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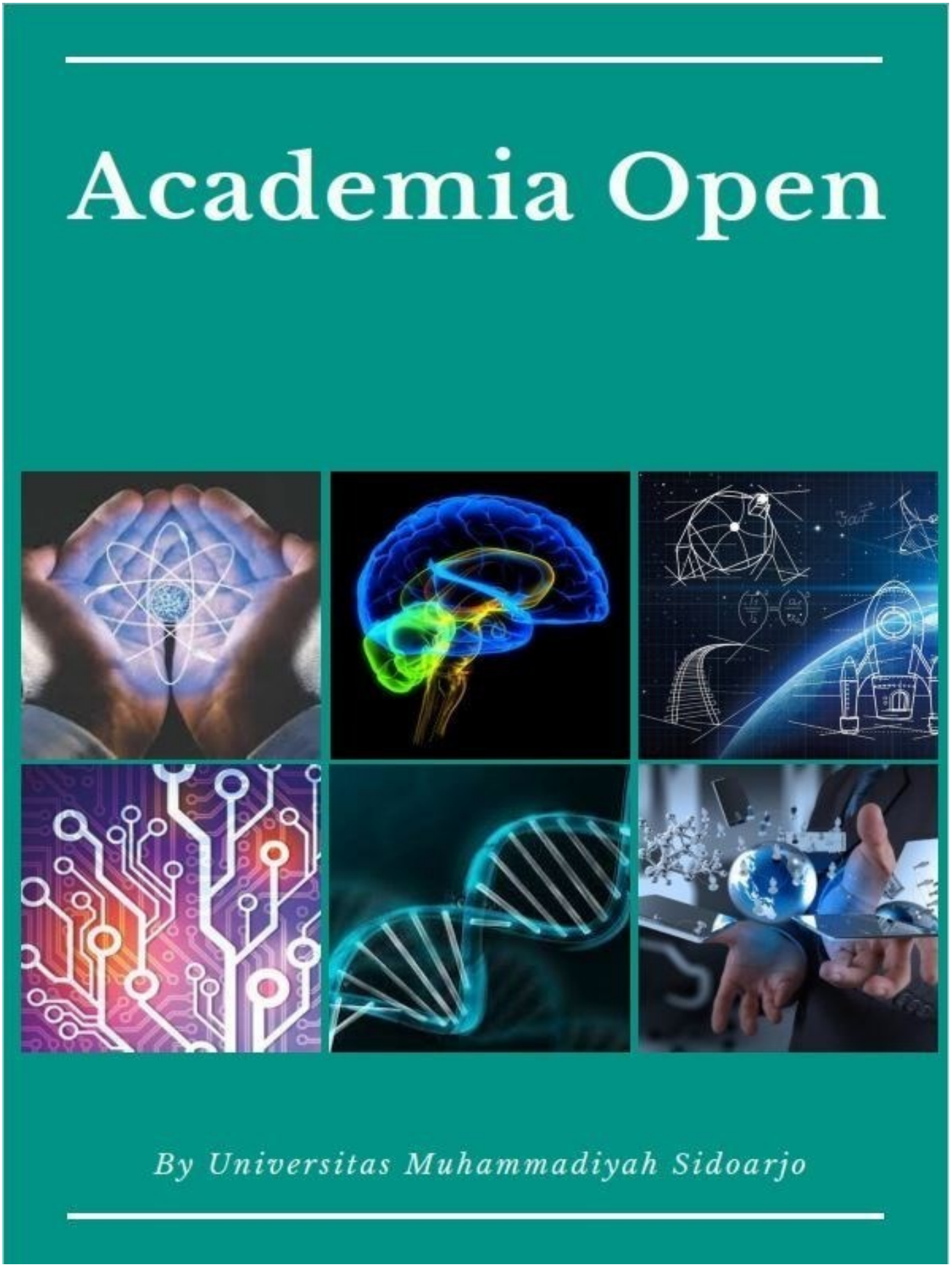

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Role of Hyaluronic Acid in Dental Implant Surgery

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Abstract

General background: Dental implants are the preferred standard for replacing missing teeth, and successful osseointegration is crucial for their long-term function. Specific background: Hyaluronic acid (HA), a naturally occurring glycosaminoglycan in connective and epithelial tissues, has gained attention for its biological roles in wound healing, regeneration, and antimicrobial activity. Knowledge gap: Despite its known physiological properties, the comprehensive role of HA in enhancing osseointegration and post-surgical healing during dental implantation remains underexplored. Aims: This review investigates the role of HA in dental implant surgery, focusing on its biological mechanisms, physicochemical properties, and clinical applications in promoting bone integration and reducing post-operative complications. Results: Evidence shows that HA facilitates osteoblast adhesion, proliferation, and differentiation, enhances wound healing, and reduces bacterial colonization. When used alone or combined with bone grafts and collagen scaffolds, HA accelerates new bone formation and minimizes inflammation. Novelty: The review highlights HA's multifaceted bioactivity, including viscoelasticity, bacteriostatic, and antioxidant properties, which collectively improve implant outcomes. Implications: HA demonstrates significant potential as an adjunct biomaterial in dental implantology, enhancing both hard and soft tissue regeneration and improving patient recovery and implant success rates.

Highlight :

- Hyaluronic acid supports bone and soft tissue healing around dental implants by enhancing cell migration and attachment.
- It helps reduce inflammation, infection risk, and post-surgical discomfort during the implantation process.
- The unique properties of hyaluronic acid make it beneficial for improving osseointegration and overall implant success.

Keywords : Hyaluronic acid, Dental implant, Osseointegration, Wound healing, Bone regeneration

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Possessions of Hyaluronic Acid

Hygroscopic nature: Hyaluronic acid (HA) considered among the most hygroscopic structure accessible. The combination of HA into a liquid allow for keep water when preserve structure rigidity. Filling factor, dampening, greasing, and polypeptide elimination as role related with organic substance [6].

Viscoelasticity characteristics: HA owns a capacity to impact cellular and intercellular macro with context through affecting cell-like action. The viscoelasticity characteristics may limit the entrance of pathogens, which considerably influence periodontal disorder [7].

Bacteriostatic properties: Lowering of the bacterial burden at the wound site may progress the treatment outcomes during regenerative surgical procedures. Results of the studies reported that HA exerts bacteriostatic effects and prevent the growth of different bacterial strains by lowering the risk of infection after-surgery [8].

Bioactivity and not-immunogenic: Tissue-compatible quality of HA simplifies the regeneration with healing of, surgical wounds, bone, also periodontal structures for repairing and regenerating. Also, it assist the development of fibroblasts, chondrocytes, in addition to mesenchyme stromal multicellular and is completely decomposable [9]. Management of HA reveals postpone granulomatous with prolonged inflammation. Furthermore treating individual immunocytes by HA show a chronic grade inflammation, generating in lymphocyte activation [10].

Disinfecting with antiradical effectiveness: This approved with macromolecular and high mass make of HA may preserve contrary the impacts of element radicals through playing as a collector consequently exhausting thromboxane's, with matrixins also can evoke different immunologic reaction [11],[12].

Wound reconstruction procedure in implantation

Bone integration

Dental implant considered as a vital process including different features of cellular reaction. This incorporate inflammation, stimulating osteogenesis, neovascularization, and, subsequently the redesigning stage. Originally, after making a marrow cavity by osteotomy, the bone cavity will blood-soaked, and thereafter, the cellular blood constituents, like red blood cells, white cells and platelets move towards the regain at which implant with bone gather. This bring about the production a clot of compact fibrin. About this fibrin structure formation, the temporary structures patterns, coding the collection with primary phase of peri-implant endosseous [13]. Some injury of the preceding bone structure initiates immediate bone recovery, which happen in imperfection, primary fracture restore, in addition to bone integration. Non-collagenous bone matrix and development factors which progressive produced by structure with excite recovery when vulnerable with interstitial fluid [14], [15].

Function of HA in different steps of implantation

Through peri-implant endosseous, the woven bone that created through the first healing stage accommodates to the capacity forces and is transformed into lamellar bone that comprise of parallel fibers. There exist comparable stages through bone defects healing and osseointegration of dental implants. Several factors that stimulate healing of the bone therefore have favorable influence on the osseointegration of implants [16]. The advantage of HA have been recorded to stimulate cell movement, adherence, multiplication, then distinction, resulting in bone arrangement. The finding by Vanden Bogaerde et al. reported the potency of curing advanced gum disease impairment utilizing transformed into an ester HA in bundle of threads within the fault. Subsequently later of management, the average depth pocket may diminished, depression of the gingiva was augment and attachment gain was documented. In similar manner, additional research reported that autogenously bone joint and converted into an ester particle HA compounds appear possess valid abilities with hastening novel ossification in infra bony disorder [17], [18]. HA controls the movement of osteoclast or osteoclasts progenitor cells with playing in a calcium-buffering representative with a wall to the enzymes spreading. This recorded that odontoclasts join with bone membrane to create their reabsorption. Finding have reported that odontoclasts own membrane polypeptide which able to join with HA, particularly CD44, that as a membrane HA ligand protein which can corroboration cell adhesion [19, 20]. In this manner either alone or in combination with other proteins matrix, also HA may influence the possible of osteoclasts to attach with the bone membrane. Nevertheless, HA can play a role in controlling the attachment of osteoblasts with the surfaces of the bone. HA can work as a distribution wall at the closing region also like a sticky under layer with novel bone cell [21].

Clinical Findings Of HA In Implantation Use Monotherapy and in Compound

Application of HA as single therapy

Study by Arajo Nobre et al. carried out where they employ either jelly HA or chlorhexidine for examine the healing of the surrounding implant diseases through the healing time as instantaneous office implants [22].

The adjusted gingival indicator among the HA sample was reported that considerably less as matched with individuals of chlorhexidine.

Additional research reported HA in reducing pain post implantation. The findings reported that employing HA within implant socket and within the bone encircling successfully lowering discomfort after implantation comparing with the group control [23].

Finding reported by Fernandez ES, reported by using of HA gel topically in the pocket and around implants show significantly lowering the inflammation and gingival fluid IL-1β grade [24]

Use of HA as a combination

According to studies, application of HA in conjunction with absorbable sponges collagen, octacalcium phosphate granules, carbon nanotubes, or MegaGen synthetic bone (MGSB), able to improve new bone formation [25]. Correspondingly, merging HA, filler substance, and growth factors considerably enhance ossification. The addition of HA gel and a collagen scaffold promotes osteogenesis creation. [26].

Also, the MGSB/HA-GEL hydrogel compound is rapidly assimilated also efficient in renewal of the bone [27].

Several research indicates that HA play a role in combination with bone graft can create bone healing. Research project by Genovesi et al. employed chlorhexidine 0.12% with HA oral rinse as a treatment of immersed one implant in point of installation. Variables of main operative findings were, significantly less than patients treated by chlorhexidine rinse alone [28].

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Conclusion

Recently implants are considered as ultimate standard to substitute teeth missing. HA can possibly impact the migration, attachment, proliferation, in addition to distinction of blast cell, reinforcing the link between bones with implant.

Active medical studies reported that as well as HA can shows a necessary role in the control of implant diseases and in healing processing. The application of HA topically detected helpful in relieving pain and post-surgical trouble. The exceptional characteristic of HA make it a fascinating contender for reinforce both bone and soft tissue recovery in the context of implantation treatments.

Studies reported that, HA might evolve into an essential supplement in enhancing the achievement with healthcare experience of dental implantation.

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