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British Journal of Oral and Maxillofacial Surgery 51 (2013) e224–e229

BRITISH Journal of Oral and Maxillofacial Surgery

www.bjoms.com

Secondary correction of posttraumatic orbital wall adhesions by membranes laminated with amniotic membrane

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Accepted 28 January 2013
Available online 19 February 2013

Abstract

The objective of the study was to find out if human amniotic membrane could be used for corrective surgery after trauma to the orbital wall. Because of its proposed antiadhesive qualities, it seemed to be potentially suitable. We studied 8 men (mean age 37 (range 19–74) years) who had deficient ocular movement after fractures of the orbital floor. Five of them had already been operated on. Inclusion criteria were trauma dating back more than 4 months and a soft tissue stricture in the orbital floor diagnosed by magnetic resonance imaging. Patients were treated secondarily with lysis of adhesions and insertion of allogeneic human amniotic membrane laminated on to polyglactin 910/polydioxanone foil, which functioned as the carrier material. Patients were followed up for 3 months, by which time disorders of motility of the ocular bulb had disappeared completely in 5. Two patients had improved motility and a reduction in both their subjective and objective symptoms. One patient had no improvement. The considerable reduction in adhesions and scarring after insertion of the membrane confirms previous assumptions, according to which the epithelial side of the human amniotic membrane has an antiadhesive effect because of its smooth surface.

Keywords: Orbital fracture; Ophthalmology; Diplopia; Restriction; Anti-adhesive

Introduction

Fresh human amniotic membrane has been used for about 100 years in reconstructive and plastic surgery. Since the introduction of a method for cryopreservation with glycerol by Kim and Tseng, transplantation of such membrane has become a common procedure in ophthalmology.[1] Recently, cryopreserved membrane has been suggested as a biodegradable graft as a substitute for soft tissue and as a suitable matrix for tissue engineering.[2] Transplanted membrane has some important properties including the introduction of adhesions, the migration of epithelial cells, and the reduction of inflammation. It also seems to be an immunologically preferred tissue.[1]

We have used human amniotic membrane to support reconstruction of the orbital floor. Fractures of the orbital walls are often followed by prolapse of periorbital tissue and its herniation through the fracture line. Scarring of tissue may cause reduced elevation of the eye with consequent diplopia. In rare cases, these complications develop even after appropriate operative treatment. Allogeneic material is routinely implanted as a substitute for the orbital wall when injuries are being repaired. However, perforated allogeneic material in particular might lead to scarring and adhesions. In a retrospective review, Lee and Nunery reported that the use of titanium orbital implants can lead to adherence of orbital and periorbital structures, which results in restrictive

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0266-4356/$ – see front matter
http://dx.doi.org/10.1016/j.bjoms.2013.01.016

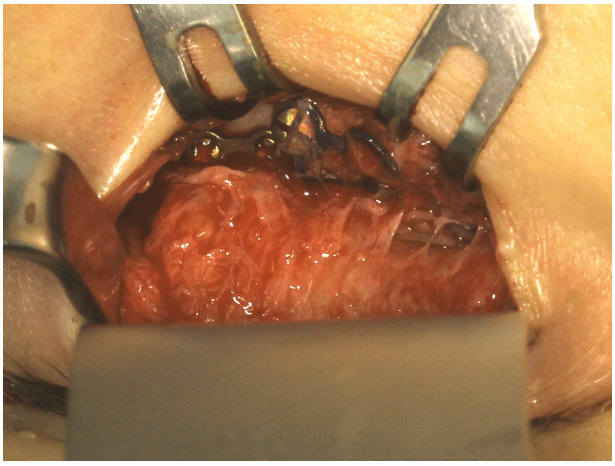

Fig. 1. Infraorbital adhesions and reconstruction material (titanium mesh and remains of a polydioxanone foil) used in the first operation.

diplopia, or retracted eyelids, or both.[3] The insertion of antiadhesive membranes might reduce or avoid diplopia. The use of various materials such as polysaccharide membranes of sodium hyaluronic acid and carboxymethycellulose (Seprafilm, Genzyme Company, Cambridge, MA, USA) and nylon (Suprafoil, S. Jackson Inc., Alexandra, VA, USA) has been proposed.[3,4] Amniotic membrane seems to be potentially suitable, not least because of its various properties and multiple uses in ophthalmological surgery. We have therefore tested it for use in orbital reconstruction to try to reduce the adverse effects of other allogeneic materials.

Patients and methods

Patients

Eight men with defective motility of the bulb after fractures of the orbital floor were treated at our Maxillofacial Unit. The methods were approved by the local ethics committee of the Technical University, Munich. All patients gave written informed consent. The criterion for inclusion in the study was a stricture of the soft tissue in the region of the orbital floor diagnosed by magnetic resonance imaging.

All necessary documents and protocols were recorded to complete the patients' history. All patients had a detailed examination of the eye by an ophthalmologist. Subsequently, an indication for operative revision was established. The mean age of patients was 37 (range 19–74) years. Five of the 8 had had the orbital wall repaired, while the remaining 3 had been treated conservatively. Of the group who were operated on, 2 patients had had a titanium mesh inserted into the orbital floor combined with a polydioxanone (PDS) foil (Ehicon, Norderstedt, Germany); one patient had had a titanium mesh alone, one patient had had PDS alone, and one patient had had an implant of unrecognisable material (Fig. 1).

Preparation and preservation of amniotic membrane

Placentas after Caesarean section were collected after informed consent had been obtained from the donors. They were tested for various viruses (HIV, hepatitis B, hepatitis C, hepatitis A, *Treponema pallidum*, and cytomegalovirus). The placentas were collected and processed under conditions of good manufacturing practice, and according to the Austrian Tissue Safety Act, based on European Community Directives 2004/23/EC, 2006/17/EC, and 2006/86/EC.

Amniotic membrane was peeled off the placenta and washed extensively with phosphate-buffered saline as described by Hennerbichler et al.[5] Subsequently transplants of membrane 8 cm × 8 cm were prepared for grafting and for microbiological and viability testing. All transplants were tested microbiologically and found to be clear of bacteria, and were tested for their residual viability by the EZ4U cell proliferation and cytotoxicity assay (Biomedica, Austria), also described by Hennerbichler et al.[5] The grafts attached to carrier material (Kettenbach, Germany) were transferred into a Cryobag^{TM} with cryomedium containing Roswell Park Memorial Institute (RPMI) medium (PAA, Austria), human albumin (Octapharma, Austria), and dimethylsulphoxide (DMSO; WAK-Chemie, Austria). After being frozen in a controlled-rate freezer (Sylab, Austria), the transplants were cryopreserved at −80 °C. On request, they were shipped to Munich on dry ice and stored at −80 °C until required. At the time of use the grafts were thawed and thoroughly washed several times in Ringer's lactate solution.

Surgical technique

We operated according to a standard protocol. For patients who had previously been operated on we used the same approach as had been used before. For patients who had been treated conservatively we used infraorbital access. After the adhesions and scars had been carefully detached, the remains of the former implant material were also removed (Fig. 2). Titanium meshes were left in place. A polyglactin 910/PDS membrane (Ethisorb, Ethicon, Norderstedt), which served as carrier material, was then coated with allogeneic amniotic membrane (Red Cross Blood Transfusion Service of Upper Austria, Austrian Cluster for Tissue Regeneration, Linz, Austria). The epithelial side of the membrane was placed facing upwards, and the carrier material merely stabilised it (Fig. 3). The preformed patch was placed on to the orbital floor with the epithelial side towards the periorbital tissue (Fig. 4). Transconjunctival incisions were left unsutured. Infraorbital incisions were closed with a continuous USP size 6-0 monofilament suture (Ethilon, Ethicon, Norderstedt).

Postoperative treatment

Patients were followed up for 3 months. During this period, they were examined by an ophthalmologist at defined intervals (1 day, 2 weeks, and 3 months postoperatively) to