

Homologous osteochondral graft transplantation for spontaneous bilateral osteonecrosis of the femoral condyle in a young patient: case report and narrative review

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SUMMARY

Spontaneous osteonecrosis of the knee (SONK) is a rare degenerative disease, the causes of which remain largely unknown. SONK develops gradually, leading to progressive pain with functional impairment, and is often misdiagnosed due to the complexity of the clinical examination, which is hampered by pain and swelling. Early diagnosis and treatment are essential to prevent joint damage and ensure good functional outcomes. We review the current literature on SONK and present a case of bilateral SONK in a 31-year-old woman who was treated with a homologous osteochondral implant. The patient of this case report had high functional demands and no comorbidities. A two-stage procedure was performed including diagnostic arthroscopy, removal of subchondral sclerosis, and allograft insertion using the compression-fit technique. At 36-month follow-up, the patient reported significant functional improvement and a reduction in pain, demonstrating the effectiveness of this therapeutic approach.

Key words: spontaneous osteonecrosis, knee, osteochondral graft, allograft transplantation, regenerative treatment

Introduction

Spontaneous osteonecrosis of the knee (SONK) is a relatively rare pathology, and the current literature on the subject is limited. This condition can develop gradually, leading to progressive analgesic limitation that negatively affects the patient's quality of life. Although clinical diagnosis can be challenging, magnetic resonance

imaging (MRI) is a fundamental tool to identify and classify this pathology. Herein, we describe a case of bilateral SONK in a 31-year-old woman with bilateral knee pain and no other comorbidities. Given the young age and high functional demands, a regenerative treatment with the implantation of homologous bone grafts (allograft) was proposed and performed.

Description of the case report

The patient of this case report is a 31-year-old woman, BMI 23 kg/m², and unremarkable past medical history. The patient was affected by osteonecrosis of the knee, with bilateral necrotic foci localized at the medial femoral condyle. The HKA (hip-knee-ankle) angle of the left and right lower limb was 5° of varus. Due to a clinical picture characterized by progressive and debilitating medial knee pain, an MRI was performed, which bilaterally revealed a picture compatible with SONK (1) (Figs. 1-2). Considering the size of the lesions and the high functional demands of the patient, it was decided to proceed with a homologous bone graft (allograft) to the affected femoral regions, performed in two stages.

Surgical technique

The first phase of the intervention involved diagnostic arthroscopy to evaluate the lesion balance at the cartilage level, followed by a medial parapatellar approach to assess the size of the lesion. Subsequently, deep bone work was performed to remove subchondral sclerosis. Bone perforations were made at the base of the lesion using a 1.2 mm Kirschner wire (K-wire). The donor bone was then processed and shaped according to the measurements of the lesion, ensuring that the curvature radius matched that of the native condyle. The graft was inserted using a press-fit technique, and the edges were filled with fibrin glue. The final assessment of joint mobility confirmed the absence of impingement (Figs. 3-4).

Results

At 3-year follow-up from the second intervention, a new bilateral MRI was performed, showing good integration of the allografts (Figs. 1-2). The patient reported significant subjective improvement and the disappearance of bilateral knee pain. The Knee Injury and Osteoarthritis Outcome Score (KOOS) was 77 points, indicating a return to normal daily activities and the sports activity she practiced before the surgeries, including dancing.

Discussion

Knee osteonecrosis is a progressive pathology that leads to the collapse of the subchondral bone, and its etiology is largely unknown. It can be classified into three types: spontaneous osteonecrosis,

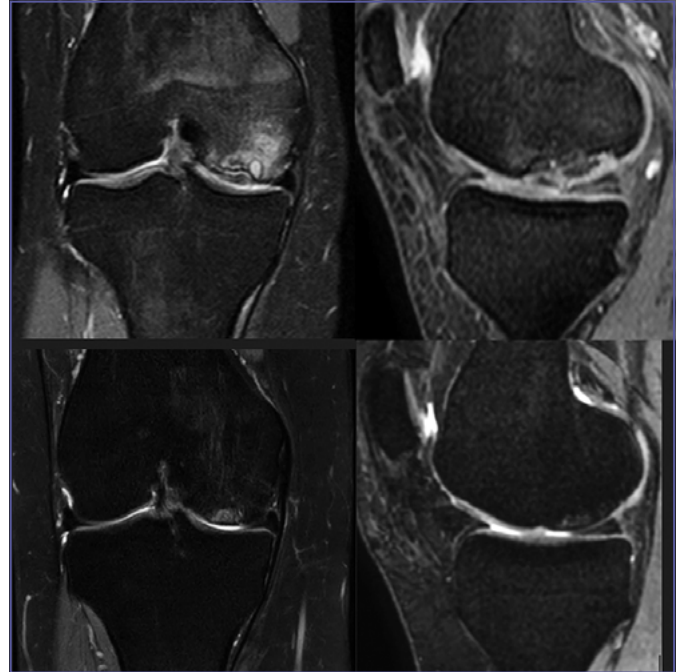


Figure 1. Preoperative MRI and follow-up at 36 months of the right knee.

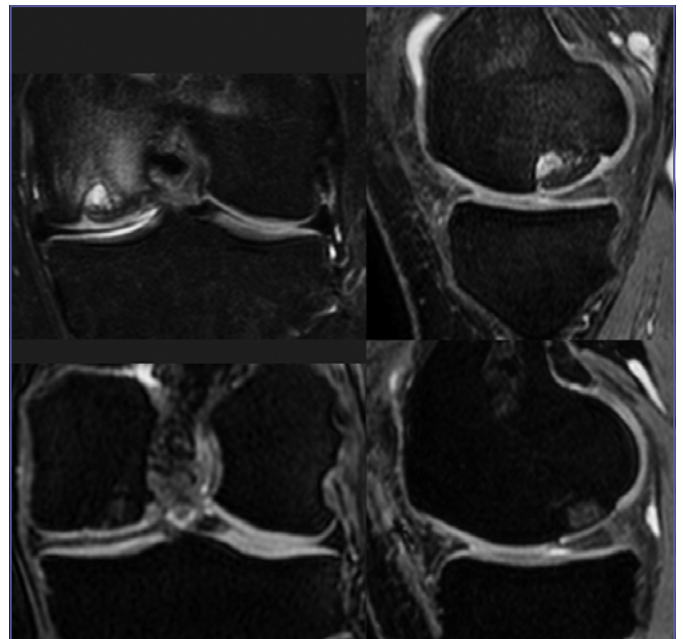


Figure 2. Preoperative MRI and follow-up at 36 months of the left knee.

secondary osteonecrosis, and post-arthroscopic osteonecrosis. The spontaneous form predominantly affects women around 60 years of age, unilaterally, mostly in the medial femoral condyle^{2,3}.

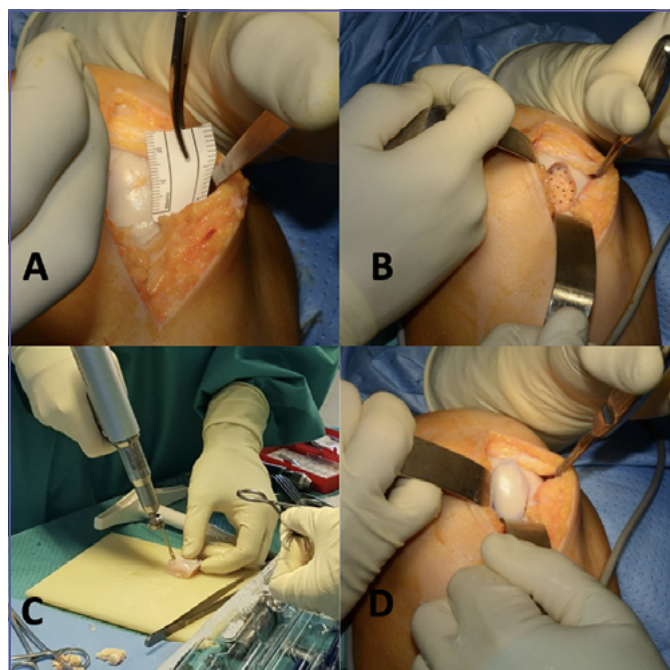


Figure 3. Intraoperative images: A) lesion assessment; B) base preparation; C) allograft preparation; D) allograft implantation.

This form is characterized by sudden onset of symptoms without trauma. The secondary form, on the other hand, affects younger patients, has a gradual symptomatology, and more often involves bilateral or polyarticular involvement⁴. Patients usually present one or more risk factors, including the use of corticosteroids, autoimmune diseases, or coagulation disorders²⁻⁴.

Post-arthroscopic osteonecrosis typically occurs after an arthroscopy or arthroscopic meniscectomy, with sudden onset of

symptoms usually involving a single condyle. The patient in this study had many characteristics in common with the secondary form; however, from an anamnestic point of view, no known risk factors were found. Consequently, she was treated as a case of SONK.

Various treatment algorithms exist for this pathology, primarily based on the size of the lesion and the involvement of the subchondral bone. If the lesion is smaller than 3.5 cm², non-surgical treatment is possible, consisting of protected weight-bearing and the use of anti-inflammatory drugs or bisphosphonates². For larger lesions, surgical treatment is indicated as the chances of improvement with conservative treatment are very low.

From a surgical treatment perspective in young patients, it is advisable to delay prosthetic replacement in the absence of clear arthritic signs. Arthroscopic treatments such as microfracture, debridement, corrective osteotomies in the presence of axial deformities, and core decompression are all techniques described in the literature with good results^{2,5}. However, if the subchondral bone is collapsed, other treatments, including osteochondral grafts, are necessary.

There are several treatments to repair articular cartilage, also indicated for large osteochondral lesions. The most supported surgical option in the literature involves the use of autologous allografts. This technique involves harvesting tissue from non-weight-bearing areas and implanting it in the damaged region (OAT)⁶. The disadvantage of this procedure is that it cannot be applied to large lesions, since the donor site is limited⁶.

Seo et al.⁷ suggests to treat the lesion not only based on its size, but also relative to the area occupied. This technique, although more expensive and with longer graft acquisition times, is safer and more effective for lesions greater than 10 cm², as in our patient. Given the uniqueness of our case and supported by this evidence, we conducted a literature review on cases of young patients with SONK or secondary osteonecrosis treated

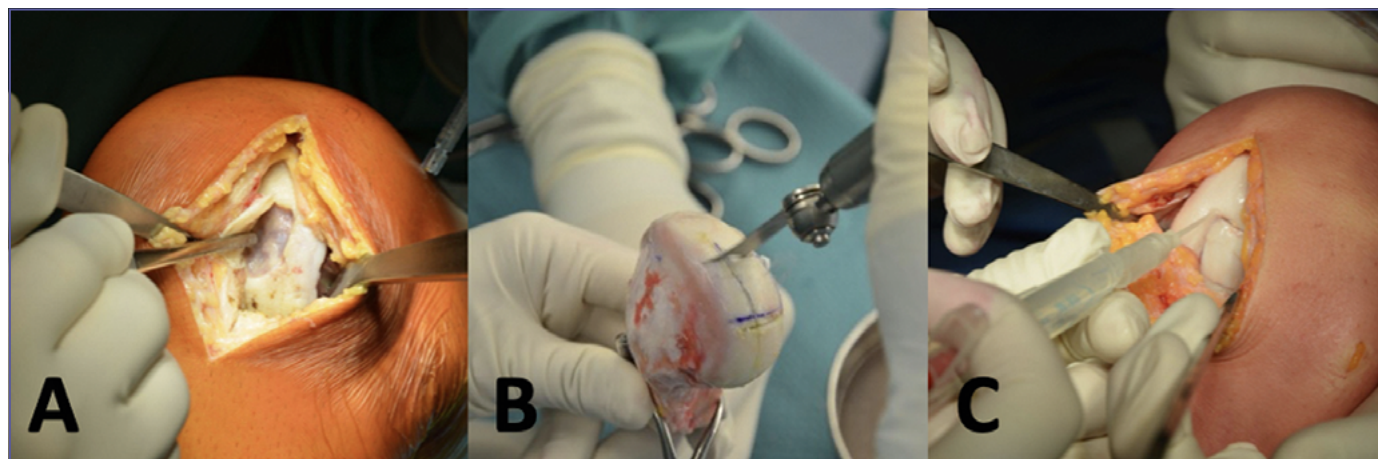


Figure 4. Intraoperative images: A) lesion assessment; B) allograft preparation; C) allograft implantation with fibrin glue.

Table I. Case report and case series results.

Author	Type of osteonecrosis	Treatment	No. of knees	Clinical outcomes	Mean FU (years)
Cusano et al., 2018 ⁶	SONK	Allograft	1	Good clinical and MRI results	1
Gortz et al., 2010 ⁷	Secondary due to corticosteroids	Allograft	28	11% failure rate	5.6
Nishitani et al., 2021 ⁸	Secondary	Autograft	14	No revision surgeries	10
Fonseca et al., 2018 ⁹	Secondary due to Lupus	Allograft	1	No revision surgeries	15
Tirico et al., 2017 ¹⁰	SONK in older patients	Allograft	7	Optimal results	4

with allografts for large osteochondral lesions. The studies examined primarily involve case reports or case series, and the results are summarized in Table I.

Cusano et al. ⁶ described a case of SONK with a massive lesion treated with allograft, reporting good clinical and MRI results at one year after the intervention. Gortz et al. ⁸ in their case series on the use of allograft in secondary osteonecrosis due to corticosteroids reported a treatment failure rate of 11%. Nishitani et al. ⁹, in a retrospective case series of 10 cases of secondary osteonecrosis, did not observe any failure with conversion to prosthesis at follow-up. Similar results were reported by Fonseca et al. ¹⁰ in patients with secondary osteonecrosis due to lupus. The study by Tirico et al. ¹¹ involved the use of allografts in the treatment of spontaneous osteonecrosis in patients older than our case, with optimal results.

There are no studies in the literature on the treatment with allograft in the case of primary bilateral osteonecrosis in young patients.

Conclusions

The treatment of osteonecrosis in young patients with high functional demands is often complex. In our case, although the clinical characteristics and type of lesion suggested secondary osteonecrosis, no risk factors were identified that could justify it. The choice of treatment was also debated, as the lesions differed in size and were susceptible to reparative treatment. Additionally, the patient had high functional demands and bilateral lesions, further complicating the picture. The choice of treatment with allograft was justified by the extensive area affected at the condylar level, the high functional demands, and the patient's age. Therefore, treatment with allograft is a valid solution in these cases.

Conflict of interest statement

The Authors declare no conflict of interest.

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Author contributions

GR: was involved in writing and revising the manuscript and editing the figures; MC: contributed to writing the manuscript; DB: edited and reviewed the figures; LP, FC, GL: critically revised the manuscript for important intellectual content; FC, GC: revised the manuscript and gave final approval for the version to be published.

Ethical consideration

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013).

This study is a case report and therefore does not require ethical committee approval. Written informed consent was obtained from the patient for study participation and data publication.

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