



Human Amniotic Membrane (HAM) in Oral and Maxillofacial Surgery: A Comprehensive Review

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Abstract

The amniotic membrane or amnion is the innermost layer of the placenta, which consist of a thick basement membrane and an avascular stromal matrix. It's a metabolically active membrane which involved in solute and water maintaining amniotic fluid homeostasis. It has various properties such as Anti-inflammatory, Anti-microbial, Anti- fibrotic, Anti- apoptotic, Immunomodulatory, Epithelialization & cell differentiation –modulating capacity, Inhibition of cancer cell proliferation, Low immunogenicity, Reasonable mechanical property, etc its uses has been described in the literature for various applications in the fields of ophthalmology, plastic surgery and in Oral and Maxillofacial Surgery. In this review we are listing the various applications of Human Amniotic Membrane (HAM) in the field of oral

and maxillofacial surgery which are available in the literature. The various applications of HAM are i) Repair of oroantral fistula ii) after Vestibuloplasty as a bandage, iii) Maxillofacial soft tissue defects, iv) Cervical necrotising fasciitis v) BRONJ vi) treatment of Gingival recession vii) Socket preservation after extraction and viii) after ankylosis surgery of TMJ and using as an Interpositional material etc. In this review we are focussing on various applications of HAM in OMFS

Key words

HAM, Human amniotic membrane, arthroplasty

Introduction

Amniotic membrane is the innermost lining of the human placenta that is normally discarded after parturition and is composed of a single epithelial layer, a thick basement membrane and an avascular stroma. HAM contains two types of cells, Human amnion epithelial cells (hAECs) which are derived from the embryonic ectoderm, and human amnion mesenchymal stromal cells (hAMSCs) which are derived from the embryonic mesoderm. Amniotic membranes have a rich inheritance of collagen types I, IV, V, and VI, proteoglycans, laminin, and fibronectin. Collagen is well tolerated, bioabsorbable and has hemostatic properties, encourages migration of adjacent autogenous connective tissue and epithelial cells over its surface. Laminin exhibits a wide variety of biological activities such as promotion of cell attachment, growth, and differentiation of number of cell types. Fibronectin is involved in many cellular processes including tissue repair, blood clotting, cell migration, and adhesion.¹ Human amniotic

membrane was first used therapeutically by Davis for skin transplantation in 1910.² Stern described the uses of HAM for burned and ulcerated skin surfaces in 1913. In OMFS it's been used for more than 2 decades for various applications and Lawson first used amniotic membrane with a pectoralis major muscle flap for intraoral lining in 1985. Because of its properties it's been used for a wide range of applications in OMFS.

Properties of Human Amniotic Membrane

- Anti-inflammatory³
- Anti-microbial¹
- Anti-angiogenic^{4,5}
- Immuno modulatory⁶
- Anti- fibrotic
- Anti- apoptotic
- Epithelisation & cell differentiation –modulating capacity
- Inhibition of cancer cell proliferation
- Low immunogenicity
- Reasonable mechanical property^{8,9,10,11,12,13}

In addition to their mechanical properties HAM possess stability, permeability, elasticity, flexibility, plasticity and resorbability in a rate which is identical to the tissue replacement.¹⁴

Applications of HAM in Maxillofacial Surgery

Various application of HAM in maxillofacial surgery includes as a dressing material after vestibuloplasty , mucosal defects after the excision of mucosal lesions, maxillofacial soft tissue defects, cervical necrotising fasciitis, BRONJ, repair of an oroantral fistula, implant site, socket preservation, bandage for the donor site of Split skin graft etc. Literature supports the finding that HAM can be successfully used as a graft after mucogingival surgeries.^{15,16,17}

1. After vestibuloplasty

One of the most dissatisfying aspect after the vestibuloplasty procedure is the raw wound which is created after the procedure, which was left open in the past, which makes the patient discomfort.

HAM can be used as a dressing material to cover this raw wound and literature reports that after the Clarks procedure, it can be used as dressing agent for covering the raw periosteal surface, which also helps in preventing the secondary contraction and maintains the vestibular depth for the future denture seating.^{15,16,17}

2. Post surgical oral mucosal defects

Post surgical oral mucosal defects created after the excision of mucosal lesions such as leukoplakia, verrucous hyperplasia etc HAM can be sutured to those sites where mucosal lesions were excised . suturing makes it immobile and offers advantages such as a dressing agent for the raw wound, promotes healing and epithelisation without specific complications. Literature suggests that

HAM is a biological graft material with useful inherent properties and offers promising results in the repair of post surgical oral mucosal defects.^{18,19,26}

3. Amnionchorion strips for the treatment of periimplantitis

Treatment of periimplantitis is one of the most challenging procedures in implant dentistry.

In a case report by Mohamed A Maksoud , reported that achievement of favourable results such as soft tissue healing and re establishment of osseo integration on treating periimplantitis with amnion chorion strips.²⁰

4. Repair of Oro antral fistula

Oro antral fistula is an abnormal communication between maxillary sinus and the oral cavity. Frequently occurs during excessive application of force for the removal of molar roots which are very close to sinus, inadvertent instrument usage etc. various modalities for the treatment of OAF are using pedicled flaps, free flaps and biomaterials. Human amniotic membrane proved to be an excellent scaffold layer for covering the defects of an iatrogenic oroantral communication . The membrane enhanced wound healing and complete functional and esthetic rehabilitation occurs without much complications. Its cost effectiveness, ease of availability, satisfactory results , simple storage and processing methods makes HAM a good alternative to the conventional methods in the treatment of an established Oro antral Communication.²¹

5. Treatment of BRONJ

Bisphosphonate related osteonecrosis of jaw (BRONJ) one of the serious complications following the usage of Bisphosphonates eg: Alendronate, Zoledronate etc

Due to the properties of HAM its believed that patients with BRONJ can be benefitted with the usage of HAM after the surgical debridement of bone. Literature suggest that results of usage of HAM in patients with BRONJ are promising as they aid in pain reduction and definitive wound healing.²²

6. Socket preservation after extraction of tooth

Alveolar ridge atrophy has significant impact on tooth replacement therapy, particularly when implant supported prosthesis are planned.²³ Socket preservation is the term used for alveolar preservation of the undamaged tooth socket with biomaterials or autologous bone following tooth removal. Rasoul Gheisari in their comparative study reported that average bone density was higher in the amniotic membrane group and has shown better results when compared to collagen membrane. Accessibility and lower cost are the advantages of using human amniotic membrane in the socket preservation. HAM is an alternative to other materials which are used for socket preservation due to its properties and cost effectiveness.²⁴

7. Biological dressing to aid reconstruction of maxillofacial soft tissue defects

Dehydrated human amniotic membrane provides an alternative to local tissue transfer and skin grafting for traumatic injuries involving the nose. Literature review have demonstrated that dehydrated human amniotic membrane to be effective as an allograft in ocular surface reconstruction and in healing chronic wounds and burns. Human amniotic membrane allograft provides an efficacious

and cosmetically acceptable alternative to local and regional tissue transfer. Application of dehydrated HAM is a cost-effective strategy for treating wounds involving of the nose not involving the cartilage and perichondrium when compared to reconstruction with local or regional tissue transfer.²⁵

8. As a dressing material for cervical necrotizing fasciitis

Necrotizing fasciitis is a severe and potentially fatal infection of the dermal, fascial and subcutaneous layers of the skin with the marked feature of absence of clear local boundaries or palpable limits. It can affect any parts of the body .the commonest cause of cervical nerotizing fasciitis is dental infections ²⁷ mostly from a carious lower molar tooth. Considering the properties of the HAM , and easy availability and lower processing and storage charges, HAM appears to be a useful dressing material after the debridement as HBO therapy cannot be afforded by all the patients due to the cost factor and unavailability of the facility especially in the developing countries.²⁸

9. As a dressing for split skin graft donor sites

Split skin grafts are used widely in fields of reconstructive surgery. Treatment with HAM as a dressing agent for split skin graft donor sites results in improved esthetic results and in less hypertrophic scarring. While comparing with the PU covered wound following first 75 days of surgery , there were no significant difference in the overall speed of re epithelisationwas noted. Thereby HAM is a cost effective dressing for split skin graft donor sites in developing countries. ²⁹

10. HAM as an interpositionalarthroplasty of TMJ ankylosis

Ankylosis of TMJ refers to fusion of mandibular condyle to the base of the skull, due to trauma and forceps delivery being the most common cause and clinically significant feature of restricted mouth opening with significant reduction in the growth and development of jaw. Most accepted treatment modality for TMJ ankylosis is the Kabansprotocol .³⁰ After the ankylosis release HAM can be used as an interpositional material as it has a number of advantages, they are,

- i) as its an avascular tissue, post surgical chances of hemorrhage or hematoma formation are reduced
- ii) the exposed periosteal neural tissues are covered with HAM causing less chances for neural irritation and pain.
- iii) Rehabilitation time is shortened
- iv) Multiple layered HAM gives good cushioning effect to the bony margins
- v) Alloplasts are associated with foreign body reactions, but its reduced by the usage of HAM.³¹

11. Amnion membrane for coverage of gingival recession

Gingival recession is the display of the root surface of the tooth characterized by displacement of the gingival margin apically from the cemento-enamel junction (CEJ). Associated with functional and esthetic problems including root caries, pulp hyperemia etc. various treatments for gingival recession as per literature are pedicle and free soft tissue grafts, and all these have drawbacks such as creation of a second surgical site, donor site morbidity, limited availability etc. HAM contains a variety of proteins which promotes cellular migration, proliferation and wound healing. HAM is an excellent alternative to the conventional procedures which are used for the treatment of gingival recession and its results are promising.³²

Conclusion

Amniotic membrane is the innermost lining of the human placenta that is normally discarded after parturition. It has multiple advantages as its readily available and reduced cost for processing and storage and its promising properties such as anti-inflammatory, anti-apoptotic, anti-microbial etc. It has been used in various treatments of Oral and Maxillofacial Surgery for eg: one of the best materials ever for interpositional arthroplasty. Its disadvantages are the risks of chances of bacterial, viral or fungal infection transmission if the donors are not screened properly for communicable disease, if the membrane is not processed or stored under sterile conditions.³³

Conflicts of interest

The authors declare they have no potential conflict of interests regarding this article.

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