INTRODUCTION. Quadriceps weakness is a potentially treatable risk factor for incident knee osteoarthritis (OA). Hence we describe results of the first randomized controlled trial of lower extremity (LE) strength training on incidence and progression of knee OA.

METHODS. Older adults (N=221, mean age 69 yrs) were stratified by sex, the presence of radiographic knee OA (standing AP view) and severity of knee pain, and were then randomized to LE strength training (ST) or range-of-motion (ROM) exercises. Subjects exercised 3x/wk (twice at a fitness facility, once at home) for 12 weeks, with gradual transition to fully home-based exercise by month 12.

Outcomes. Each ST session had the same structure: Subjects performed a general warm-up 5-min walk), followed by a series of exercises on resistance training equipment (CYBEX International, Medway, MA) interspersed with cool-down periods: leg press, leg curls, seated chest press, and seated back rows. In-home sessions included similar exercises (i.e. wall squats, standing leg curls, wall pushups, and seated rows) working the same muscle groups with elastic bands to provide resistance.

The ROM group served as controls and performed flexibility exercises involving no external loading. The ROM group underwent the same transition from facility- to home-based exercise as the ST group.

RESULTS. One hundred fifty-four (70%) of the 221 subjects completed the study per protocol. The most common reason for discontinuation (31%) was the burden of participation (i.e., time and travel constraints). Dropouts were 11-18% weaker at baseline and attended 33% fewer exercise sessions in the first 12 wks than completers. Dropouts also were more frequent in the ST group than in the ROM group (36% vs. 24%, P=0.05). Only one subject discontinued prematurely because of an adverse effect of ST (i.e., increased knee pain), and 174 subjects (79%) underwent some or all of the 30-month assessment.

Subjects in the ST and ROM treatment groups each attended only about half of the 24 exercise sessions scheduled during the first 12 weeks of the study (49% and 46%, P=0.453). With renewed effort by the fitness trainer, adherence rates rose somewhat in both treatment groups over the full duration of the study (59% in the ST group and 64% in the ROM group, P=0.397). Over both intervals, men participated in more exercise sessions than women (P=0.003 at 12 months, P=0.007 at end of study).

Isokinetic Strength. Kin-Com assessment revealed overall decreases in isokinetic strength in women and men in both treatment groups (Table 1). However, in both women and men, the rate of loss of isokinetic quads strength at 120°/sec was marginally slower in the ST group than in the ROM group (P = 0.090). OA knees lost more quad strength than non-OA knees (mean change from baseline = ~20 N-m vs. -15 N-m at 60°/sec, P=0.041). Moreover, subjects with moderate or more severe knee pain at baseline lost quads strength to a greater degree than asymptomatic subjects (-18 N-m vs. -12 N-m at 120°/sec, P=0.040).

<table>
<thead>
<tr>
<th>WOMEN</th>
<th>Men</th>
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<tbody>
<tr>
<td>Extension at 60°/sec</td>
<td>-24 ± 3</td>
<td>-25 ± 3</td>
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<tr>
<td>Extension at 120°/sec</td>
<td>-19 ± 3</td>
<td>-22 ± 3</td>
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<tr>
<td>Flexion at 60°/sec</td>
<td>-13 ± 2</td>
<td>-14 ± 2</td>
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<tr>
<td>Flexion at 120°/sec</td>
<td>-12 ± 2</td>
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*P-value for difference between treatment groups, adjusted for baseline strength, age, sex, BMI, knee, presence of OA and pain.

DISCUSSION. In light of numerous positive studies in this area, the failure to demonstrate gains in isokinetic quads strength in the ST group of the present study is difficult to explain. Adherence to the exercise programs was only moderate during the first 12 months of the trial, although it increased slightly over the following 18 months.

The apparent loss of LE strength seen with isokinetic testing may have been due to “strength specificity”; i.e., the mode of testing (Kin-Com) did not match the mode of training (Cybex). If the mode of testing is not specific to the mode of training, the ability to detect increases in strength may be substantially limited, if not negated [5].

This is the first randomized controlled trial of attempted structure modification in knee OA using LE strength training as the treatment modality. Compared to ROM exercises, strength training slowed the rate of loss of isokinetic quads and hamstring strength and had a marginal effect on the frequency of progression of JSN rated in standardized knee radiographs. However, the increase in frequency of incident JSN associated with ST was unexplained and requires confirmation in other samples.


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EFFECTS OF LOWER EXTREMITY STRENGTH TRAINING ON INCIDENCE AND PROGRESSION OF KNEE OSTEOARTHRITIS

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