



## Hallux rigidus treated with adipose-derived mesenchymal stem cells: A case report

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### Abstract

#### BACKGROUND

First metatarsophalangeal joint arthritis (FMTPA), also known as hallux rigidus, is the most frequent degenerative disease of the foot. Diagnosis is made through both clinical and radiological evaluation. Regenerative medicine showed promising results in the treatment of early osteoarthritis. The aim of the present study was to report the results of a case of FMTPA treated with the injection of autologous adipose-derived mesenchymal stem cells.

#### CASE SUMMARY

A gentleman of 50 years of age presented with a painful hallux rigidus grade 2 resistant to any previous conservative treatment (including nonsteroidal anti-inflammatory drugs and hyaluronic acid injections). An injection of autologous adipose-derived mesenchymal stem cells into the first metatarsophalangeal joint was performed. No adverse events were reported, and both function and pain scales improved after 9 mo of follow-up.

#### CONCLUSION

The FMTPA joint injection of mesenchymal stem cells improved symptoms and function in our patient with FMTPA at 9 mo of follow-up.

**Key Words:** First metatarsophalangeal joint arthritis; Hallux rigidus; Stem cells; Regenerative medicine; Early osteoarthritis; Adipose derived-mesenchymal stem cells; Case report

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**Core Tip:** Recently, the use of intra-articular injections of stem cells has been proposed as a promising treatment in early osteoarthritis. In particular, autologous adipose-derived stem cells (aASCs) have attracted considerable attention, considering the easy access to fat tissue and the absence of adverse events registered. These characteristics make aASCs one of the most promising cell types used in regenerative medicine. Hallux rigidus, is the most frequent degenerative disease of the foot. Patients with hallux rigidus present a history of pain, gait discomfort, articular effusion, and a reduction in range of motion. Different types of treatment are available, both conservative and operative, but both are often ineffective. aASCs might overcome the gap between these two methods of treatment.

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## INTRODUCTION

First metatarsophalangeal joint arthritis (FMTPA), also known as hallux rigidus, is the most frequent degenerative arthritis disease of the foot<sup>[1]</sup>. Depending on the severity of the disease, the symptoms in the case of FMTPA are pain, gait discomfort, articular effusion, and a reduction in range of motion. The diagnosis is generally completed by observing the typical findings of osteoarthritis (OA) revealed by X-rays. Coughlin and Shurnas proposed a classification for FMTPA based on both clinical features and imaging<sup>[2]</sup> (Table 1).

Different types of treatments had been proposed, both conservative [*i.e.*, orthosis, nonsteroidal anti-inflammatory drugs, hyaluronic acid (HA) injections] and operative (*i.e.*, cheilectomy, arthroplasty, arthrodesis)<sup>[3]</sup>.

Recently, emerging evidence has supported the use of autologous adipose-derived mesenchymal stem cells (aAMSCs) for the treatment of early OA<sup>[4-7]</sup>.

The aim of the present study was to report the clinical results of a case of FMTPA treated with the injection of aAMSCs.

## CASE PRESENTATION

### Chief complaints

A gentleman of 50 years of age presented with a painful FMTP joint in the left foot.

### History of present illness

His symptoms were resistant to both nonsteroidal anti-inflammatory drugs and HA injections.

### History of past illness

The patient was already scheduled for an aAMSCs injection due to right knee Kellgren-Lawrence grade 2 OA.

### Personal and family history

Personal and family history were negative for foot pathologies.

### Physical examination

The clinical examination showed a positive axial grind test and joint pain, exacerbated by the dorsiflexion that impaired the patient's ability to walk.

### Laboratory examinations

Laboratory tests did not support the final diagnosis.

**Table 1 Coughlin and Shurnas clinical and radiographic classification of hallux rigidus**

Grade	Dorsiflexion	Radiographs	Clinical
0	40°-60°	Normal	No pain, stiffness with loss of motion
1	30°-40°	Dorsal osteophytes; Minimal narrowing; Minimal flattening	Mild pain and stiffness pain with maximum dorsiflexion/plantar flexion
2	10°-30°	Global osteophytes, mild/moderate narrowing	Moderate to severe pain and stiffness relatively constant, pain near extreme ROM
3	< 10°	Cystic changes	Nearly constant pain and stiffness, no midrange pain
4	< 10°	Same as grade 3	Grade 3 + midrange pain

### Imaging examinations

Antero-posterior and latero-lateral standard X-rays showed FMTPA stage 2.

## FINAL DIAGNOSIS

FMTPA stage 2 was diagnosed.

## TREATMENT

The patient was already scheduled for an aAMSCs injection due to right knee Kellgren-Lawrence grade 2 OA, and therefore a similar injection was proposed to treat the hallux rigidus.

Concentrated aAMSCs were obtained from the abdomen, filtered as previously reported<sup>[5]</sup>, and then injected into the FMTP joint after its distraction (**Figure 1**).

Protected weight bearing was prescribed during the first week after the procedure.

## OUTCOME AND FOLLOW-UP

The patient was followed up at regular intervals. The clinical evaluation was completed using both the American Orthopedic Foot and Ankle Society (AOFAS) for hallux metatarsophalangeal-interphalangeal scale and the Visual Analog Scale (VAS).

No adverse effects were reported, excluding a transient pain in the FMTP joint in the first week after surgery. During the entire follow-up, an improvement in both VAS and AOFAS scales were observed (**Table 2**), leading to a final VAS scale of 0 and an AOFAS of 78 at 9 mo of follow-up.

## DISCUSSION

Recently, the use of regenerative medicine principles has been proposed for various applications in both trauma and orthopedics, and especially for the treatment of early OA<sup>[4-6,8-11]</sup>. While conventional therapies for early OA (*i.e.* physical therapy, glucosamine and chondroitin sulfate supplementation) showed little benefits, regenerative medicine was demonstrated to be a promising option, due to the paracrine, anti-apoptotic, anti-inflammatory, and anti-aging effects of stem cells<sup>[12,13]</sup>.

aAMSCs showed some theoretical advantages over other sources of stem cells. In fact, aAMSCs are easy to harvest, because of the wide availability of adipose tissue, and their sampling is generally associated with minimal discomfort, considering that it can be carried out using local anesthesia<sup>[7]</sup>. Moreover, aAMSCs demonstrated a high capacity for proliferation and fibroblastic differentiation<sup>[14]</sup>. Hass *et al*<sup>[15]</sup> showed that adipose tissue should be considered a primary source of cells for regenerative medicine as it contains 500 times more MSCs than the same volume of bone marrow.

Emerging literature has underlined the role of aAMSCs in the treatment of early OA. Schiavone Panni *et al*<sup>[5]</sup> conducted a study of 52 patients with early knee OA treated with arthroscopic debridement and aAMSCs injection, and showed improvement in both function and pain at an average of 15.3 mo of follow-up.

**Table 2 American Orthopedic Foot and Ankle Society and Visual Analog Scale scores**

	Pre-operatively	6-mo follow-up	9-mo follow-up
AOFAS score			
Pain	30	30	30
Function	35	40	40
Alignment	8	8	8
Total score	73	78	78
VAS	7	5	0

AOFAS: American Orthopedic Foot and Ankle Society; VAS: Visual analog scale.



**Figure 1 Intraoperative picture showing the autologous adipose-derived mesenchymal stem cells injection into the first metatarsophalangeal joint.**

Similarly, Song *et al*<sup>[16]</sup> reported the amelioration of pain, function and cartilage volume of the knee after multiple injections of aAMSCs. The efficacy of aAMSCs in OA was recently confirmed in a systematic review conducted by McIntyre *et al*<sup>[17]</sup>.

FMTPA is a degenerative disease with an incidence of 2.5% in patients over 50 years of age. Its treatment might be frustrating for both the orthopedic and the patient, considering the conflicting outcomes reported after conservative treatment, including HA injections. Petrella *et al*<sup>[18]</sup> in their study of 47 patients with FTMPA, described the long-term improvement in both pain and function after multiple HA injections; however, Munteanu *et al*<sup>[19]</sup> in their randomized controlled trial did not observe any differences when HA was compared with placebo.

Pons *et al*<sup>[20]</sup> in a randomized study compared the use of sodium hyaluronate with triamcinolone acetonide in FMTPA, and reported an improvement in pain relief and function at 3 mo after the injections. However, a high percentage of patients in both groups required subsequent surgery after 1 year of follow-up, due to further progression of the disease with worsening of both pain and function.

To the best of our knowledge, this is the first report on the use of aAMSCs for FMTPA. A single injection was effective in treating FMTPA, improving both the AOFAS and VAS score at 9 mo of follow-up.

## CONCLUSION

The present case report indicates that the injection of aAMSCs might be a promising treatment for FMTPA. Obviously, larger cohorts and longer follow-up studies are needed to confirm these findings.

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