



Contents lists available at ScienceDirect

## Journal of Cranio-Maxillo-Facial Surgery

journal homepage: [www.jcmfs.com](http://www.jcmfs.com)

# The use of temporalis muscle graft, fresh and cryopreserved amniotic membrane in preventing temporomandibular joint ankylosis after discectomy in rabbits



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## ARTICLE INFO

## Article history:

Paper received 9 May 2014

Accepted 24 July 2014

Available online 13 August 2014

## Keywords:

Ankylosis  
Temporomandibular joint  
Amniotic membrane  
Muscle graft

## ABSTRACT

**Purpose:** The aim of the study was to evaluate the efficacy of temporalis muscle-fascia graft, fresh and cryopreserved human amniotic membrane as an interpositional material in preventing temporomandibular joint ankylosis in a rabbit model.

**Materials and methods:** In this experimental study, 21 New Zealand white rabbits were used. The condyle and the joint disc were removed to induce ankylosis in left TMJs. Reconstruction was immediately performed with temporalis muscle-fascia graft (tMFG) in group I ( $n = 7$ ), fresh human amniotic membrane (fHAM) in group II ( $n = 7$ ) and cryopreserved human amniotic membrane (cHAM) in group III ( $n = 7$ ). All rabbits were sacrificed at 3 months after the operation. The comparison was made among three groups by means of vertical mouth opening and weight measurements, radiologic and histologic findings obtained before and after surgery.

**Results:** In all rabbits, there was no statistically significant difference in the jaw movements and weight among groups at commencement and 3 months after surgery. The condylar surfaces were more irregular in HAM groups. There were mild osteophyte formations, sclerosis, fibrosis and calcification around the condyle in all groups however the joint gap was more preserved in group I. All interpositional materials were also seen to be partially present in the joint gap at 3 months. Ankylosis was not seen in the joint gap in any group.

**Conclusion:** With the results of this study it was concluded that interpositional arthroplasty with HAM and tMFG have an almost similar effect in preventing TMJ ankylosis after discectomy in the rabbit model.

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## 1. Introduction

Many methods using autogenous and alloplastic materials have been reported for preventing TMJ ankylosis in the literature (Shira, 1984; Dattilo et al., 1986; Posnick and Goldstein, 1993; Shenaq and

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Klebuc, 1994; Ozcan et al., 1998; Dimitroulis et al., 2011, Karamese et al., 2013; Yadav et al., 2014). Gap arthroplasty alone is a standard treatment, but reankylosis of the TMJ has been reported clinically and experimentally (Tuncel and Ozgenel, 2011). Reconstruction with costochondral graft, dermal/fat graft and cartilage graft has some drawbacks such as donor site complications, graft necrosis and also has a risk of overgrowth of the graft (Guyuron and Lasa, 1992). Muscle flaps, particularly temporalis muscle flaps, have been proposed as a way to decrease the risk of reankylosis and to limit the risk of postoperative occlusal changes (Shimizu et al., 2006; Bayat et al., 2009; Liu et al., 2010; Yazdani et al., 2010; Holmlund et al., 2013). Some of the disadvantages of

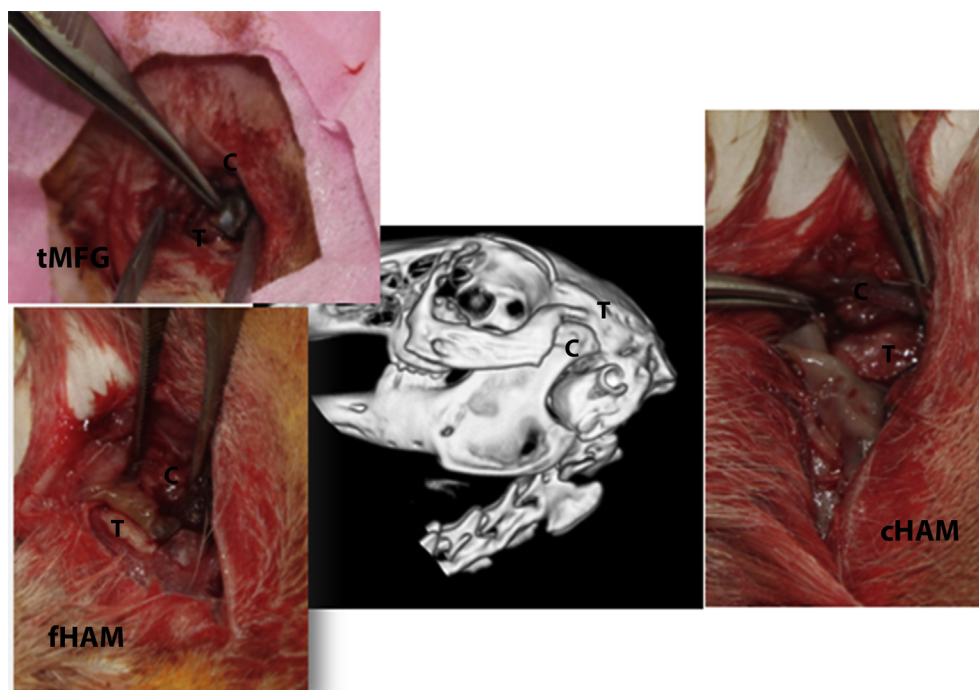
temporalis muscle flap are fibrosis and scar contracture of the temporalis muscle, which may cause trismus, depression in temporal region and chronic headache (Bayat et al., 2009). Also, fresh human amniotic membrane (HAM) as an interpositional material was experimentally first described for preventing TMJ reankylosis in our previous experimental study in 2011 (Tuncel and Ozgenel, 2011). In that study, interpositional arthroplasty with fresh human amniotic membrane was found to be superior to gap arthroplasty alone in the rabbit model at 3 months after discectomy. In similar in vitro and in vivo studies, fresh or cryopreserved human amniotic membrane was shown to be an effective biologic dressing in wound healing and could promote bone healing owing to its osteoinductive activity (Gomes et al., 2001; Karaçal et al., 2005; Lindenmair et al., 2010; Mattioli et al., 2012; Kesting et al., 2014). The absence of rejection of HAM by the rabbits and its antibacterial and antiadhesive properties has been reported in the literature as well (Tuncel and Ozgenel, 2011; Gomes et al., 2001; Kesting et al., 2014). These studies indicate that the amniotic membrane is mainly associated with the early induction of the repair process due to the presence of angiogenic and growth factors.

In the present study, we have tried to make a comparison between temporal muscle graft which is one of the commonly used interpositional arthroplasty materials and HAM. In our previous experimental study, HAM was used only in fresh form. This time, we have used HAM in two different form; fresh and cryopreserved as well. In this study, rabbit model was preferred again owing to the advantages of similar size, shape, and joint structure of rabbits to humans (Sato et al., 1998; Widmer et al., 2002; Tuncel and Ozgenel, 2011).

The aim of this experimental study was to assess and compare the efficacy of the temporalis muscle-fascia graft, fresh and cryopreserved human amniotic membrane as an interpositional material in preventing temporomandibular joint ankylosis in a rabbit model.

## 2. Materials and methods

This experimental study was conducted in accordance with ethical approval of Gaziosmanpaşa University. Twenty-one New Zealand adult white rabbits weighing an average of  $2.69 \pm 0.54$  kg (range, 2.57–2.81 kg) were used. Anesthesia was induced with intramuscular injection of 20 mg/kg ketamine hydrochloride and 2 mg/kg Xylazine hydrochloride. After the left preauricular area was shaved and prepared with antiseptic solution, a 3-cm vertical preauricular skin incision was made and the joint space was opened by a horizontal incision through the joint capsule. The condylar articular head and the joint disc were excised from the articular surface. The temporal articular joint surfaces were shaved. Thereby, a gap of 10 mm was created in TMJ. The rabbits were randomly divided into 3 groups and reconstruction of TMJ was made with three different materials (Fig. 1). In group I ( $n = 7$ ), the reconstruction of TMJ was performed with using temporalis muscle-fascia graft (tMFG) in diameter of  $1 \times 1$  cm obtained from left temporalis muscle. The muscle graft was placed into the gap of the joint. Thus, the muscle filled the gap between the condyle stump and the temporal bone, and no additional fixation was made. Debris was removed by irrigation, and the overlying tissues were repaired in layers. In group II ( $n = 7$ ) and III ( $n = 7$ ) (fHAM and cHAM, respectively), human amniotic membrane (HAM) was used as an interpositional material. HAM was obtained from the delivery room of the Gynecology and Obstetrics Department. Amniotic membrane was separated from chorion under sterile conditions. The membrane was rinsed several times with sterile saline containing penicillin to remove blood residues. In group II, fresh human amniotic membrane (fHAM) with a dimension of  $1 \times 1.5$  cm was immediately placed into the gap. The epithelial surface of the membrane was placed to face the articular fossa. No additional fixation was performed. In group III ( $n = 7$ ), amniotic membrane was cryopreserved prior to surgery. It was stored in a 1:1 mixture of



**Fig. 1.** The preoperative view shows the reconstruction with three different interpositional material. c: condyle; t: temporal; tmfg: temporalis muscle-fascia graft; fham: fresh human amniotic membrane; cham: cryopreserved human amniotic membrane.

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