

CHAPTER I INTRODUCTION

PRINCIPLE, THEORY, AND RATIONALE

Orthodontic treatment is based on the principle that prolonged optimal mechanical force, being applied to the tooth, can affect the periodontium response. This results in cellular and extracellular matrix (ECM) changes within the periodontium. The ECM provides important functions within the connective tissue of periodontium in maintaining structural integrity and in regulating cellular activity. The principle element of the ECM is a collagenous fibrous network providing structural support. The fibrous network is embedded in a non-collagenous matrix consisting of various proteoglycans and glycoproteins (Sato *et al.*, 2002). Proteoglycans are ubiquitous components of connective tissues. These macromolecules are comprised of one or more heteropolysaccharides, called glycosaminoglycans (GAGs) that are covalently linked to a core protein in the native state.

Tooth movement is achieved after the remodeling of the periodontal ligament (PDL) and the alveolar bone (ALV) as well as gingival tissue as the primary response (Redlich *et al.*, 1999). The remodeling processes are caused by the synthesis and the degradation of the ECM within connective tissue. The ECM remodeling leads to the release of the ECM components, such as bioactive peptides, proteoglycans, and particularly GAGs. These changes may induce a fluid pressure flow and cause the discharge of ECM components into the gingival crevicular fluid (GCF).

The GAGs components have been detected in GCF samples from the tooth that is moved with orthodontic force. It has therefore been suggested that the profiles and the levels of GAGs in GCF may form the basis of laboratory special test for assessing the periodontal tissue remodeling during orthodontic treatment (Waddington, 2001).

The ECM components of the periodontium have various types of GAGs, such as hyaluronic acid or hyaluronan (HA), chondroitin-4-sulphate (C-4-S), chondroitin-6-sulphate (C-6-S), dermatan sulphate (DS), heparan sulphate (HS), and keratan sulphate (KS). All types of GAGs, except HA, are sulphated. (Waddington, 2001).

The study of GAG compositions in the periodontal tissue may well provide some insights into the origins of GAGs detected in the GCF. In humans, the HA is found approximately 17% of the GAGs in the gingival tissues, 1.3% of the GAGs in the ALV, and a minor component in the PDL and the cementum (Embery *et al.*, 1979; Bartold *et al.*, 1988; Waddington *et al.*, 1989). The high content of the HA in the gingival tissues suggests that the gingival tissue is the main source of the HA released into GCF (Samuels *et al.*, 1993).

The findings of this study will be useful to better understand the biological changes during orthodontic movement, and may then be developed to be used in orthodontics as a useful non-invasive indirect method in monitoring the gingival tissue responses to orthodontic tooth movement, which could make orthodontic practice more reliable.

THE OBJECTIVE OF THE STUDY

The objective of this longitudinal study was to detect and quantify the changes in the hyaluronic acid levels from human gingival crevicular fluid during orthodontic tooth movement.

THE HYPOTHESIS

Tooth movement by orthodontic force causes either synthesis or breakdown of the extracellular matrix in the gingival tissue, or soft tissue remodeling, which will lead to changes in HA levels in gingival crevicular fluid that can be detected and quantified by the competitive-based ELISA assay.

ANTICIPATED BENEFITS

After completing this study, we wish:

1. To find a possible biomarker of gingival tissue changes during orthodontic treatment.
2. To help an orthodontist assess the soft tissue remodeling during orthodontic movement and provide more reliable treatment.
3. To gain basic knowledge in the changes of HA levels from gingival crevicular fluid undergoing orthodontic treatment for the future study.

SCOPE OF THE STUDY

The biological changes of HA levels measured in GCF have been questioned. Consequently, we would like to address this question with a specific aim. This was to study the longitudinal changes of the HA levels in the GCF collected from a canine moving distally compared to those collected from an incisor, as a control tooth.