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Review Article

Amniotic Membrane- A New Vista in Periodontics

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ABSTRACT:

Periodontal diseases are very common these days and thus it is a matter of concern for dentist. The infection affects the teeth as well as structure surrounding the teeth for example gums, periodontal ligament etc. surgical as well as non surgical treatment is most commonly preferred for the treatment of periodontal disease however a satisfactory result is not obtained. Recently amniotic membrane is being admired in periodontics because of its healing potential and regenerative capacity. Amniotic membrane is nothing but the inner most lining of placenta. This amniotic membrane has proteins, growth factors, stem cells etc which all together helps in regeneration and repair.

Keywords: Periodontal disease, amniotic membrane, regeneration, repair

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INTRODUCTION:

Periodontal disease is one of the most common dental diseases faced by patients as well as clinicians. Various factors are responsible for periodontal pathology life age, eating habits, smoking, pan chewing etc. However the gram negative bacteria underlying beneath the plaques are considered to be the main culprit of periodontal pathology.¹ Periodontal pathologies lead to loss of periodontal attachment which includes cementum, periodontal ligament, and alveolar bone. Efforts have been made by clinicians to regain the lost attachment however the end result obtained was repair. Original morphology can be obtained through repair; repair simply means healing of tissue. The curiosity to obtain original morphology of tooth,

surrounding tissue and to restore the functionality of tissue leads us to regeneration.

Regeneration of tissue is a complex phenomenon and so is wound healing. Healing of wound requires growth factors, proteins, extracellular matrix, cells etc. Mesenchymal stem cells have a very important role to play in healing; these cells are rich in connective tissue, growth factors, proteins and very well known for their regenerative capacity. Langer and colleagues suggested tissue regeneration for regeneration of periodontal tissues in the year 1993.² Stem cell therapy in near future will be the boon in periodontics. Mesenchymal cells can be derived from amniotic fluid, umbilical cord. Around 100 years back Davis in the year 1910 suggested that fetal membranes can be used as skin substitute in treatment of open wound.⁴ Later

Dino et al in the year 1965 demonstrated that amniotic membrane could be separated, sterilized, stored and safely used later when needed.⁵ After that research were done to understand the process of regeneration. Few authors suggested that periodontal regeneration is a complex process and it requires locally-derived progenitor cells which can differentiate into periodontal ligament cells, cementoblasts, or osteoblasts.^{6,7}

According to the literature studies have shown that amniotic cells have the capabilities to stimulate the repair of injured tissues. The process takes place via paracrine actions, and it act as vectors for bio-delivery of exogenous factors.³ This cells is preserved and stored can serve as an alternative source of stem cells. These cells have potential to form bone, muscles, and soft tissue etc. studies have reported that amniotic cells were used successfully in treatment of neurotrophic corneal ulcers, reconstruction of conjunctival and ocular surfaces, ocular cicatricial pemphigoid or Stevens-Johnson syndrome, in furcation defects, intrabony defects, and gingival recession coverage.

Basic structure of amniotic membrane

Human placenta is an organ that develops few days after fertilization. Placenta has immense role in survival and development of fetus as it connects the developing fetus to uterine wall and allows nutrient uptake, thermoregulation, and gas exchange via mother. Placenta not only provides oxygen and nutrient to fetus but also helps to remove waste products from fetus. Placenta produces various hormones to support pregnancy. Placenta consists of two membranes, outer and inner membrane. Inner membrane is known as amniotic membrane and outer membrane is known as chorion.⁹

Amniotic fluid and fetus is surrounded by amniotic membrane. Its highly flexible in nature and can be easily separated from chorion.⁸ Amniotic membrane consist of two different types of cellamion epithelial cells which is derived from embryonic ectoderm and amnion mesenchymal cells from embryonic mesoderm. Studies have shown that at ultra structural level it is a thin, tough, transparent, avascular composite membrane composed of three major layers: a single epithelial layer, a thick basement membrane, and an avascular mesenchyme consisting mainly of collagen.^{10,11} The amniotic epithelial cell layer is cuboidal and columnar cells and this cells are in direct contact with the amniotic fluid. Amniotic MSC are obtained from amniotic epithelial cell layer and is stored and further used for regenerating tissues. These cells are pluripotent cells and act as a perfect reservoir for stem cells. Amniotic membrane lacks nerves, muscles, or lymphatics.¹² studies have suggested that amniotic mesoderm consist of macrophages and fibroblast-like mesenchymal.¹³

Basement membrane of amnion and other parts of body like gingiva, conjunctiva is very similar to each other. This similarity makes amniotic membrane an ideal carrier for ex vivo culture and transplantation of embryonic stem

cells. The basal lamina of amniotic membrane consist of huge amount of proteoglycans like heparan sulfate which is also one of the major proteoglycan in the gingiva. Actin, α -actinin, spectrin, ezrin, cytokeratins, vimentin, and desmoplakin are present in amnion epithelium. This justifies their role in the structural integrity and modulation of cell shape of the healing tissue. The stromal portion of the amnion which is spongy has an abundance of hydrated proteoglycans and glycoproteins that form a non fibrillar network along with collagen.^{14,15}

The extracellular matrix of amniotic membrane is rich in growth factors like keratinocyte growth factor, basic fibroblast growth factor, TGF- β , nidogen growth factor, and epidermal derived growth factor. These growth factors are considered to be responsible for periodontal regeneration. Amniotic epithelial cells also secrete collagen type III and IV and non collagenous glycoproteins.¹⁵ studies have shown that enamel matrix derivate causes an increase in cell attachment of epithelial cells, gingival fibroblasts, and PDL fibroblasts.¹⁶

Advantages

- Anti-inflammatory
- Antimicrobial
- Epithelialization
- Mesenchymal source
- Anti scarring
- Minimizes pain
- Increases fibro genesis and agenesis
- Immunomodulatory
- Angiogenesis
- Increases vascularization and revascularization

Anti inflammatory:

The mesenchymal stem cells of amniotic membrane down regulates the secretion of proinflammatory cytokines like tumor necrosis factor alpha and interferon while increases the production of anti-inflammatory cytokines interleukin-10 and interleukin-4. It also suppresses the pro inflammatory mediators, interleukin-1 α and interleukin-1 β . The inhibitors of matrix metalloproteinases (MMPs) is also found in the amniotic membrane which decreases matrix MMPs released by infiltrating neutrophils and macrophages. According to the researchers Amniotic memberane secretes vascular endothelial growth factor, hepatocytes growth factor that maintain a proper balance between TGF-1 and TGF-3 that prevents scarring.¹⁷ amniotic membrane also supresses immune cells like T cell, dendritic cell and B cell that prevents pathological remodeling and excessive fibrosis.^{18,19}

Antimicrobial

Amniotic membranes antimicrobial activity helps to prevent wound from infection. A firm adherence barrier is formed within the wound with the help of fibrin and elastin, which

in turn seals the wound and prevent bacterial contamination.²⁰ Tight adherence obtained from seal helps in restoring lymphatic integrity, protects circulating phagocytes from exposure and allows faster removal of surface debris and bacteria from the wound.²¹ Two mechanisms are generally responsible for antimicrobial nature of amniotic membrane i.e. via secretion of antimicrobial factors such as LL-37 and indirectly, via secretion of immunomodulative factors which will upregulates bacterial killing and phagocytosis by immune cells.^{22,23}

Epithelialization

Amniotic membrane helps in wound healing by promoting epithelialization in healing wound. It also facilitates migration of epithelial cells, reinforces basal cell adhesion, and promotes epithelial differentiation. Amniotic membrane is considered to be an ideal tissue for growth of epithelial cells because basement membrane of amniotic membrane enmeshes growth of epithelial cells and provide sufficient oxygenation to cells.⁷

Minimizes pain

Its special role in reducing pain during surgical procedure is noticed. Studies have shown that it decreases inflammation and provides a better state of hydration that soothes the wound bed to promote faster healing.²⁴ Exposed nerve endings are protected by soft mucoid layer of amniotic membrane from external irritant are that help to decrease pain sensation by preventing nerve stimuli. CAM also supported the growth of the epithelium and facilitates migration and reinforced adhesion.

Increases fibrogenesis and angiogenic

Amniotic membrane increases the production of VEGF by activating the VEGF receptors 1 and 2. Extensive neovascularization occurs due to the release of angiogenic factor like insulin derived growth factor that promotes granulation tissue formation and epithelialization. This property helps in the development of tissue engineered vascular grafts.

Role of amniotic membrane in dentistry

Role of amniotic membrane has recently increased in dentistry especially in periodontics as an allograft material for both acute and chronic wound, scar tissue. Its role in soft tissue regeneration graft is also observed.²⁵ Meng et al suggested that ECM of the amniotic membrane is effective for peripheral nerve regeneration and is used as a biodegradable scaffold with unique biochemical because of this it is used for neuronal regeneration and differentiation.²⁶ Its anti inflammatory property as shown promising result in scalpel and laser surgeries.²⁷

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