Hyaluronic Acid Uses in Oral Health

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ABSTRACT

Hyaluronic acid is an essential component of connective tissue. It is present in the extracellular matrix of tissues, synovial fluid, and other bodily fluids. Its biological activity results from their interaction with growth factors, osmotic pressure regulation, and tissue lubrication. All of these functions support the preservation of the tissue's homeostatic and structural integrity. The majority of cells in the body produce hyaluronic acid, which is synthesized in the cell membrane by a membrane-bound protein and secreted into the extracellular space, primarily by fibroblasts, when endotoxins are present. In dentistry, hyaluronic acid has evidenced anti-inflammatory, antiedematous, antibacterial, and wound healing properties that are helpful in the treatment of many oral diseases like periodontitis, which is caused by various bacteria present in subgingival plaque with mechanical therapy that causes tissue regeneration. This type of treatment might benefit many individuals, particularly those who are predisposed to systemic disorders such as cardiovascular disease and diabetes caused by periodontal disease.

Key words: Gingivitis, healing, hyaluronic acid, implant, oral mucous regeneration, oral ulcers and periodontitis.

Hyaluronic acid (HA) is a polysaccharide which is present in the connective tissue. Several bodily fluids, including synovial fluid, serum, saliva, gingival crevicular fluid (GCF), and others contain this high molecular weight, biocompatible molecule. This substance exhibits a wide range of physiological and structural traits, including volume maintenance and improved tissue resistance, cellular and extracellular interactions, interactions with growth factors, regulation of osmotic pressure, tissue lubrication, bactericidal and fungistatic effects, anti-edematous and osteoconductive effects1. Hyaluronic acid (HA) is used in numerous medical studies for all of the aforementioned reasons. Most recently, it was also introduced into the dentistry field for perioral aesthetics. It has been noticed that its intraoral use may have a number of advantages, despite the fact that this is not well documented. The aim of this review was to summarize the potential uses of hyaluronic acid (HA) in intraoral dental procedures.

Importance of Hyaluronic acid in human body

A homogeneous, unbranched glycosaminoglycan made up of repeating disaccharides is termed HA ($C_{14}H_{21}NO_{11}$). The extracellular matrix (ECM) in the human body contains a significant amount of HA biopolymer (native HA), which is present in many different tissues.2,3 Native HA is a biomolecule that is found in low concentrations in cementum and alveolar bone as well as in oral tissues like the gingiva and periodontal ligaments (which are produced by fibroblasts and keratinocytes). Additionally, total saliva that has not been stimulated contains HA at a concentration of 148–1270 ng per milligramme of protein.2,4 This variation in HA levels is mainly due to variations in the individual diet, oral hygiene, genetics, oral anatomy, health and disease state, and others.

HA is normally synthesized by the proteins (HA synthases), which are of several forms in humans: HAS1, HAS2, and HAS.3,5 The several kinds of hyaluronidase enzymes found in the human body are in charge of the enzymatic breakdown of HA. An estimated 85% of HA is excreted in the lymph nodes, with the remaining 15% being eliminated through the liver and kidneys. Hepatocytes further metabolize the CO_2, NH_3, acetate, and lactate produced by complete HA breakdown to produce CO_2, H_2O, and urea. HA molecules, their receptors, HA synthases, and HA hyaluronidase enzymes are tissue-specific and influenced by a variety of factors, including stage of development, gender, age, health/disease condition, and environmental factors.

Hyaluronic acid and Oral ulcers

A linear polymer of glucuronic acid and N-acetylglucosamine disaccharide is known as hyaluronic acid (HA). The primary purpose of HA is to promote angiogenesis, cell proliferation, migration, and tissue repair, including the activation and control of inflammatory reactions.6 Through the growth of basal keratinocytes, it also encourages re-epithelization. HA is a hygroscopic macromolecule, and its solutions are highly osmotic. This property allows for control of tissue hydration in the oral mucosa during times of inflammation or in response to tissue damage that results in the formation of

ulcers. HA 0.2 percent is superior to topical steroids because it can be used on all patients, including infants and pregnant women, who are contraindicated to using steroids. It may be used for oral ulcerations of various grades.

Hyaluronic acid in gingivitis

HA is a helpful adjuvant therapy for gingivitis nowadays. In addition to scaling and regular oral hygiene, topical treatment with 0.2 percent HA in spray or gel twice daily for three to five weeks improved plaque indices, papillary bleeding index (PBI), and gingival crevicular fluid (GCF) variables in patients with gingivitis. This treatment significantly improved the gingival index (GI) and PBI compared to other forms of treatment.7

Hyaluronic acid in periodontitis

HA is an essential component of the periodontal ligament matrix and plays various important roles in cell adhesion,migration and differentiation mediated by various HA-binding proteins and cell-surface receptors such as CD44.8,9 In addition, the large size and high negative charge of HA enable it to absorb large amounts of hydration water and exert significant pressure onto the surrounding tissue, producing expansion of the extracellular space. This function of hyaluronan exerts the buffering action to the bite force on the periodontal ligament. It also possesses a bacterios-tatic effect and anti-inflammatory effect. It plays a major role in the early stages of wound healing.

Conventional periodontal treatment consists of providing information to the patient about periodontal disease, instructions concerning oral hygiene, and professional scaling. In some cases if there is no improvement, surgery is indicated to gain access to the pocket area for proper debridement, to eliminate the pathological tissue, and to reconstruct bone, cementum, periodontal ligament and gingiva.

Hyaluronic acid in dental implant surgery

Immediate dental implant placement was introduced more than 30 years ago by Schulte and Heimke in 1976.The primary benefits of immediate implant placement are fewer visits, which decreases treatment time and enhances patient satisfaction, perfect three-dimensional implant positioning, and preservation of alveolar bone in the extraction socket. However, immediate implants may have several disadvantages that might impact the success rate, such as inadequate primary implant stability when compared to delayed implants, inadequate soft tissue closure, particularly in the case of thin tissue biotype, inability to inspect all parts of the extraction site for defects or infection.

Hyaluronic acid (HA) is an extracellular component of connective tissue that belongs to the glycosaminoglycan family. Because of its non-immunogenic and non-toxic properties, it may be employed in a variety of medical fields including dentistry, ophthalmology, and dermatology. HA supports wound healing by stimulating early granulation tissue development, inhibiting destructive inflammatory processes during tissue healing, and encouraging re-epithelialization and angiogenesis.10

HA not only acted as a carrier of growth factors and cells, but it also induced bone formation through chemotaxis, proliferation, and osteoblast differentiation of mesenchymal cells. Although HA has osteogenic growth factor characteristics with bone morphogenetic protein 2 and osteopontin. HA also has an anti-inflammatory effect by scavenging reactive oxygen species such as superoxide radical (O2) and hydroxyl radical (OH) species and inhibiting neutrophil generated serine proteinases. HA may also have an anti-edematous effect due to its osmotic buffering capacity. As a result, covering an implant with hyaluronic acid has the potential to increase new bone production and bone/implant contact, hence improving healing time and implant stability.

Hyaluronic acid uses in dentistry

- The use of HA as a topical treatment for mouth ulcers.
- Using HA in conjunction with gingivitis and peri-implantitis therapies.
- Using HA in conjunction with non-surgical gingival recession therapy.
- HA is combined with platelet-rich fibrin, plasma, and growth factors to improve overall outcomes.11
- Using HA to cover the surgery area (from the inside and outside) improves and accelerates tissue repair (including surgical gingival recession therapy).12
- Using HA as an adjunct treatment after scaling and root planning for Periodontitis.
- Using HA to regenerate the papilla.11
- Using HA to cover the dental implant to improve osseointegration.
- Mixing the HA (recommended mixing ratio: 1:1) with synthetic bone even sinus lifting grafting material, socket preservation, and periodontal regeneration techniques for increased bone growth.13
- Using HA as a nano-sized drug carrier.
- Using HA as a matrix to encapsulate stem cells and signaling molecules for reconstruction of the temporomandibular joint, salivary glands, dental pulp, dental bone, enamel, root-canal, and mucosa.14,15,16

Conclusion

To date, topical treatments have improved the delivery of high concentrations of pharmacologic drugs to soft periodontal tissue, gingiva, and periodontal ligament, as well as hard tissue like alveolar bone and cementum. Topical hyaluronic acid (HA) has recently been recognised as an adjuvant treatment for chronic inflammatory diseases, in addition to its use to improve healing after dental procedures. Not only does topical administration of HA play a pivotal role in the postoperative care of patients undergoing dental procedures, but positive results were also observed in all patients with chronic inflammatory gingival and periodontal disease, osseointegration of dental implants, and in patients with oral ulcers.

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