0 mm cannulated screw and a buttress plate. The wound was sutured in layers with separate stitches. The operated area was protected by a thick soft bandage, and the leg was immobilized with a circular plaster bandage cut lengthwise. The postoperative period passed without complications; the stitches were removed after 2 weeks. Active movements in the ankle joint were initiated at the same time. Complete unloading of the operated limb lasted 6 weeks. After radiological verification of the union of the osteotomized medial malleolus, the patient began weight-bearing. No additional treatment was required.

Follow-up examination 2 years after surgery. The patient walks without additional support and does not limp. She occasionally experiences minor pain in the medial part of the right ankle joint. Active and passive movements in the right hindfoot do not differ from those in the opposite healthy foot (Fig. 3). Radiographically, the augment remains in the anatomical position, with no signs of resorption around it or the screws. There is a barely noticeable compaction of the bone tissue at the site of the osteotomy of the medial malleolus.

Conclusion

Replacement of the articular surface with metal augments is a relatively new direction in the treatment of OCD of the talus. In 2010, Van Bergen C.J. et al. [4] demontrated the possibility of replacing OCD of the talus with Hemi CAP®. Although the

Fig. 3. Clinical and radiological outcomes after 2 years.

results of this technique were generally positive, the expected small patient population prevents drawing any valid conclusions regarding the role of Hemi CAP® in the treatment of OCD of the talus. Custom augmentations allow for solving more complex clinical problems, which may be their significant advantage. The clinical case presented by us illustrates the possibility of replacing a part of the talus with a complex configuration that cannot be restored through osteoplasty or osteochondroplasty. Although such cases will likely remain rare, advances in modern technology will continue to expand the arsenal of surgical techniques.

Conflicts of interests. None.

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Часткове заміщення таранної кістки титановим аугментом у пацієнтки з остеохондральним дефектом

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Резюме. *Представлено випадок заміщення остеохондрального дефекта таранної кістки у пацієнтки віком 18 років за допомогою аугмента із титанового сплаву, надрукованого на 3D-принтері. Термін спостереження становить 2 роки. Клініко-рентгенологічний результат добрий. Функція оперованої стопи не відрізняється від функції здорової стопи.*

Ключові слова: *стопа, таранна кістка, остеохондральний дефект, 3D-друк.*