Available online at www.sciencedirect.com

ScienceDirect

Tanta Dental Journal 11 (2014) 122–129

www.elsevier.com/locate/tdj

# The effect of adding hyaluronic acid to calcium phosphate on periapical tissue healing following periradicular surgery in dogs

Wafaa Ahmed Omar Segari [a,*], Dalia Abd El Khalek Radwan [b], Mohamed Ayad Abd El Hamid [c]

[a] Department of Endodontics, Faculty of Oral and Dental Medicine, Cairo University, Cairo, Egypt
[b] Oral and Maxillofacial Surgery, Faculty of Oral and Dental Medicine, Cairo University, Cairo, Egypt
[c] Veterinary Surgery, Anesthesiology and Radiology, Faculty of Veterinary Medicine, Cairo University, Cairo, Egypt

Received 8 May 2014; revised 14 July 2014; accepted 21 July 2014
Available online 30 September 2014

**Abstract**

*Objective:* This study aimed to evaluate the effect of adding exogenous hyaluronic acid (HA) to Beta-tricalcium phosphate (CP) on osseous tissue healing of induced apical lesions following periradicular surgery in a dog model.
*Methods:* In the first and second sessions, periapical lesions were induced by exposing pulp cavities of selected teeth for 7 days then sealing them with glass ionomer for 60 days. Root canals were then cleaned, shaped and obturated. Surgical treatment included buccal osteotomy to expose the root apex and root-end resection and filling. Osteotomy cavities were randomly allocated to two study groups 12 samples each according to the graft materials; CP or combination of HA and CP. The graft materials were prepared and applied in each animal in alternate quadrant in a randomized manner. Animals were sacrificed after 60 days and bone treated cavities were prepared for histological study and histomorphometric analysis for the area percentage of new bone tissue and trabecular bone thickness.
*Results:* All samples displayed signs of regeneration as newly formed bone tissue and fibrovascular connective tissue within the treated cavity sites with complete resorption of the implemented materials. The newly formed bone consisted mainly of osteoid bone trabeculae with some more mature dense bone present at the periphery of cavity site. There was no significant difference in the percentage of newly formed bone tissue ($P > 0.05$) and bone trabeculae thickness ($P > 0.05$) between the two study groups.
*Conclusions:* Addition of exogenous HA to CP after periradicular surgery did not improve the histological outcome of osseous tissue healing in a dog model.


*Keywords:* Hyaluronic acid; Hyaluronan; Calcium phosphate; Bone grafts; Alloplasts; Periapical lesion induction

* Corresponding author. 131 Hadek El Ferdous, 6 October City, Giza City, Egypt. Tel.: +20 01156471101.
*E-mail addresses:* wafaasegari1@gmail.com, wafaaaomar@gmail.com, wafaa.omar@dentistry.cu.edu.eg (W.A.O. Segari).
Peer review under the responsibility of the Faculty of Dentistry, Tanta University

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.tdj.2014.07.001

## 1. Introduction

Periapical surgery with root-end resection is indicated for endodontically treated teeth with periapical pathosis where an orthograde revision cannot be done or not able to resolve the periapical disease [1]. In such conditions, surgical approach provides better access to clean the root surface and apical lesion, to eliminate the source of inflammation and reactive periradicular tissue and to prepare and seal the apical portion of the root canal system [2]. This will allow the regeneration of hard and soft tissues, including the formation of a new attachment apparatus [3]. To promote bone regeneration following periapical surgery, bone graft materials are used especially when the surgical site is compromised [4].

Bone grafts fall into four general categories: autografts, allografts, xenografts, and alloplasts [2,5]. The role of these materials in regenerative procedures is based on that; they possess the osteogenic potential (contain bone-forming cells), they are osteoinductive (contain bone inducing substances), or they are osteoconductive (serve as a scaffold for bone formation) [6]. Autograft and allograft remain the most effective grafting materials because they have more potentials for bone regeneration [2,4]. However, alternatives such as alloplast have been used because of donor site morbidity, limited supply with increased cost of autographs and risk of disease transmission and response rejection by allografts [2,4,7]. An alloplast is a synthetic or inert foreign body material that has ostoeconductive capacity [2]. Its distinct advantage over autograft and allograft is that it can be produced in unlimited quantities without risk of disease transmission [7,8]. Currently used allopasts include; coralline hydroxyapatite, collagen-based matrices, calcium sulfate, and tri-calcium phosphate [2,7].

Hyaluronic acid (HA) is also known as hyaluronan or hyaluronate is a high molecular weight polysaccharide (glycosaminoglycan) and a major component of extracellular matrix almost in all living tissues [9,10]. It plays a critical part in the function of extracellular mineralized and non mineralized matrices, including tissue hydrodynamics and cell migration, proliferation and differentiation [9,11]. HA has an important anti-inflammatory role through inhibition of tissue destruction and facilitation tissue healing [9,12]. Consequently, application of exogenous HA in the treatment of inflammatory processes is shown in different medical fields such as orthopedics, dermatology and ophthalmology [9,10].

In the dental field, HA demonstrated beneficial effects in the treatment of gingivitis and periodontitis as well as periodontal surgery [13−15]. It demonstrated bacteriostatic effect on bacterial strains commonly found in gingival lesion and periodontal wound [16]. In addition, it has been used as a carrier for demineralized bone allograft without reducing its effectiveness for sinus lift augmentation [17]. Furthermore, it has been proposed as a scaffold for regeneration therapy of dental pulp because of its appropriate structure, biocompatibility and biodegradation [18].

Previous studies demonstrated the ability of exogenous hyaluronic acid in enhancing bone healing both experimentally [11,19−22] and clinically [14,15,23]. In animal studies, HA recorded significant bone mineralization acceleration compared to untreated bone cavities (11). The adjunctive use of HA to grafting process when combined with autografts and allografts recorded favorable results. Previous studies recorded the capacity of HA in supporting the significant bone formation when combined with bone marrow stromal cell and basic fibroblast growth factors [21], recombinant human bone morphogenic protein −2 [20] and spongiosal bone graft [22]. Clinically, application of HA in combination with autologus bone demonstrated good capabilities in accelerating bone formation when used in extractive socket and periodontal bony defect [14,15,23].

Experimental evaluation of the efficiency of different materials and techniques requires conditions similar to clinical environments for its relevance interpretation. Therefore, inducing one of the situations requiring the use of grafting materials when tested in the animal model such as periapical lesion is required. Periapical lesion induction was done previously to evaluate periradicular tissue response to bone grafts in apical surgery of dogs' teeth [24].

Based on these data, and considering that, no previous study exists on the use of HA combined with alloplast as adjunctive to grafting process, the purpose of this study was to histologically examine the hypothesis that adding exogenous hayluronic acid (HA) to Beta-tricalcium phosphate (CP) could enhance osseous tissue healing of induced apical lesions following peria-radicular surgery in a dog model.

## 2. Materials and methods

### *2.1. Experimental animal and materials*

Animal right commity of Faculty of Veterinary Medicine (Cairo University) approved the