A novel retrograde technique for ankle osteochodral lesions: the sub-endo-chondral regenerative treatment (SECRET)

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INTRODUCTION:

Ankle osteochondral lesions (OCL) are defects of the subchondral bone and its overlying cartilage, which frequently affect young and active patients. Main symptoms are represented by chronic ankle pain, intermittent swelling, stiffness, and instability.

Many surgical options for ankle OCL have been described, and the ideal treatment is still debated. Bone marrow stimulating techniques are recommended for cystic lesions, with some concerns regarding the healing potential of the subchondral bone. In case of wide osteochondral defects, regenerative solutions are preferred but a massive chondral debridement is usually required. To overcome these problems, a new technique was proposed.

Aim of this study is to describe a new surgical retrograde technique for OCL of the ankle. The proposed procedure allows for cartilage sparing and tries to exploit the properties of regenerative medicine.

METHODS:

The proposed technique was performed on patients affected by osteochondral lesions of the ankle, either cysts with intact cartilage or wide osteochondral defects. Patients younger than 18 years, with previous ankle surgery, affected by ankle osteoarthritis, rheumatoid arthritis, malalignments of the lower limb, and joint laxity were excluded.

The proposed surgical technique combines several procedures already validated in the literature. First, bone marrow aspiration was performed from the posterior iliac crest. A total of 60 mL of bone marrow aspirate was collected and inserted into a concentrator device. After the working cycle, the aspirate was reduced in volume to obtain 6 mL of bone marrow aspirate concentrate (BMAC). Ankle arthroscopy was made using standard anteromedial and anterolateral portals. The OCL was reached using different entry points. A Kirschner (K) wire was driven toward the lesion using anterior, posterior, medial, or lateral approaches. The K wire was driven toward the lesion via fluoroscopy, to confirm the proper placement in both antero-posterior and lateral views. During this phase, an arthroscopic intraarticular view may be used to verify that the K wire was not penetrating the intact cartilage. The K wire was used as a guide for a 6-mm cannulated reamer, reaching the lesion under fluoroscopic view. A 6mm tarsal tunnel was created retrogradely towards the lesion to allow complete sub-endo-chondral debridement while preserving healthy cartilage. A hyaluronan scaffold soaked with a previously prepared bone marrow concentrate was retrogradely positioned under the cartilage surface and the tunnel was filled with homologous bone graft.

The American Orthopaedic Foot and Ankle Society Score (AOFAS) and the visual analogue scale (VAS) were evaluated preoperatively.

Pre-operative X-ray and magnetic resonance imaging (MRI) were performed to localise the lesion and post-operative assessment was performed at 1 year follow-up. In addition, a more detailed MRI evaluation was performed using T2-mapping sequences, which can distinguish the qualitative nature of the reparative tissue based on the interaction of water molecules and the collagen network within the regenerated cartilage.

RESULTS:

Twenty-one patients were surgically treated using this novel technique, consisting of 10 males (48%) and 11 females (52%). The mean age at surgery was 40.6 years (range, 19-61). Twenty lesions were located on the talus, with 17 on the medial side (81%) and 3 on the lateral side (14%), and one lesion (5%) on the tibia. At a mean follow-up of 15.3 (range, 8-24) months, the mean AOFAS score increased from 60 (range, 24-72) preoperatively to 75.3 (range, 54-100, $p<0.001$). The mean VAS score at rest and during activity improved from 2.6 (range, 0-5) and 7.9 (range, 6-10) to 0.7 (range, 0-5, $p<0.003$) and 3.1 (range, 0-8, $p<0.001$), respectively. No intraoperative complications were observed, with only one patient experiencing delayed wound healing, completely resolved over time. X-ray controls showed good bone remodelling.

A postoperative MRI indicated effective resolution of bone edema and satisfactory cartilage and bone remodeling. T2 mapping at the 1-year follow-up revealed regenerated tissue with T2 values ranging from 35 to 45 milliseconds, closely resembling hyaline cartilage. This regenerated tissue covered a mean of 81% of the repaired lesion area, with a range of 69% to 90%.

DISCUSSION AND CONCLUSION:

Aim of this study is to describe a new cartilage-sparing retrograde technique with regenerative properties, which may be a viable option in case of both subchondral cysts with intact cartilage or wide osteochondral defects.

The proposed technique combines the mini-invasiveness of retrograde drilling with the regenerative properties of a biological scaffold soaked with bone marrow concentrate; in addition, it takes advantages of an arthroscopic intraarticular view to assess the cartilage quality, and treat concomitant pathologies such soft tissue or bony impingement.

In case of large subchondral cysts, the biodegradable hyaluronan scaffold soaked with the BMAC represent an important source of mesenchymal stem cells and promote cell interaction and mechanical stability for the intact cartilage surface during the regenerative process.
For OCL with damaged cartilage, in particular for lesions close to the talar gutter, the proposed procedure allows a complete sub-endo-chondral debridement, restricting the chondral removal to only compromised cartilage.
Despite further research being needed, the sub-endo-chondral regenerative treatment seems a new viable and versatile solution for OCL, whose management is still controversial in the literature.