Effect of submaximal contraction intensity in contract-relax proprioceptive neuromuscular facilitation stretching

J B Feland, H N Marin

Objective: To determine if submaximal contractions used in contract-relax proprioceptive neuromuscular facilitation (CRPNF) stretching of the hamstrings yield comparable gains in hamstring flexibility to maximal voluntary isometric contractions (MVICs).

Method: Randomised controlled trial. A convenience sample of 72 male subjects aged 18–27 was used. Subjects qualified by demonstrating tight hamstrings, defined as the inability to reach 70° of hip flexion during a straight leg raise. Sixty subjects were randomly assigned to one of three treatment groups: 1, 20% of MVIC; 2, 60% of MVIC; 3, 100% MVIC. Twelve subjects were randomly assigned to a control group (no stretching). Subjects in groups 1–3 performed three separate six second CRPNF stretches at the respective intensity with a 10 second rest between contractions, once a day for five days. Goniometric measurements of hamstring flexibility using a lying passive knee extension test were made before and after the stretching period to determine flexibility changes.

Results: Paired t tests showed a significant change in flexibility for all treatment groups. A comparison of least squares means showed that there was no difference in flexibility gains between the treatment groups, but all treatment groups had significantly greater flexibility than the control group.

Conclusion: CRPNF stretching using submaximal contractions is just as beneficial at improving hamstring flexibility as maximal contractions, and may reduce the risk of injury associated with PNF stretching.
visually as bar-type graph on the computer monitor to allow the subject to visually maintain a 20% or 60% contraction for each six second repetition. The 12 control subjects (group 4) were also measured twice with about five minutes between measurements to simulate the time it took to set up and stretch the subjects in the intervention groups.

RESULTS
All data were analysed in SPSS version 7.5. As each subject served as his own control, paired t tests were generated to determine if a significant change in flexibility occurred within groups by comparing the flexibility measurement before the test on Monday with the flexibility measurement on Friday. Analysis of variance showed insignificant (p = 0.06) differences between treatment groups.

Subjects were disqualified from participation after missing one day of testing. This gave a final sample size of 18 in group 1 (20%), 17 in group 2 (60%), 15 in group 3 (100%), and 12 in group 4 (control). The mean age of the participants was 22.6 years (range 18–27). The paired t test showed that groups 1, 2, and 3 exhibited a significant change in flexibility, whereas group 4 did not significantly change (table 1).

DISCUSSION
It has long been standard to perform a maximal contraction in PNF techniques. However, maximal contractions are intense enough to produce symptoms of delayed onset muscle soreness and may increase the risk of injury. The results of this pilot study suggest that contractions at 20% and 60% MVIC are just as effective as 100% MVIC during CRPNF hamstring stretching. The results also verify that all interventions improved flexibility more than no stretching (control group). Although the maximum contraction group showed greatest improvements overall, it averaged just 0.13° greater flexibility than the 20% group, which, in our opinion, is not clinically significant.

One other submaximal PNF study suggested that PNF stretching should be submaximal (75% in their study) and progressive. Schmitt et al also proposed that soft tissue length may be neurologically “reset” through stretching, rather than permanent deformation to more resistive tissues, whereas Magnusson et al suggest that PNF stretching simply alters stretch perception. The results of our study, as with Schmitt et al, lead to further questions about the role of the muscle spindle and Golgi tendon organ response to submaximal contractions.

Whether submaximal contractions less than 20% would elicit a neurological response great enough to cause similar changes is not known. Future studies should try to determine an intensity threshold, as well as the effect of different contraction durations at a submaximal level.

CONCLUSIONS
The use of submaximal contraction intensities of 20% and 60% MVIC in CRPNF stretching of the hamstrings yields comparable gains in flexibility to 100% MVIC. The benefit is to make the stretch more comfortable and to decrease the risk of contraction induced injury. The exact mechanism behind these results is unclear, and future research should focus on finding neurophysiological and anatomical explanations.

Table 1  Paired samples statistical analysis of change in flexibility over five days

<table>
<thead>
<tr>
<th>Group</th>
<th>df</th>
<th>Mean change (°)</th>
<th>SD</th>
<th>p Value</th>
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</thead>
<tbody>
<tr>
<td>1 (20%)</td>
<td>17</td>
<td>5.00</td>
<td>4.83</td>
<td>0.0001</td>
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<tr>
<td>2 (60%)</td>
<td>16</td>
<td>4.47</td>
<td>6.58</td>
<td>0.013</td>
</tr>
<tr>
<td>3 (100%)</td>
<td>14</td>
<td>3.13</td>
<td>5.11</td>
<td>0.002</td>
</tr>
<tr>
<td>4 (control)</td>
<td>11</td>
<td>0.33</td>
<td>0.98</td>
<td>0.220</td>
</tr>
</tbody>
</table>

<REFERENCES>

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