Bone mineral density of the ultra-distal radius is responsive to loading

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INTRODUCTION

Wrist fractures are among the most frequently reported fall-related injuries [i]. Sudden impact to the wrist frequently results in injury to the bone. In severe cases this injury often presents itself as a distal radius or Colles' fracture (Figure 1). It is essential to develop treatment and prevention programs for this devastating health issue.

Bone is an exceptionally dynamic tissue that adapts its mass and architecture to meet the requirement of the physical forces to which it is regularly subjected [ii]. It has been well documented that loading the bone increases the quality of the bone (Figure 2). The purpose of the study was to measure the bone mineral density (BMD) of the ultra-distal radius and to determine if axially loading the radius influences BMD of this site in a sample of young healthy women

Figure 1
In this study the BMD was measure at the ultra-distal radius (UD). This is the site of a severe wrist fracture, also known as Colles' fracture.

References
[i] Vogt, M.T., et al., Distal radius fractures in older women: a 10-year follow-up study of descriptive characteristics and risk factors. The study of osteoporotic fractures. J Am Geriatr Soc, 2002. 50(1): p.97-103.
[iii] Lanyon, L.E., Rubin, C.T., Static vs. dynamic loads as an influence on bone remodeling, Journal of Biomechanics, 1984. 17: p.897-905

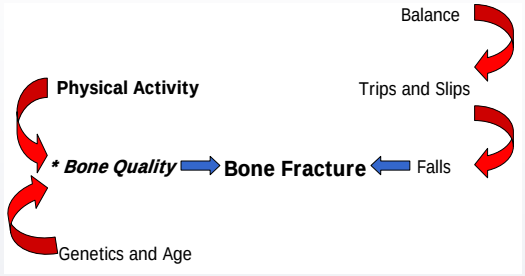


Figure 2
Many factors are involved in the overall occurrence of fracture. Certain factors such as age and genetics are non-modifiable. *Bone quality is a generalized term that describes overall bone strength derived from both bone mineral density and bone micro- and macro- architecture. An increase in physical activity, especially which loads a specific skeletal site, may improve the quality of the bone and lower fracture risk.

METHODS

Subjects:
•52 young healthy women
•Group I, **control group**, 35 women who did not participate in specific loading activities of the wrist. (162.3 ± 8.0 cm, 64.2 ± 19.7 kg, 21.7 ± 1.5 yrs. mean ± SD)
•Group II, **gymnast group**, 17 women who axially load the radius, specifically, collegiate gymnasts.
•(159.1 ± 9.5 cm, 62.2 ± 5.5 kg, 20.0 ± 1.8 yrs. mean ± SD)

Methods:
•Subjects were pre-screened by telephone, and came in for a single visit.
•Subjects were asked to fill out a physical activities questionnaire.
•Each participant was given a pregnancy test to exclude the possibility of exposing a fetus to radiation during early pregnancy.
•The BMD of both wrists were measured using, dual energy X-ray absorptiometry (DEXA).
•The scans were taken by a single investigator.
•The hypothesis was tested using an independent t-test, significance was set at $p<0.05$. The results were statistically analyzed using SPSS software.

RESULTS

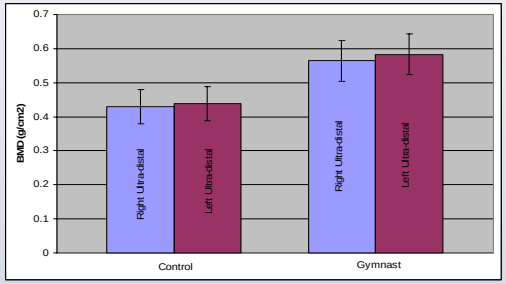
- BMD was significantly ($p<0.001$) greater in gymnast than controls at the radius (Table 1) (Figure 3a).
- The percent increase vs. control was greater at the ultra-distal radius than the total radius (right 31% and 17%, left 33% and 18% respectively) (Figure 3b).

Table 1
Bone mineral density measure (mean (standard deviation) for the control group and collegiate gymnast group.

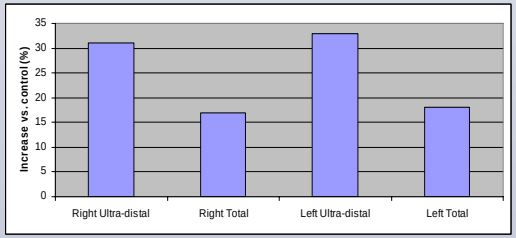
BMD (g/cm^2)	Control Group	Gymnast Group	Increase vs. control
Right Ultra-distal	0.43 (0.054)	0.564 (0.068)	31% *
Right Total	0.562 (0.048)	0.656 (0.055)	17% *
Left Ultra-distal	0.439 (0.053)	0.583(0.079)	33% *
Left Total	0.564 (0.046)	0.668(0.064)	18% *

* $p<0.001$ vs. control group

Figure 3
a) BMD of Control vs. Gymnasts



b) Percent increase in gymnast group vs. control group



DISCUSSION

• The results of this study supported the hypothesis that the gymnast group would have higher BMD of the ultra-distal radius.
•These results suggest that the ultra-distal radius is responsive to site-specific loading.
•This outcome may be used to develop an intervention for women in which programmed loading at the wrist may increase BMD and improve bone quality.
•Ultimately, if some falls are unavoidable in the aged population the incidence of fall related injuries, such as Colles' fracture, can hopefully be reduced.

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