INTRODUCTION

Osteoporosis is a serious health problem that is characterized by low bone mineral density (BMD). Since the exercise produces high levels of mechanical force on bone and develops the high peak bone mass, the exercise has been suggested as a possible mean to prevent the osteoporosis from occurring and/or progressing (19,62).

Dual energy x-ray absorptiometry (DXA) is applied to measure areal BMD (aBMD); i.e., the bone mineral content (BMC) per projected area. In DXA studies, the positive effects of exercise on aBMD had been well documented by comparing athletes with sedentary controls (7,14,23,42,90). And it was suggested that the greatest aBMD increase could be mainly obtained if bones were loaded during the growing years (7,53,90). The ability of bone to adapt to mechanical loading is much greater in the growing than in the matured bone and exercise after maturity has a much smaller effect (67). Furthermore, the previous studies of different physical exercises, which were begun during growing years, revealed the importance of weight bearing activity to increase aBMD (23,37,47,90,92). The young female athletes who engaged in weight bearing activities, such as volleyball and gymnastics, had a greater aBMD at a majority of skeletal sites when comparing to athletes in non-weight bearing activities

(swimming) and controls (23,47,92).

Compared with DXA, peripheral quantitative computed tomography (pQCT) measures the volumetric BMD (vBMD; in grams per cubic centimeter) and allows for the assessment of bone geometric properties (cross-section area, bone thickness). In contrast to the studies using DXA, pQCT study suggested that long-term tennis playing was related to geometric adaptation but less to changes in vBMD of young tennis players who had begun training during growing years (1). And it was further reported that the structural adaptation to long-term tennis or squash playing seemed to be achieved through periosteal enlargement of the bone cortex but not through an increase in vBMD (33).

The studies by DXA suggested that the greatest increases in BMD could be obtained if bones were loaded during the growing years. The aim of the first study in this thesis is to examine the pQCT-derived structural side-to-side differences in the radius of tennis players who had started training after their peak bone mass. Applications of pQCT studies examined the effect of exercise on bone was limited to side-to-side differences in upper-arm of tennis players. The aim of the second study in this thesis is to evaluate the effect of extremely greater mechanical loading on the bone by evaluating lower limb of jumpers. Furthermore, the geometric parameters of bone

were generally calculated assuming cylindrical configuration of the bone, which does not reflect the true shape of the bone. The aim of the third study of this thesis is to understand the true geometric bone adaptation to mechanical loading along 64 directions centering center of gravity of the bone.