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Successful treatment of avascular necrosis of the distal femoral condyle with osteochondral autograft in an HIV positive woman: A case report

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Abstract
Treatment of avascular necrosis is challenging and requires patient individual treatment planning. A 26-year-old HIV positive woman presented with increasing pain and stiffness in her left knee. We diagnosed an avascular necrosis of the knee with a severely limited range of movement. During her treatment, she also developed an avascular necrosis of both hips. To minimize the risks of prosthetic joint infection in an immunocompromised patient, we decided to perform a hip arthroplasty with an autologous full-thickness osteochondral transfer of the femoral head to the femoral condyle. Despite a lack of compliance and physiotherapy, the symptoms and range of movement significantly improved postoperatively, without the patient being pain-free.
We propose that in cases of simultaneous avascular necrosis of hip and knee, a large autologous transfer is an option to prolong or prevent knee arthroplasty, especially in patients with risk factors for a poor outcome of arthroplasty.

Keywords: Osteochondral autograft, osteonecrosis treatment, Hip autograft, osteonecrosis Knee

1. Introduction
Avascular necrosis (AVN) or osteonecrosis is defined as an ischaemic death of subchondral bone due to an insufficient arterial blood supply (Mehta *et al.*, 2013) [15] and has a multifactorial aetiology (Chokotho *et al.*, 2013; Govender *et al.*, 2008) [2, 8]. It can be categorized in spontaneous and secondary (Karim). Secondary osteonecrosis is further divided into traumatic and atraumatic origin, traumatic onset being the most common. Non-idiopathic atraumatic osteonecrosis has been described to be associated with risk factors such as high dose steroids, alcohol abuse, HIV, drug addiction, hyperlipidemia, hypercoagulability, smoking, pancreatitis, renal disease, osteopenia or gout (Chokotho *et al.*, 2013; Scribner *et al.*, 2000) [2]. The Incidence of AVN in HIV patients is between 0.5 and 1.3% (Chokotho *et al.*, 2013; Govender *et al.*, 2008) [2, 8] and therefore 100 times higher than in the general population (Morse *et al.*, 2007) [19]. Osteonecrosis of the femoral head is most common, followed by osteonecrosis of the knee, but multiple joints can be affected (Karim *et al.*, 2015) [12]. Treatment planning is generally based on age, symptom severity, activity level, functional demands, extent of deformity, secondary osteoarthritis and stage of the lesion (Patel *et al.*, 1998). In the early pre-collapse stage joint-preserving treatment, such as arthroscopy, core decompression or bone grafting can be used. In advanced stages, arthroplasty remains the most frequently used treatment, besides osteochondral allograft or autologous bone grafting (Jakob *et al.*, 2002; Karim *et al.*, 2015; Mont *et al.*, 2015) [11, 12, 16]. A further issue is that HIV patients have a higher risk for joint infections both pre- and post-operatively due to the weakened immune system (Falakassa *et al.*, 2014) [5]. To date, only 1 case report was able to achieve a successful joint reconstruction using an autologous osteochondral transfer as a treatment option for AVN of the Knee (Weinrauch *et al.*, 2013) [27]. We report an even larger transfer with a successful 6 year follow up, such that we present this method for a large autologous osteochondral bone transfer in younger patients as an alternative definitive reconstruction treatment option for AVN of the knee.

2. Case Report

A 26-year-old, HIV-positive woman with history of intravenous drug abuse presented to our clinic with increasing pain, swelling and stiffness of her left knee. She has been treated for inflammatory arthritis by Rheumatology with repeated aspirations and steroid injections as well as anti-inflammatory and anti-rheumatoid drugs for one year prior to this, which only improved symptoms temporarily. In her background medical history, she had had 3 major infective episodes which had resulted in intensive care admissions, and in 1 admission, age 20, with the use of high dose steroids to improve a pneumonitis.

On assessment in our Orthopaedic clinic, she presented with a swollen knee, a visible varus deformity with 5-6mm medial opening, ACL-laxity, medial tenderness, range of movement (ROM) 20-80º and was mobilizing with one crutch. X-rays suggested an avascular necrosis of the medial femoral condyle, with fragmentation and sclerotic changes, which has later been confirmed by an MRI scan and diagnostic arthroscopy with bone biopsy, which also excluded an overt deep infection (Figure 1). Post-arthroscopy, she complained of painful locking symptoms and a decreased ROM to 20-60°. A second arthroscopy with extensive debridement did not relieve these symptoms.

Besides her knee symptoms, she started to develop pain and stiffness in her hips, with strong evidence for AVN on X-ray and MRI scans (Figure 2).

Due to deterioration of her symptoms in both hips and the knee, the patient decided to proceed with surgical treatment two years after her first presentation in our clinic. After a detailed discussion, we performed a hybrid Exeter/Trident (Stryker, Newbury UK) total hip replacement using a posterior approach with a plan to then undertake an osteochondral autologous transfer for the ipsilateral avascular distal femoral condyle if possible. On inspection, the femoral head showed a section of partially undamaged cartilage and was therefore deemed suitable as an autograft.

For the knee, we used a standard anteromedial approach under general anaesthesia. The posterosuperior third of the femoral head was identified and the reverse side cored out using a 38mm concave reamer to form a convex surface. A reciprocal 34mm standard reamer was used to clear away the osteonecrosis and even out a cavity within the medial distal femur. The size of the femoral head was matched and impacted into position. Due to a persisting loud clunk after trial reduction, we excised a small section of the medial posterior femur (1.5x1x1cm). This fragment was used to fill a central trochlea defect and fixed with three 2.4mm SmartNail bioabsorbable fixation pins (Conmed, Shrivenham, UK). The medial femur fragment was fixed with a 4mm 3-hole distal humeral AxSOS plate (Stryker, Newbury UK) with 4 locking screws, which were introduced from the plate into the autograft fragment and a 45x2.4mm Smartpin for the superior part. The PCL had become partially detached and was therefore reattached on the femoral side using a single G2 suture anchor (DePuy Synthes, Welwyn Garden City, UK). We were able to achieve a good, well-aligned and stable construct at the end of the procedure (Figure 3).

6 months post-operatively the patient's Oxford Knee Score had improved from 7/48 to 23/48, the ROM increased to 0-90° and she was able to mobilise without crutches, despite insufficient conditioning exercises and physiotherapy. The X-rays showed satisfactory results (Figure 4). The OKS dropped to 13/48 after 1 year and subsequently improved to 18/48 2 years postoperatively. Despite the improvement of her symptoms compared to before the operation, persisting symptoms of painful crepitus led to further arthroscopic debridement being done 28 months following the reconstruction surgery. Arthroscopy showed Grade III shallow erosive chondral defects of the patella, medial tibia, medial and lateral femoral condyle as well as extensive synovitis. After 6 years, hip and knee X-rays were still satisfactory with no progression of her distal femur AVN, maintenance of the osteochondral graft and without signs of implant failure (Figure 5). The OKS was 16/48 and with a ROM of 0-100°, the symptoms significantly decreased compared to before her operation. However occasional locking symptoms persisted and she continued mobilising with a crutch. Her hip remained persistently symptomatic but with a good radiographic outcome.

During her follow up treatment she developed AVN of her right elbow, and the AVN of left hip and knee did not progress.

3. Discussion

The Success of joint arthroplasty can be negatively influenced by female gender, low socioeconomic status, higher pain, comorbidities, low back pain, poor functional status and psychological factors (Clement, 2013) [3]. Total Knee arthroplasty in patients with advanced osteonecrosis have shown success rates between 55% (Mont *et al.*, 1997) [17] and 97% (Mont *et al.*, 2002) [18] and was observed to be higher with cemented implants (Myers *et al.*, 2006) [20]. Immunocompromised patients are known to have a higher risk of prosthetic joint infections (Falakassa *et al.*, 2014) [5]. We, therefore, concluded that the risks of a poor functional outcome and heightened complication rate of knee arthroplasty in our patient outweighed the potential benefits and that this was less of an issue for the hip joint. We, therefore, considered all alternative treatments for late-stage osteonecrosis in both hip and knee joints. On the basis of limited previous experience, but utilizing experience of osteochondral allografting and autografting (Ahmad und Jones, 2016; Fitzpatrick und Morgan, 1998; Matsushita *et al.*, 2017; Weinrauch *et al.*, 2013) [1, 6, 14, 27], we felt knee Joint reconstruction using an osteochondral autograft represented a promising alternative to arthroplasty in a young patient such as ours, in the presence of multiple joint osteonecroses.

Autogenous osteochondral grafts can significantly decrease further surgical treatment in pre- and post-collapse AVN of the knee (Lieberman *et al.*, 2014) [13]. Historically there are many studies that demonstrate good outcomes with osteochondral bone transfer. However, most of these studies used cylindrical plugs from non-weight-bearing areas of the knee, generally onto focal femoral condyle lesions (Hangody *et al.*, 2008; Jakob *et al.*, 2002; Tanaka *et al.*, 2009) [9, 11, 26], patella groove defects (Nakagawa *et al.*, 2004) or less frequently larger cartilage defects, often in combination with ACL injuries (Erdil *et al.*, 2013; Imade *et al.*, 2012; Okamoto *et al.*, 2007) [4, 10, 22]. In patients with osteonecrosis of the femoral head autologous osteochondral transfer is also reported to have a good outcome, but is related to a high conversion rate to total hip replacements in the late post-collapse stage (Gagala *et al.*, 2013) [7]. However, these methods are accompanied by a high donor site morbidity (Quarch *et al.*, 2014) [24].

In 2013, Weinrauch *et al.* first described the use of the femoral head as a fresh osteochondral autograft, harvested in a total hip arthroplasty, to reconstruct the femoral condyle in a patient with multiple joint AVN. Instead of using small

cylindrical grafts they used two larger, approximately 1cm thick fragments of the femoral head and fixated them to the medial condyle using headless compression screws (Weinrauch *et al.*, 2013) [27]. Instead of using fragments of the femoral head, we report the use of a far larger full thickness section of the femoral head, which enabled us to replace a larger amount of necrotic bone and abnormal or absent chondral surface.

Although the patient achieved a satisfactory radiological outcome as well as improved clinical measures, a better compliance regarding her post-operative exercises in addition to physiotherapy may well have resulted in an even better outcome.

We, therefore, propose that in cases of simultaneous AVN of hip and knee avascular necrosis, a large autologous transfer is an option to prolong or prevent knee arthroplasty, especially in patients with risk factors for a poor outcome of arthroplasty.

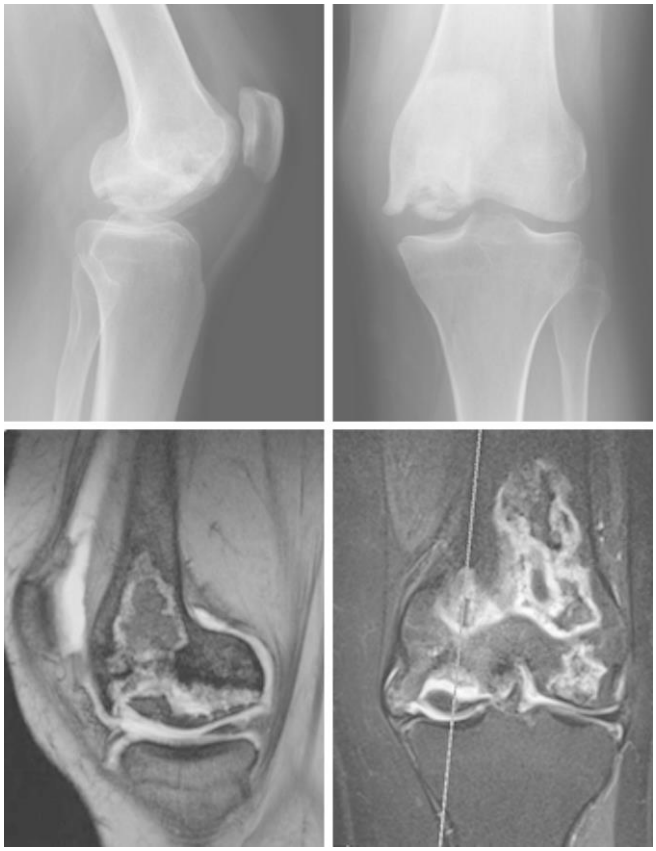

Fig 1: X-ray (top) and MRI scan (bottom) of the left Knee at first presentation in our clinic, showing signs of AVN of the knee, worse on the medial femoral condyle.

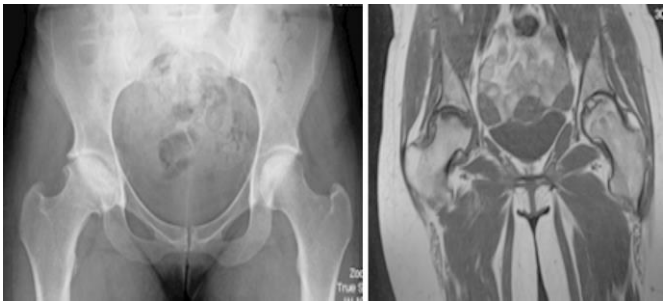

Fig 2: X-ray (left) and MRI scan (right) of the pelvis confirming avascular necrosis of the femoral head, which was predominant on the right side.

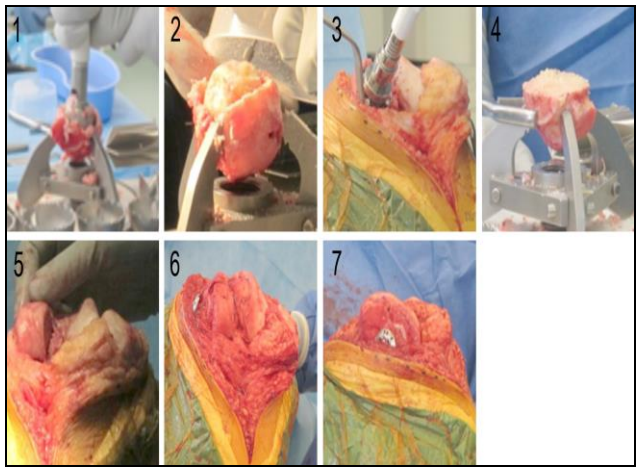

Fig 3: operative procedure: autograft preparation and implantation (1) A concave 38mm reamer was used to form a convex surface of the femoral head. (2) A surgical fraise was used to adjust the size of the femoral head. (3) A 34mm standard reamer was used to clear out a reciprocal cavity within the medial condyle. (4) Final adjustments were made to the femoral head and the size aligned to the formed cavity. (5) The femoral head was impacted into place. (6+7) 2 views of the final construct which shows an almost anatomical alignment

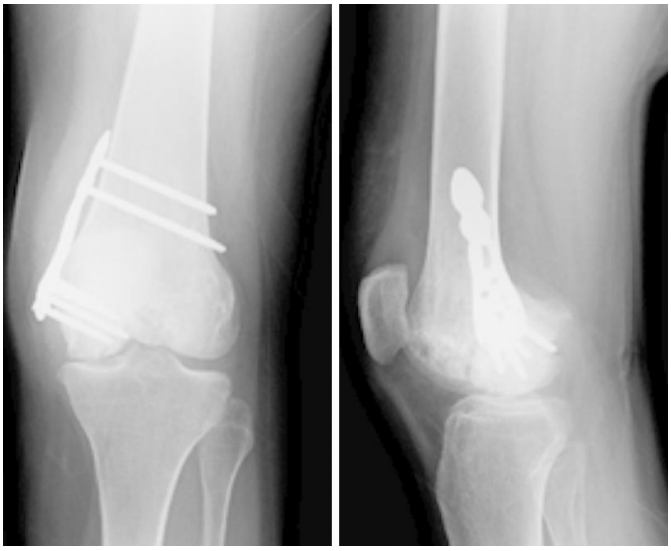

Fig 4: Postoperative AP (left) and lateral (right) X-ray, showing good alignment of the autograft.

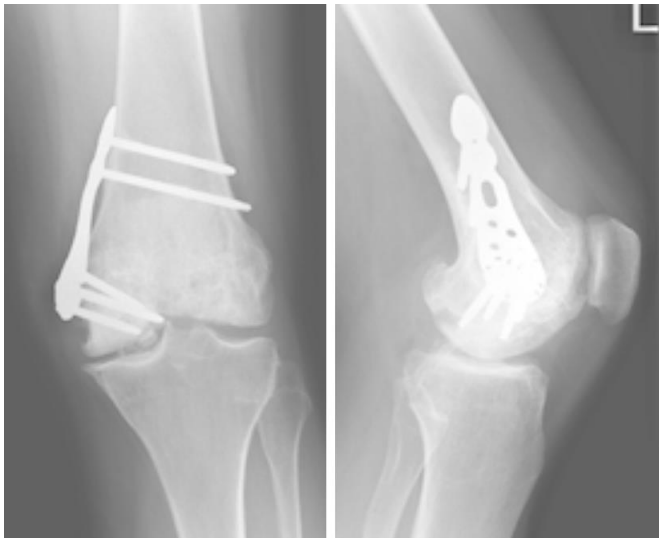

Fig 5: AP (left) and lateral (right) X-ray at 6 year follow-up.

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