

## IS PATELLAR CARTILAGE THICKNESS REDUCED IN INDIVIDUALS WITH PATELLOFEMORAL PAIN?

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### INTRODUCTION

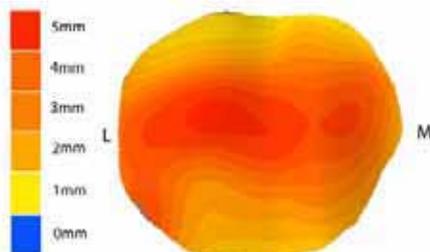
Patellofemoral pain is a common and debilitating knee disorder. Increased stress in the articular cartilage may lead to stimulation of pain receptors in the subchondral bone. Thinning of the articular cartilage is one possible mechanism leading to increased cartilage stress. We tested the hypothesis that subjects diagnosed with patellofemoral pain have thinner patellar cartilage than control subjects.

Magnetic resonance imaging (MRI) has been used to accurately and non-invasively measure cartilage thickness [1,2]. Patellar cartilage thickness has been estimated in pain-free control subjects using MRI [3]. However, comparisons of cartilage thickness between control subjects and individuals with patellofemoral pain have previously not been performed.

### METHODS

Sagittal plane MR images were obtained from 10 pain-free control subjects and 10 subjects with patellofemoral pain. All subjects were between the ages of 20 and 35 to minimize the effect of osteoarthritis on cartilage thickness. Equal numbers of male and female subjects were present in each group. Subjects were imaged while lying supine with the knee in full extension, minimizing cartilage load and deformation. Images were acquired with a 1.5T scanner (GE Healthcare, Milwaukee, WI), using a standard knee coil and a 3D fat-suppressed spoiled gradient echo MR sequence, with a scan time of approximately 15 minutes. The following scan parameters were used: TR: 60ms, TE: 5ms, Flip Angle: 40°, Matrix Size: 256x256, FOV: 12cmx12cm, slice thickness: 1.5mm, Sections: 60.

The subchondral bone and articular cartilage boundaries of the patella were manually segmented using custom software to generate 3D point clouds representing the cartilage surface. Triangulated surfaces were created of the subchondral bone boundary (Geomagic, Raindrop Geomagic, NC). Cartilage thickness was determined by computing the minimum distance between the subchondral bone surface and the articulating cartilage surface, along the surface normal vectors of the subchondral bone (Figure 1). The peak and average thicknesses of the cartilage were computed and compared

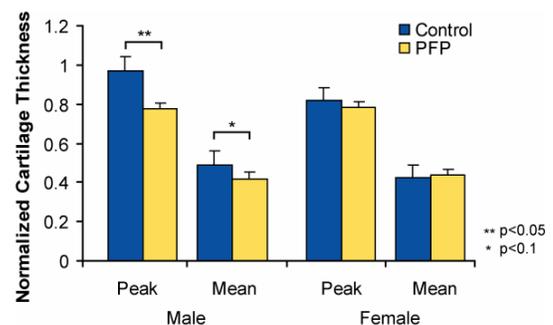


**Figure 1:** Cartilage thickness distribution on patella of a female volunteer.

between subject groups. To account for differences in subject size, we normalized the thickness measurements by scaling according to  $(\text{body mass})^{0.45}$  [4]. The significance of the differences was evaluated using a one-tailed t-test.

### RESULTS AND DISCUSSION

We found that the average peak thickness among control subjects was  $5.8 \pm 1.6$  mm while the average mean thickness was  $2.9 \pm 0.7$  mm. These results are comparable to previous measurements of patellar cartilage thickness in active, healthy subjects made using MRI ([1], peak = 5.8-5.9mm, mean = 2.8-2.9mm). The average peak thickness among subjects with patellofemoral pain was  $5.2 \pm 0.7$  mm while the average mean thickness was  $2.9 \pm 0.3$  mm. Compared to the control subjects, the male subjects with patellofemoral pain had significantly lower peak cartilage thickness both before and after normalization ( $p < 0.05$ ) and showed a trend towards a lower mean cartilage thickness ( $p < 0.1$ ). There were no significant differences in cartilage thickness between the female control and patellofemoral pain subjects both before and after normalization (Figure 2). When both genders were pooled, there was a trend for the patellofemoral pain subjects to have a smaller normalized peak cartilage thickness than the control subjects ( $p < 0.1$ ).



**Figure 2:** Comparison of Peak and Mean Cartilage Thickness between Subject Groups

These data suggest that thin cartilage may be correlated with patellofemoral pain in male subjects. Future studies that examine patellar and femoral cartilage thickness on a larger group of subjects are required to confirm this finding.

### REFERENCES

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