CHAPTER 1
INTRODUCTION

Excellent control of dental anchorage is an important element to achieve successful orthodontic treatment. Conventional methods to provide reinforcement of dental anchorage have been extensively described in the literature and include both intra- and extra-oral devices. However, because of the aesthetics constraints and lack of compliance to use these devices, the anchor teeth have the tendency to be moved toward the orthodontic force application causing loss of anchorage and, consequently, compromising the treatment outcomes.

To solve these problems, devices that are connected directly to the bone to provide absolute anchorage, also known as skeletal anchorage devices, have been developed. Initially, the skeletal anchorage was provided by means of dental implants that were inserted in the edentulous areas of mandible (Goodacre *et al.*, 1997; Roberts *et al.*, 1990; Roberts *et al.*, 1994) or maxilla (Odman *et al.*, 1988) for prosthetic purposes. However, the main limitation of this method was the reduced number of placement sites, the necessity of an invasive surgical procedure, high cost, and the long waiting period for allowing osseointegration before force application. To reduce these problems, Block and Hoffman (1995) had developed a disc like structure called "onplant" that was specially designed to provide skeletal anchorage. The onplants are placed subperiosteally on the palatal bone to provide orthodontic anchorage with the advantage of requiring less bone depth for its placement. However, the long waiting period to obtain complete osseointegration before force application, high costs and the need of a second surgical procedure for the removal after orthodontic treatment is completed, have limited its application. Creekmore and Eklund (1983) had successfully applied a surgical vitallium bone screw to the maxillary bone to obtain absolute skeletal anchorage. Anchorage was obtained mainly by mechanical retention of the screw into the bone. Orthodontic load was applied shortly after the screw placement without the need of waiting periods for osseointegration. Kanomi (1997) demonstrated the possibility of clinical application of miniscrews inserted into the dentoalveolar area of mandible to allow the intrusion of the anterior incisors. Later, several screws of small diameter with specially designed head shapes to facilitate orthodontic use, the so-called "miniscrew implants" were developed. Because the implants have a small size, it can be inserted in several areas of maxilla and mandible, including the dentoalveolar space and between the roots of adjacent teeth.

Recently, these miniscrew implant methods have been successfully applied clinically for promoting orthodontic anchorage. This anchorage method have numerous advantages over the previous skeletal anchorage devices such as; simple placement and removal procedures, reduced costs, and the possibility of immediate orthodontic loading since the skeletal anchorage provided by these screws are obtained mainly by the mechanical retention of the screw into the bone. Although these anchorage devices have confirmed advantages for controlling anchorage, there is still scarcity of data concerning the biomechanical characteristics of these devices. Moreover, clinical reports have shown divergent rates of implant failure (Cheng *et al.*, 2004; Fritz *et al.*, 2004; Miyawaki *et al.*, 2003; Motoyoshi *et al.*, 2006). However, the failure of implants have been described mainly as the loosening of the mechanical stability, or mobility i.e., have been associated to several factors such as; peri-implant inflammation (Freudenthaler *et al.*, 2001; Fritz *et al.*, 2004; Miyawaki *et al.*, 2003), quality (Miyawaki *et al.*, 2003; Motoyoshi *et al.*, 2006) and quantity (Huja *et al.*, 2005) of bone surrounding the implant, type and size of implants (Buchter *et al.*, 2005; Holmgren *et al.*, 1998), placement technique (Kim *et al.*, 2005), placement sites (Cheng *et al.*, 2004), amount of loading forces (Buchter *et al.*, 2005). These factors are largely associated to the mechanical retention of the implant to the surrounding bone structure.

The use of insertion angulations during miniscrew implant placement have been recommended as a practical clinical approach that it would provide an increase in the surface contact area between the miniscrew and bone (Deguchi *et al.*, 2006). However, the influence of such insertion angulations on the biomechanical performance of miniscrew implants placed in the dentoalveolar bone has not been extensively investigated.

Therefore, the purpose of this study was to investigate the effects of insertion angulations on the biomechanical performance of the miniscrew implant placed in the dentoalveolar bone of swine model.