ening, isometric QS exercises may actually be more beneficial than SLR/ADL exercises.

Acknowledgments

We wish to thank Patricia Hageman and Evelyn Boonyawiroj for their editorial comments.

References


Commentary

There is a need in physical therapy to evaluate common rehabilitation practices, so it can be determined whether the desired outcome of a particular therapeutic procedure has been achieved. It is only after this sort of scrutiny that we will grow as a profession. The authors are to be commended for pursuing this aim. They have investigated the common clinical claim that particular modification of the straight-leg-raising (SLR) exercise causes preferential activation of the vastus medialis obliquus muscle (VMO). Specific activation of the VMO has been advocated for patients with patellofemoral pain to improve patellofemoral tracking. It must be questioned, however, whether this report adds much to our body of knowledge, as similar research was performed by Soderberg and colleagues.2 2 The difference with this study is that the authors have examined the effect of a lateral rotation component, as well as an adduction component, to the SLR maneuver. The rationale for this addition was that exercises combining activity of the hip adductors in conjunction with conventional knee extensor strengthening exercises such as the SLR have been advocated as means of preferentially activating and exercising the VMO.
The above statement contains some unchallenged assumptions that have formed the basis of quadriceps femoris muscle (QF) rehabilitation for many years. One such assumption is that activation of the VMO requires knee extension. The work of Lieb and Perry, which was referenced by the authors, established that "no extension of the knee could be accomplished by applying weight to the VMO tendon. In fact, the femur was fractured in each case before any extension was accomplished." (Cadaver specimens were used in the study). Lieb and Perry concluded that the function of the VMO was to align the patella medially, thus overcoming "the malaligning effects of the vastus lateralis." From Lieb and Perry's meticulous work on QF function, we should have learned at least two things to help us implement an appropriate VMO strengthening program. First, the VMO is not an extensor of the knee, but a medial stabilizer of the patella, and second, the VMO is active throughout the entire extensor range, not just in the last 10 to 15 degrees.

Recently, however, Petschnig and colleagues demonstrated in asymptomatic individuals that the VMO exhibited more activity than the vastus lateralis muscle (VL) at 20 degrees of knee flexion than at 90 degrees. Subjects with patellofemoral pain showed a reversal of electromyographic (EMG) activity, with more VMO than VL activity being present at 90 degrees and less at 20 degrees. This preliminary study gives some justification for performing inner-range extension exercises, because it appears that there is a deficit in VMO activity in this range in individuals with patellofemoral pain.

To preferentially recruit the VMO, however, isometric hip adduction, rather than knee extension, should be emphasized in treatment, because the VMO is a medial patellar stabilizer that arises from the adductor magnus tendon. This supports Hanten and Schulthes' rationale of selectively strengthening the VMO by isometric adduction at 60 degrees of flexion without active extension of the knee. Interestingly, according to the 36th edition of Gray's Anatomy, "the adductors are essentially synergists in the complex patterns of gait activity" and are rarely required to perform forcible adduction. During a VMO exercise regimen, in weight bearing, where adduction is emphasized, perhaps it is this synergistic action of the adductor magnus muscle that is being retrained. Additionally, it must be remembered that the adductor magnus and adductor longus muscles assist in lateral rotation of the thigh, so basing the theoretical rationale for SLR exercises performed with the hip in lateral rotation on an anatomical link between the VMO and the adductor magnus muscle, as stated by the authors, seems to be unfounded.

When utilizing isometric adduction to enhance a VMO contraction, however, it seems that the position of the limb is a critical factor. A recently completed study by Hodges and Richardson supports the finding of the authors that the addition of isometric adduction of 5% of body weight (about 30% of a maximal contraction) has no differential effect on the activation of the VMO in the non-weight-bearing situation. Hodges and Richardson found that a maximal contraction was required before any increase in activity in the VMO relative to the VL could be demonstrated. Yet, in weight bearing, only 20% of a maximal contraction of the adductors was required to differentially increase VMO activity relative to the VL. This finding suggests that we should consider the effect of limb position and the relationship of the synergists if we desire preferential activation of the VMO.

Unfortunately, specific training in a weight-bearing position for the treatment of the patient with patellofemoral pain has been actively discouraged, because the flexed weight-bearing position increases the patellofemoral joint reaction force (PFJRF)—the greater the flexion, the greater the compressive force. The PFJRF has been calculated to be one half body weight during level walking, three to four times body weight during stair climbing, and seven to eight times body weight in a squat. Rather than avoiding knee flexion activities, which are an integral part of a patient's daily living, the aim of physical therapy intervention should be to increase the surface area of contact of the patella on the femur. This distributes the load over a wider area and decreases any localized concentration of pressure. Abnormal concentration of stress, if prolonged, may result in chondromalacia patellae on the posterior surface of the patella, not, as the authors suggest, on the inferior surface. In fact, patients with problems at the inferior surface of the patella have their symptoms exacerbated by the very exercises that are supposed to be beneficial, that is, the QF setting (QS) and SLR exercises. These maneuvers displace the inferior pole of the patella posteriorly, causing further irritation of an already inflamed fat pad.

Correcting the patella position, by taping the patella into an appropriate position, for example, should increase the surface area of the patella in contact with the femur and result in an immediate decrease in the patient's symptoms. This then allows the therapist to be specific with muscle training. Exercises can, therefore, be commenced in pain-free weight-bearing positions, particularly the first 20 to 30 degrees of knee flexion, as this is the range at which the amount and timing of the VMO activity are critical in controlling the seating of the patella in the trochlea. As strength gains are considered to be largely an acquisition of skill, strength training must be specific to the movement pattern, limb position, velocity, and contraction type. For many years, coaches and athletes have been aware of the benefits of specificity of training, yet in physical therapy we have been more reluctant to adopt this concept of training. Imagine a tennis coach asking his or her players to strengthen their playing arms by one-armed swimming. Sounds absurd, doesn't it, but, why is lying supine, bracing the knee, and lifting the leg in
the air to strengthen the knee for stair climbing any less absurd? Why, too, do physical therapists regard SLR as a progression of QS for VMO strengthening, despite mounting evidence to the contrary?

It has been demonstrated in this and other studies that activity in the vastus muscles is less in SLR than in QS and the muscle that is preferentially activated by SLR is the rectus femoris muscle, which is not usually the aim of physical therapy intervention for patients with patellofemoral pain. How many more studies do we need before we discard the SLR as being ineffective for these patients? Perhaps a more appropriate study in the future (as there will be more) would be to measure, in healthy individuals and in individuals with patellofemoral pain, the EMG activity of the back extensors, the obliques, and all the hip flexors during an SLR with and without a weighted boot. This information could be used to determine which patients are at risk of developing back pain during their rehabilitation program. Clinicians need to be proactive and examine better methods of preferentially activating the VMO to hasten the rehabilitation of patients with patellofemoral pain.

A recent study by Ingersoll and Knight, could be adapted further by physical therapists, demonstrated the effectiveness of EMG biofeedback in specifically recruiting VMO. The study involved three groups of healthy female college students—a control group, a group strengthening the QF with biofeedback, and a group performing progressive resistive exercises with no biofeedback. The group that received biofeedback training to increase VMO activity and to decrease VL activity demonstrated an improvement in congruence angle (ie, a reestablishment of fit of the patella in the trochlea) after 3 weeks of training. The training included QS and SLR exercises with biofeedback, as well as integrated functional activities of deep knee bends, step-ups, and bicycle riding with biofeedback. The control group, which received no training, showed no significant change in patellar position, whereas the group performing short-arc QF exercises with progressive resistance demonstrated a deterioration in the congruence angle, even though their QF had increased in strength by 170%. The authors concluded that "terminal extension progressive resistive exercises (in non-weight bearing) do not produce medial relocation of the patella and may actually predispose individuals to the likelihood of lateral subluxation of the patella." Although this study has significant implications for physical therapists in the rehabilitation of the QF, it cannot be determined whether the combined effect of all the training or a particular part of the training was more effective in altering the congruence angle.

Researchers in physical therapy examine current clinical practice. It is our (the clinicians’) responsibility to direct the research focus. To do this, we must critically evaluate treatment outcome to determine whether our intervention has substantially effected change in the patient’s condition. The findings must be published to disseminate the information. This allows the researchers to test more clinical hypotheses. However, we must act on research findings, discarding, if necessary, ineffective techniques, modifying existing techniques, and developing further treatment procedures to improve patient management. With the rising cost of health care and the shrinking of the health care dollar, this is essential for our survival as a profession. My final plea is let’s relegate to the annals the SLR (and all variations on the theme) and rejoice in its departure from patellofemoral pain management.

Jenny McConnell, PT
Private Practitioner
The Sports Clinic
Cumberland College of Health Sciences

The University of Sydney
Lidcombe, New South Wales 2141, Australia

References