Chorion Membrane: Periodontal Aspect

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Abstract :

Chorion membrane it is a fetal membrane, composed of amniotic and chorion tissues. The chorion forms the outer limit of the sac that encloses the fetus and is composed of different type of collagen and cell adhesion bioactive factors. These are known to aid in the formation of granulation tissue by stimulating fibroblast growth and neovascularisation. These properties suggest that a chorion membrane may have considerable potential for regeneration.

Introduction

Placental membranes have their origin from extraembryonic tissue. This tissue is composed of a fetal component (the chorionic plate) and a maternal component (the deciduas). The fetal component includes the amnion and chorion membranes which separate the fetus from the endometrium. The structure of amniotic membrane has three parts which are epithelial monolayer, a thick basement membrane, and an avascular stroma[1].

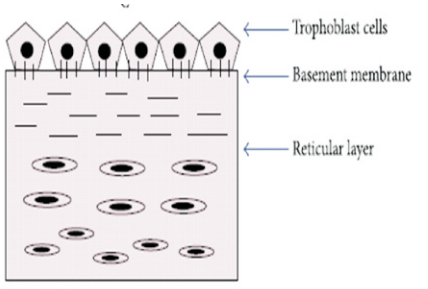

Fig 1. Line diagrammatic representation of histological architecture of chorion membrane[1]

Placental membrane	Layers of placental membrance	Extracellular matrix component
Chorion	(1) Reticular Layer (2) Basement membrance (3) Trophoblasts Collagen	Type I,III,IV & VI, Proteoglycans Collagen type IV, fibronectin & laminin

Table 1.Structure and composition of placental membrane (chorion)[1].

Anatomy & Histology :

Chorion membranes have a rich inheritance of collagen types I, IV, V, and VI, proteoglycans, laminin, and fibronectin. Collagen is well tolerated and bioabsorbable, has hemostatic properties, and encourages migration of adjacent autogenous connective tissue and epithelial cells over its surface. Laminins exhibit variety of biological activities including 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. Such diverse properties make them a unique novel and potential biomaterial for use in medicine, tissue engineering, stem cell research, repair, and regeneration.[2].

Properties of Chorion Membrane :

- **Biomechanical Properties**

Thickness of normal chorion membrane lies between 0.02 and 0.5 millimetres which includes around 6–8 layers of cells. An average surface area of this membrane is about 1600 square centimetres . An important property of chorion membrane is its resistance to various proteolytic factors owing to the presence of interstitial collagens. Elastin present in amnion is responsible for providing elasticity. It has multiple metabolic functions such as its role in water and soluble material transportation and production of bioactive peptides, growth factors, and cytokines[3].

- **Promotion of Epithelialization**

Chorion membrane facilitates migration of epithelial cells, reinforces basal cell adhesion, promotes epithelial differentiation, prevents epithelial apoptosis, and promotes epithelialization in healing of wounds[4]. Various growth factors produced by amniotic membrane can stimulate epithelialization[5]. It can also promote expansion and maintenance of epithelial progenitor cells in vivo and can produce endothelin-1 and parathyroid hormone related protein. Brain natriuretic peptide and corticotrophin releasing hormone are also produced by membrane epithelial cells which play roles in increasing cellular proliferation and calcium metabolism. Expression of mRNA for epidermal growth factor, hepatocyte growth factor receptor, and keratocyte growth factor receptor was demonstrated by Koizumi et al. in 2000[22] in cryopreserved amniotic membrane. Its basement membrane serves as a safe and suitable bed for the growth of epithelial cells. Sufficient oxygenation for epithelial cells is provided by its good permeability in contrast to other synthetic materials. Thus, amniotic membrane is an ideal tissue which facilitates the growth of epithelial cells, helping in their migration and differentiation[6].

- **Inhibition of Fibrosis**

The amniotic membrane possesses antifibrosis property. Fibroblasts are naturally responsible for scar formation during wound healing and are activated by transforming growth factor β. Amniotic membrane reduces the risk of fibrosis by down regulation of transforming growth factor β and its receptor expression by fibroblasts. There-fore, scaffold of an amniotic membrane modulates wound healing by promoting reconstruction of tissues rather than promoting formation of scar tissue[7].

- **Inhibition of Inflammation and Angiogenesis**

The exact mechanism of the anti-inflammatory properties of amniotic membrane is not clear. It is hypothesized that it decreases influx of inflammatory cells to the wound area and consequently reduces inflammatory mediators by serving as a barrier. It entraps T lymphocytes when it is applied as a patch in vivo[29]. Matrix metallo-proteinases released by neutrophils and macrophages are taken care of by inhibitors of matrix metalloproteinases found in the amniotic membrane. Presence of various tissue inhibitors of metalloproteinases 1, 2, 3, and 4, interleukin-10, and interleukin-1 receptor antagonists and endostatin which inhibit endothelial cell proliferation, angiogenesis, and tumor growth has also been observed in amniotic membrane[30]. The presence of proteinase inhibitors may facilitate wound healing[31]. Thrombospondin-1, secreted by the amniotic epithelium, acts an antiangiogenic factor. Two very potent proinflammatory mediators, interleukin-1α and interleukin-1β, are suppressed by matrix of stroma of amniotic membrane. Shimmura et al. in 2001[29] reported that amniotic membrane reduces inflammation through entrapment of inlammatorycells . A high molecular-weight glycosaminoglycan, hyaluronic acid, present in large quantities in amniotic membrane acts as a ligand for CD44 which is expressed on inaflmmatory cells. It plays an important role in adhesion of inflammatory cells including lymphocytes, to the amniotic membrane stroma . Other substances expressed in the amniotic membrane are low-molecular-mass elastase inhibitors which include secretory leukocyte proteinase inhibitor and elastin .These inhibitors have antimicrobial actions in addition to their anti-inflammatory properties. They protect related surfaces from infection, thereby acting as components of the innate immune system[32]. Both antimicrobial and anti-inflammatory properties can also be induced into amniotic membranes by their treatment with both lacto ferrin and interleukin-1 receptor. Lactoferrin, a globular multifunctional protein, has both antimicrobial and anti-inflammatory qualities. It serves as an antioxidant and an iron chelator in tissues and suppresses the production of interleukin-6 in the amniotic fluid during amniotic infection. Interleukin-1 receptor antagonist on the contrary reduces inflammation as it is a potent inhibitor of interleukin-1 which is a mediator of inflammation[8].

- **Lack of Immunogenicity**

Occurrence of acute rejection after transplantation of amniotic membranes is negated by the fact that amniotic epithelial cells do not express HLAA, HLA-B, HLA-D, and HLA-DR antigens but express HLA-G on their surfaces[34]. Presence of interferon γ and other immunologic factors has also been observed in the amniotic membrane. It seems that amniotic membrane may induce immunologic reactions in the presence of viable epithelial cells. One study revealed that transplantation of fresh

amniotic membrane is associated with a mild inflammatory response. This could be probably due to expression of HLA-I antigens by viable epithelial cells[35]. However, immunogenicity of cryopreserved amniotic membrane is less than that of fresh amniotic membrane as epithelial cells are lost in cryopreservation. T lymphocytes in allograftedlimbus cells are suppressed by amniotic membrane. this implies immuno suppressive properties of amniotic membrane which can increase the chances of successful grafting. As tissue grafts of placental membrane materials present a low risk of immune rejection, they are considered to be bestowed with "immune privilege[9]

- **Antimicrobial and Antiviral Properties**

The risk of infection is reduced by amniotic membrane due to its antimicrobial and antiviral properties[38]. Microorganisms upon their entry into the body are eliminated by our immune system through an adaptive immune response, β-defensins, a major group of antimicrobial peptides and an integral part of the innate immune system, which are expressed at surfaces of mucosa by epithelial cells and leukocytes[39,40]. Amniotic membranes also have the ability to produce β-defensins with the predominant type present in amniotic epithelium being β3-defensin . Kjaergaard et al. in 2001[41] have also shown in vitro antimicrobial effects of the amnion and chorion against certain microorganisms. Its antiviral properties are exhibited by presence of cystatin E, the analogue of cysteine proteinase inhibitor[41]. There is still further need for studies to verify these properties of the amniotic membrane[42]. Amniotic membrane may prevent infiltration and adhesion of microorganisms to wound surfaces by acting as a barrier. The hemostatic property of collagen fibers of amniotic basement membrane prevents hematoma formation in clean surgical wounds. This reduces bacterial load and risk of infection by preventing accumulation of microbes. Another mechanism of action against infection by membranes is through their adhesion to the wound surface. This attachment prevents formation of dead space and accumulation of serous discharge. Furthermore, bacterial entrapment and stimulation of migration of phagocytes also occur by fibrin filaments formed during wound healing. These laments cause adhesion of the wound bed to amniotic membrane collagens. There is a report that bacterial proliferation is reduced even in contaminated wounds by amniotic membrane[10].

- **Cell Differentiation Property**

The fetal placental tissues have the potential to transform into different cell lineages. The hematopoietic lineage is found in the chorion, allantois, and yolk sac; and the mesenchymal lineage is found in both the chorion and amnion. The cells isolated from the chorion are good sources of cells of hematopoietic and mesenchymal lineages as they possess these properties. It is considered that the amniotic membrane can maintain pluripotent stem cell potential for cell differentiation[10]

Uses in Periodontics :

1. Periodontal Regeneration
2. Promotes Wound Healing
3. Act As A GTR Membrane
4. Promotes Osteogenesis

Related Studies:

Chakroborthy S, Sambastiviah S, Kulal R, Blicnomath S. (2015)[11] conducted a clinical trial with twelve systemically healthy patients having at least 2 bilateral Miller's Class I or Class II gingival recession were recruited and coronally advanced flap was performed with amnion membrane or chorion membrane. Clinical parameters such as gingival Index, plaque index, length of the recession, width of the recession, width of keratinized gingiva, relative attachment level were evaluated at baseline, 3 and 6 months post-surgery. Results comes out to be, total mean percentage of root coverage was 34% for chorion site and 22% for amnion site. Both amnion membrane and chorion membrane has shown to be versatile allograft material to be used in the treatment of root coverage.

Suresh DK, Gupta A (2013)[2]They have presented a case report in which a 56-year-old male with a vertical recession depth of 2 mm in the maxillary right canine was treated with coronally advanced flap along with placement of chorion membrane. Three months after surgery, there was 100% root coverage, and the soft-tissue biotype also changed from thin to thick. Chorion membrane, which is a rich source of various collagen and non-collagen proteins, can be used for root coverage and enhancement of thin gingival biotype to thick biotype.

Refrences :

1. Gupta A, Kedige SD And Jain K. Amnion And Chorion Membranes: Potential Stem Cell Reservoir With Wide Applications In Periodontics. Int J Biomaterials. 2015;---:1-9.
2. Suresh DK, Gupta A. Gingival Biotype Enhancement And Root Coverage Using Human Chorion Membrane. ClinAdvPerio. 2013:3:237-42.
3. Rao TV And Chandrasekharam V, Use Of Dry Human And Bovine Amnion As A Biological Dressing. Arch Surg 1981;116:891-96.
4. Pollard SM, Aye NN, And Symonds EM. Canning Electron Microscope Appearances Of Normal Human Amnion And Umbilical Cord At Term. BJOG 1976;83:470-77.
5. Fukuda K, Chikama T , Nakamura M. Differential Distribution Of Subchains Of The Basement Membrane Components Type IV Collagen And Laminin Among The Amniotic Membrane, Cornea, And Conjunctiva. Cornea 1999;18:73-9.
6. Robson MC, Krizek TJ, Koss N, AndSamburg JL. Amniotic Membranes As A Temporary Wound Dressing. Surgery, Gynecology& Obstetrics 1973;136:904-6.
7. Koizumi NJ et al. Growth Factor MrnaAnd Protein In Preserved Human Amniotic Membrane. Curr Eye Res 2000;20:173-77.
8. Datta H, Sarkar K, AndChatterjee PR. Amniotic Membrane Transplantation In Ocular Surface Disorders. J Ind Med Assoc 2004;102:726-29.
9. Tseng SCG, Li DQ, And Ma X. Suppression Of Transforming Growth Factor-Beta Isoforms, TGF-B Receptor Type II, And Myofibroblast Differentiation In Cultured Human Corneal And Limbal Fibroblasts By Amniotic Membrane Matrix. J Cell Physiol 1999;179:325-35.
10. Streilein JW. Unraveling Immune Privilege. Science;1995:270:1158-59.
11. Chakraborthy S Et Al. Amnion AndChorion Allografts In Combination With Coronally Advanced Flap In The Treatment Of Gingival Recession: A Clinical Study. J ClinDiag Res. 2015;9:98-101