Autologous adipose tissue-derived stem cells induce persistent bone-like tissue in osteonecrotic femoral heads.

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Abstract

BACKGROUND:
Osteonecrosis, also known as avascular necrosis, of the femoral head is a debilitating disorder that commonly affects 30- to 50-year-old individuals. Currently, definitive treatment is limited to total hip replacement. However, recent studies have demonstrated bone regeneration in the femoral head after the infusion of bone marrow-derived mesenchymal stem cells. In addition, local injection of adipose tissue-derived stem cells has been shown to regenerate medullary bone-like tissue 3 months after treatment. However, there have been no long-term follow-up studies on humans treated with adipose tissue-derived stem cells for osteonecrosis.
OBJECTIVES:
To determine if treatment with adipose tissue-derived stem cells and platelet-rich plasma leads to the regeneration of medullary bone-like tissue and long-term reduction of hip pain in patients with femoral head osteonecrosis.
METHODS:
This report of two clinical cases was in compliance with the Declaration of Helsinki. Also, the Korean Food and Drug Administration has allowed the use of adipose tissue-derived stem cells (ADSCs) in medical treatments since 2009. To obtain ADSCs, lipoaspirates were obtained from lower abdominal subcutaneous adipose tissue. The stromal vascular fraction was separated from the lipoaspirates by centrifugation after treatment

with collagenase. The stem-cell-containing stromal vascular fraction was mixed with calcium chloride-activated platelet rich plasma and hyaluronic acid, and this mixture was then injected into the diseased hip. The affected hip was reinjected with calcium chloride-activated platelet rich plasma weekly for 4 weeks. Patients were subjected to pre- and post-treatment magnetic resonance imaging (MRI) scans.
RESULTS:
Two patients (34- and 39-year-old men) with femoral head osteonecrosis and severe hip pain were treated with adipose-derived stem cells. The MRI scans of the affected hip in both patients showed segmental areas of low signal intensity (T1 axial views) in the subchondral bones with a "double line sign" consistent with osteonecrosis. The visual analog scale score, physical therapy testing, and Harris Hip score of both patients improved after stem cell treatment. Both patients also demonstrated post-procedure improvement in their MRI scans, evidenced by positive T1 signal changes consistent with medullary bone regeneration. Further, the long-term reduction in hip pain was correlated with the MRI findings indicative of bone regeneration.
LIMITATIONS:
A biopsy of the regenerated tissue was not conducted in either patient. Thus, the true nature of the treatment-induced changes is unknown. Further, the MRI results may contain artifacts due to the difficulty in capturing the exact treatment location. It can only be speculated that there was neovascularization to support the newly regenerated medullary bone-like tissue.
CONCLUSION:
These 2 cases demonstrate the presence of sustained, regenerated medullary bone-like tissue in 2 severely necrotic femoral heads and suggest that this rather simple, minimally invasive percutaneous procedure may hold great promise as a therapy for patients with femoral head osteonecrosis.