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## **Knee Rehabilitation, Part II**

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Last month, we discussed the findings of several studies on electromyographic (EMG) responses to several commonly used exercises in knee rehabilitation. This month, we will discuss several important, commonly employed approaches to knee rehabilitation. Issues that will be addressed include:

- What elastic tubing exercises are beneficial for knee rehabilitation?
- Is there a way to isolate the vastus medialis obliquus (VMO)?

### **Elastic Tubing Exercises**

A recent study by Hintermiester et al.<sup>1</sup> evaluated EMG activity (surface electrodes) of five exercises using elastic tubing. These exercises included:

1. **single knee dip:** subject stood on the elastic tubing with the involved side only; holding end of tubing in hand (on involved side), other end attached to chair (which the subject used for stability); subject performed partial squats on the involved side at a rate of 30 knee dips/minute while balancing with the chair;
2. **double knee dip:** subject stood on tubing and grasped end of tubing with hands (held at waist level) and performed squats;
3. **leg press:** subject was seated with tubing around heel and other end attached behind the subject; with the hip in maximum flexion there was some taughtness in the tubing; subject then pressed the leg into extension against the resistance of the tubing;
4. **hamstring pull:** subject seated with the tubing anchored around the ankle with the other end anchored in front with the knee flexed approximately 20 degrees with some taughtness in the tubing; subject was instructed to drag the foot across the floor as far as possible and lift slightly while returning to the initial position;

5. **side-to-side jump:** subject had the tubing secured around the waist and anchored away from them to the side; subject jumped laterally (to their side) in the opposite direction of the tubing attachment.

Recommendations by the authors suggest using the less stressful exercises first based on needs of a specific rehab program (e.g., ACL problem versus patellofemoral problem). For example, for patients with an ACL deficiency, a hamstring pull and leg press might be good starting exercises. Progression to more challenging exercises should be based on the ability to perform the less stressful exercises first. It should be noted that most of the exercises demonstrated a slight increase in VMO activity as compared to VLO activity, but it is not believed that this is clinically significant by most researchers.

### **VMO Recruitment**

It is generally accepted that the VMO is important for patellar stabilization, in particular through the last 15 degrees or so of extension. As a result, many studies have attempted to determine if any particular exercise was significantly better at isolating the VMO. It has been almost unanimously agreed based on numerous EMG studies that most exercises do not show a clinically significant increase in VMO activity over VLO activity.

A study by Laprade et al.<sup>2</sup> re-emphasizes this point and in addition calls into question a commonly reported claim that adding adduction to knee extension increases VMO activity over extension alone. In the past, it was assumed that because the VMO originates primarily from the adductor longus and magnus tendons and the medial intramuscular septum, adding adduction would increase or preferentially stimulate the VMO. This is a logical assumption not borne out by this study. Although one study (upon which most of this connection between adduction and VMO activity was based) indicated significant increases, it is clear that their EMG values were not normalized; therefore, their conclusions must be questioned.

It has also been suggested that the VMO might have some medial (internal) rotation affect on the tibia, based on the observation that the lowermost fibers of the VMO attach to the anteromedial aspect of the tibia. The study by Laprade et al. tests this hypothesis. This study also addresses whether there are any significant differences in VMO or VLO recruitment between patients with and without patellofemoral pain syndrome.

In this current study by Laprade et al., subjects were asked to perform four isometric exercises while surface EMG readings were taken:

1. **adduction:** subjects adducted their thighs against two rubber cups with their knees flexed to 50 degrees and hips flexed to 80 degrees;
2. **adduction with knee extension:** subjects performed simultaneous adduction and knee extension. Subjects were instructed to squeeze their knees together and lift against an ankle strap;
3. **medial tibial rotation:** subject's knee was at 70° flexion/30° lateral rotation; hip at 80° flexion; footplate that was padded provided resistance to medial rotation;
4. **medial tibial rotation with knee extension:** similar to the positioning for medial rotation, the subjects were asked to simultaneously medially rotate and extend the knee.

The results did not demonstrate any difference in the activity of VMO or VLO muscles or ratio of activity between the VMO/VLO between the symptomatic and asymptomatic groups. The results also indicated no preferential recruitment of the VMO over the VLO for most exercises including adduction with extension. There was some increase in VMO over VLO contraction using medial rotation with extension. Still, the difference between VMO and VLO activity would in no way isolate the VMO over the VLO. This exercise would, however, guarantee a good strengthening effect for both muscles with some degree of VMO focus.

#### *References*

1. Hintermeister R, Bey M, Lange G, et al. Quantification of elastic knee rehabilitation exercises. *JOSPT* 1998;28:40-50.
1. Laprade J, Sulham E, Brouwer B. Comparison of five isometric exercises in the recruitment of the vastus medialis oblique in persons with and without patellofemoral pain syndrome. *JOSPT* 1998;27:197-204.



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