

Review Article

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The Use of Hyaluronic Acid in Reducing Postoperative Complications in Minor Oral Surgery: A Review

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ABSTRACT

Aim: Hyaluronic acid (HA) is a major carbohydrate component of the extracellular matrix, and it is distributed widely throughout connective, epithelial tissues, and neural tissues. Since HA is used to promote healing following dental treatments, it has lately gained recognition as an adjuvant treatment for minor oral surgery. This review aims to give practitioners the most recent possible information regarding HA as an adjuvant treatment for minor oral surgery.

Method: A literature search of PubMed and Google Scholar for obtaining the relevant studies revealed an initial screening of 54 studies, and after excluding the out-of-scope, the final included studies were 29 studies.

Conclusion: Most reviewed studies reported positive associations with the usage of HA in treating AO, edema, pain, and trismus due to its inherent favorable properties. However, the data suggest that HA interferes with bleeding management.

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Introduction

Management of postoperative complications after minor surgery has been an area of debate for many years; complications after oral surgery can alter a patient's quality of life [1]. These complications can be addressed systematically and topically with topical methods to guarantee a better delivery of effective pharmacologic agents to the tissues [2]. Hyaluronic acid (HA) is a major carbohydrate component of the extracellular matrix. It was first discovered in 1934 and subsequently synthesized in vitro in 1964 [3]. HA is a basic unit of two sugars, glucuronic acid, and N-acetylglucosamine, polymerized into large macromolecules of over 30000 repeating units [4, 5]. Therefore, it is one of the largest extracellular matrix components; HA is distributed widely throughout connective, epithelial, and neural tissues [6]. There are three main types of HA based on their molecular weight: high-molecular-weight HA (HMW > million Da) is used as an immunosuppressant and anti-angiogenic. Medium-size HA (HMW form 2 × 104 to 1 million

Da) is used in embryogenesis, wound healing, and regeneration. Small HA molecules (HMW from 6 × 103 Da to 2 × 104 Da) mainly contribute to pro-inflammatory [7].

HA is a critical structural and physiological component in the soft periodontal tissues, gingiva, periodontal ligament, and hard tissue, such as alveolar bone and cementum because of its exceptional features Figure 1 [7]. It has many structural and physiological functions within these tissues. HA also showed a valuable role in viscoelastic properties, reducing the penetration of viruses and bacteria into the tissue [8]. HA has been developed for topical administration as an adjunctive treatment and has shown an association with wound healing in mineralized and non-mineralized tissues (inflammation, granulation tissue formation, epithelium formation, and tissue remodeling) [9, 10].

Since minor maxillofacial procedures involve vital tissue invasions, this review article focuses on the model rules of hyaluronic acid in reducing postoperative complications in minor oral surgery.

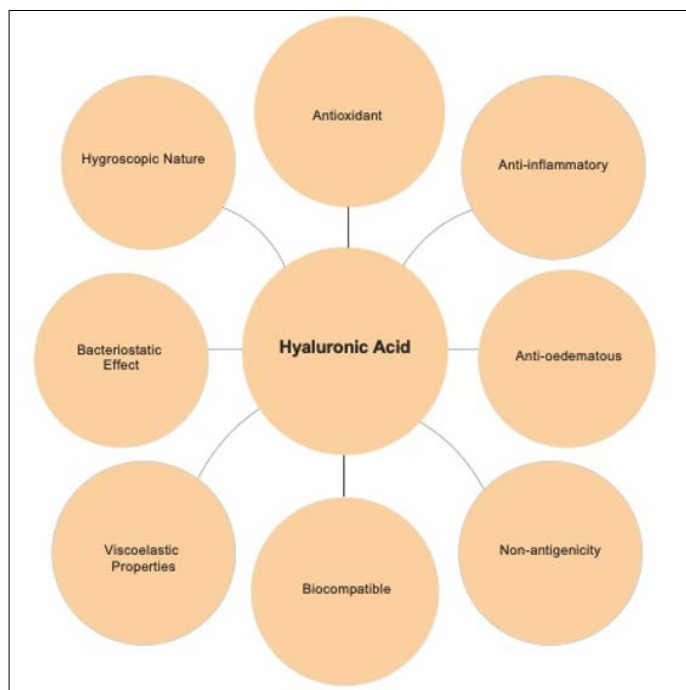


Figure 1: Illustration Showing the Important Features of Hyaluronic Acid

Roles of Hyaluronic Acid in Managing Postoperative Minor Oral Surgery Complications

Edema
The most common oral surgical treatment is the extraction of mandibular third molars, frequently resulting in swelling, pain, and trismus [11]. Surgical edema begins sooner after this tooth is removed, peaks two to three days later, and diminishes within seven days [12]. Surgical trauma causes an accumulation of fluids at the extraction site that leads to the development of edema [13]. Since HA is hydrophilic, it gives a faster resolution of the edema. This anti-edematous action may also be linked to removing prostaglandins and metalloproteinases [13]. High molecular weight HA is used to prevent severe inflammation and ensuing exacerbation. HA performs a significant anti-inflammatory effect by scavenging reactive oxygen species such as superoxide radicals (O₂) and hydroxyl radicals (OH) species and inhibiting inflammatory cell-derived serine proteinases, so this reduces tissue destruction and speeds up healing. HA's osmotic buffering ability may be connected to the reported anti-edematous action [14].

Moreover, one of the researched papers showed that second day postoperatively, HA significantly reduced facial swelling and trismus more than benzylamine hydrochloride spray, and these results imply that HA is more effective at controlling postsurgical edema that results from the inflammatory response promoted by the surgical trauma [14]. The facial Edema in both groups was minor by the seventh postoperative day, and there was no statistically significant difference between the two groups [14]. A meta-analysis of three studies revealed that HA considerably reduced swelling on the first postoperative day. However, no difference was seen on the second, third, or seventh postoperative days [15]. Sultana Shuborna et al. measured facial swelling before extraction, on days 2 and 7 after the lower third molar intervention. The findings revealed a significant difference in edema levels between the study and control groups. On postoperative days 2 and 7, the swelling in the control group was higher than in the HA group [16]. However, In the Yilmaz et al. study, there was no difference between the control group and the 0.8% HA group

regarding face Edema or maximal mouth opening ($P = 0.001$) [17].

Bleeding

Hemostasis is a normal process that occurs immediately after minor oral surgery producers like tooth extraction, which is achieved through a balance of hemostasis (clot formation) and fibrinolysis (clot breakdown), resulting in a clot [18]. High amounts of HA are believed to extend the duration of bleeding by preventing platelet aggregation and adhesion. It coats endovascular stents due to its antithrombotic characteristics [19]. HA promotes fibroblast and leukocyte proliferation and is frequently used to accelerate the healing of oral wounds [19]. Although HA helps wound healing, this may be associated with increased bleeding. In a study by Gocmen et al., topical injections of 0.8% HA in the early postoperative days showed increased bleeding time, swelling, and hemorrhage [20].

Pain and Trismus

Pain is one of the most common postoperative complications after third molar extraction [21]. Since the tissues surrounding the third molars are made up of loose connective tissue, rich in blood vessels and dense cortical bone, surgical trauma leads to an excessive inflammatory response that leads to pain and trismus in the period immediately after surgery [15]. All these complications adversely affect the patient's quality of life. A study by Maria de Souza et al. suggested that HA helps reduce pain on the third and seventh day after the extraction of the third molars, but it does not reduce trismus after the extraction [13]. Koray et al.'s research evaluated HA's effectiveness compared with benzydamine hydrochloride in controlling pain, swelling, and limited mouth opening after third molar surgery. After surgery, limited mouth opening, and edema were significantly reduced in the HA group compared with patients receiving benzydamine hydrochloride [14]. Another study by Al-Saadi et al. showed that pain was significantly reduced in the HA and A-PRF groups compared with the control group. These results are consistent with several previous studies demonstrating the effectiveness of HA or A-PRF in reducing postoperative pain, and they concluded that 1% HA gel (periokin®) or advanced platelet-rich fibrin can significantly reduce pain, trismus, and postoperative edema after mandibular third molar surgery. However, ease of use reduces HA preparation time and interrupts patient blood collection, making HA superior to A-PRF [12].

Alveolar Osteitis

Due to the disruptions in the healing processes, alveolar osteitis (AO) can arise after tooth extraction; it can be identified by the presence of pain in and around the extraction site postoperatively, which increases from the first to the third post-extraction day and by the partial or complete breakdown of a blood clot in the alveolus [22]. AO is most likely caused by increased fibrinolytic activity in the post-extraction coagulum, which results in the fibrin matrix's breakdown and blood clot disintegration [23]. Numerous techniques to treat AO involve utilizing various resources, rinsing solutions, and procedures [24]. These techniques were proposed to alleviate AO symptoms. On average, the exposed bone takes 7-10 days to be covered with young granulation tissue [25]. Hyaluronic acid has anti-inflammatory and anti-edematous properties, aiding wound healing and tissue elasticity [26]. A pilot study on rats found that treating a dry socket with a 1% hyaluronic acid preparation resulted in rapid coagulum production and accelerated healing of post-extraction wounds [27]. With the use of hyaluronic acid, with or without aminocaproic one, a significantly faster reduction in pain sensations and a reduction in the number of symptoms and signs of AO compared to the use of Alvogyl. Using sponge-like

material made of fully dissoluble medicaments (hyaluronic acid, calcium chloride, and octenidine dihydrochloride) provided a statistically significant success rate of 96.0% after pharmacological device administrations.

Conclusion

Most reviewed studies reported positive associations with HA in treating AO, edema, pain, and trismus due to its favorable properties. The reviewed data assumes that HA impairs bleeding clots because it promotes fibroblast and leukocyte proliferation. Further clinical data is also needed to assess the efficacy of utilizing HA and determine the correct dosage and form.

Ethical Approval

This article does not include any studies involving human participants or animals performed by the author.

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Authorship Contribution

Ahmed Alomar: Project Administration, Resources, Supervision, Validation.

Abdulaziz al Hasson: Investigation, Writing – Original Draft, Writing – Review & Editing, Project Administration, Supervision, Resources, Validation, Visualization, Methodology.

Abdullah Alkadhi, Turki Alshahrani, Khalid Alshahrani: Investigation, Resources, Visualization, Writing – Original Draft, Writing – Review & Editing.

Saud Alayed, Khalid Alaman, Abdulaziz Naitah: Resources, Writing – Review & Editing, Writing - Original Draft.

Ebtehal Albeshir: Reviewing and Mentoring.

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