Restoration of corneal transparency in a patient with corneal scarring using Mesenchyme Stem Cells

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Dear Editor,

Corneal scarring is one of the leading causes of vision loss for millions of people worldwide. Studies have been reported therapeutic effects of stem cells. In this study, we evaluated the efficacy and safety of stem cell therapy in a patient with corneal scarring.

A 60-year-old man presented to the eye clinic with a longstanding history of blurred vision in his right eye due to corneal scarring. He had a history of keratoconus in both eyes and herpes simplex keratitis in right eye. His best corrected visual acuity (BCVA) was hand movement in right eye and 20/30 in left eye. Slit lamp examination showed corneal scarring in right eye with non-measurable refractive errors. The patient asked any modality other than penetrating keratoplasty. We suggested stem cells therapy as a research method with potential positive or negative effects. For stem cells therapy, we used adipose-derived stem cells (ASCs) from adipose tissue in the abdomen. The prepared ASCs were injected into the corneal stroma. Surgical procedure was similar to intracorneal ring implantation.

After local anesthesia of the cornea, using femtosecond laser (Technolas 520F), an intrastromal pocket was created in the corneal stroma (a depth of half of the cornea according to pachymetry data) with a diameter of 7.0 mm. A 30 degrees anterior side cut incision was made. The intrastromal pocket was opened with a Morlet lamellar dissector. A volume of 1 cc of a solution containing 3×10^6 cells is injected into the stromal pocket. Finally, a bandage contact lens were fit on the cornea to close the incisions, which are removed a week after surgery. To prevent postoperative inflammation and infection, Betamethasone eye drops and Chloramphenicol eye drops were prescribed for 3 weeks.

One month after intrastromal injection of ASCs, a significant decrease in corneal haze was observed, which continued for the next 3 months. During the six-month follow-up examinations, right cornea was transparent and similar to normal cornea (Figure1). After 3 months, the refractive errors of the patient were +4.0/-6.0*165 D and BCVA was 20/80 in left eye. At the six-month examination, the refractive errors of the patient were +3.50/-5.25*170 D and BCVA of the right eye was 20/60. Topographic images showed decreased irregularities and increased regularity in both anterior and posterior surfaces of cornea (Figure2). No evidence of inflammation, infection and side effects were seen after 6 months.
In this patient transplantation of ASCs led to significant improvement in corneal transparency due to stromal remodeling with regular re-arrangement of collagen. For easier access to cells and their extraction from adipose tissue, lack of subsequent immune reactions, we used autologous ASCs from adipose tissue for cell therapy. The use of stem cells in the treatment of corneal diseases showed promising results in the initial studies \(^1\)-\(^3\). Intrastromal injection of human stromal stem cells in mice with stromal opacity restored stromal thickness and improved collagen fibril defects. These cells reconstructed the structure of the stromal matrix and reorganized the corneal collagen and proteoglycans\(^1\). Intrastromal injection of human stromal stem cells in mice with stromal opacity restored stromal thickness and improved collagen fibril defects. These cells reconstructed the structure of the stromal matrix and reorganized the corneal collagen and proteoglycans\(^2\). Stem cells have the ability to regenerate a stable and non-regenerating tissue such as the corneal stroma. These cells regenerate collagenous matrix with uniform diameter and regular interfibrillar spacing, indistinguishable from native stroma\(^3\). Stem cells have immunosuppressive properties and anti-fibrotic wound healing properties\(^4\). Stem cells also release the molecule hepatocyte growth factor (HGF) to suppress the expression of opacity-inducing \(\alpha\)-smooth muscle actin and tumor necrosis factor \(\alpha\). HGF inhibits the conversion of corneal fibroblasts into myofibroblasts, and inhibits the tissue infiltration of inflammatory cells\(^5\). In our view, the therapeutic effects of intrastromal injection of ASCs for corneal scars are related to a set of these factors.

In conclusion, intrastromal injection of ASCs could restore corneal transparency and improve visual acuity in the patient with corneal scarring. This modality was safe and less invasive than the common corneal transplantation. We suggest further studies with more patients and combined other therapies.

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References


Figure

**Fig. 1.** Changes in corneal transparency and topographical findings in a patient with corneal opacity after intrastromal transplantation of ASCs. (A) Preoperative corneal photograph of the right eye. (B) Preoperative corneal topography of the right eye showing the corneal irregularities. Topographic assessments showed corneal remodeling. Initially, K1, K2, and K max were 30.50 D, 39.50 D, and 53.00 D respectively. (C) Postoperative (6- month) corneal photograph of the same eye. (D) Postoperative (6- month) corneal topography of the right eye showing the corneal remodeling. At the six-month examination, K1, K2, and K max were 43.20 D, 45.80 D, and 53.00 D respectively. Firstly, astigmatism of the patient was 8.90 D which was 2.50 D after 6 months. The preoperative thinnest corneal thickness was 301 μm, which reached to 384 μm after 6 months.