THE ROLE OF ABDOMINAL MUSCLE RECRUITMENT

IN ATHLETES WITH LONG-STANDING ADDUCTOR-RELATED GROIN PAIN

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INTRODUCTION

Groin injuries are very common in high intensity athletic activities, especially in sports with lots of twisting and turning, such as soccer and field hockey[1]. Furthermore, the fact that the soccer kick requires lots of adductor muscle activity contributes to the risk of groin overload[2]. In general, injury duration is short and athletes can return to sports within 3 weeks[3].

In most cases, groin pain is located at the inner upper thigh, but pain can also be located in the lower medial abdominal region, the symphyseal region and even the iliopsoas region[4]. Generally speaking, the physical examination of the groin region can be performed in a reliable manner using pain provocation tests like forceful muscle contractions and palpation of the suspected areas[5]. On palpation, most patients mention recognisable pain in the muscle-tendon-bone junctions of the adductor muscles. As a consequence, adductor-related groin pain is a diagnosis that is generally recognised and accepted by clinicians in sports medicine.

A test that is commonly used to identify subjects with adductor-related groin pain is the squeeze test: the patient lies supine on the bench with knees and hips flexed 90°, while an assessor asks the patient to squeeze both knees together[6]. The presence of pain is evaluated. By placing a hand held dynamometer between the knees, adduction strength can be measured as well. Interestingly, adduction strength during the squeeze test has shown to be a valid measure of problem severity in women with pregnancy-related pelvic girdle pain (PPGP)[7]. In addition, a test called the Active Straight Leg Raise (ASLR) has been described in both athletes with long-standing adductor-related groin pain and women with PPGP[8,9]. During this test, self-reported effort of lifting a leg during ASLR is evaluated with a score of 0 to 5 per leg. A score ≥1 is defined as positive and is positive in a relatively large percentage of both patient categories. This suggests that there are some similarities between athletes with longstanding adductor-related

groin pain and women with PPGP.

BIOMECHANICS OF SQUEEZE TEST AND ASLR TEST

The biomechanical rationale for the use of the squeeze test in women with PPGP is that the squeezing action of the

Figure 1: Most patients with adductor-related groin pain experience decreased pain during the squeeze test when a pelvic belt is tightened with at least 50 N.

adductor muscles distracts both iliac bones at the level of the pubic symphysis, thus provoking instability-related complaints of the pubic ligaments or other tissues of the anterior pelvic ring during pregnancy or following birth.

In contrast to distraction of both iliac bones, the ASLR test is developed to provoke anterior rotation of the ipsilateral iliac bone due to rotatory torque of the leg being raised in women with suspected pelvic instability.

Research by Mens et al[8] has shown some interesting similarities between athletes with adductor-related groin pain and women with PPGP. In both groups of patients, the performance of the squeeze test usually improves (i.e. less pain and improved adduction strength) when subjects are wearing a pelvic belt tightened with at least 50 N around the pelvis, at the height of the pubic symphysis (Figure 1)[10]. Furthermore, in patients with a positive ASLR test, performance improves when wearing a pelvic belt in all subjects, i.e. ASLR scores decrease[8]. Biomechanically, a pelvic belt gives force closure of the pelvic ring and counteracts the distracting action of the adductor muscles during the squeeze test. It could also theoretically minimise the anterior rotation of the ipsilateral iliac bone during ASLR[11].

As many athletes with long-standing adductor-related groin pain have a positive response to a pelvic belt, it may be that pelvic instability plays a role in athletic groin pain associated with painful hip adduction, similar to women with PPGP. Findings reported in imaging studies show that clinical signs in patients with adductor-related groin pain are not limited to the adductor tendon only, presenting as pubic bone oedema and a so-called cleft sign on MRI[12], or other radiographic signs of pubis involvement[17]. The combination of a positive squeeze test and recognisable pain during palpation of the adductor insertion is used to diagnose the clinical entity of adductor-related groin pain.

DYSFUNCTION OF THE ABDOMINAL MUSCLES

Considering the anatomy of the abdominal muscles, it can be concluded that obliquus internus and transversus abdominus (TA) both have proper fibre orientation to contribute to force closure of the anterior pelvis (Figure 2). Richardson et al showed that an exercise specifically recruiting TA (abdominal hollowing; drawing in the belly button) increases pelvic stability to a greater extent than a general abdominal bracing technique, where all muscles surrounding the abdominal cavity contract in a more non-specific manner[13].

In later research, Cowan et al used electromyography (EMG) to study abdominal muscle recruitment in athletes with adductor-related groin pain. They showed in a cross-sectional design that in athletes with long-standing adductor-related groin pain, recruitment of TA during a quick-response ASLR test was employed just after rectus femoris onset. In contrast, healthy subjects present an anticipatory activation of TA[14]. This might indicate dysfunction of the deep abdominal muscle and therefore these findings contribute to the theory that groin pain can be associated with pelvic instability.

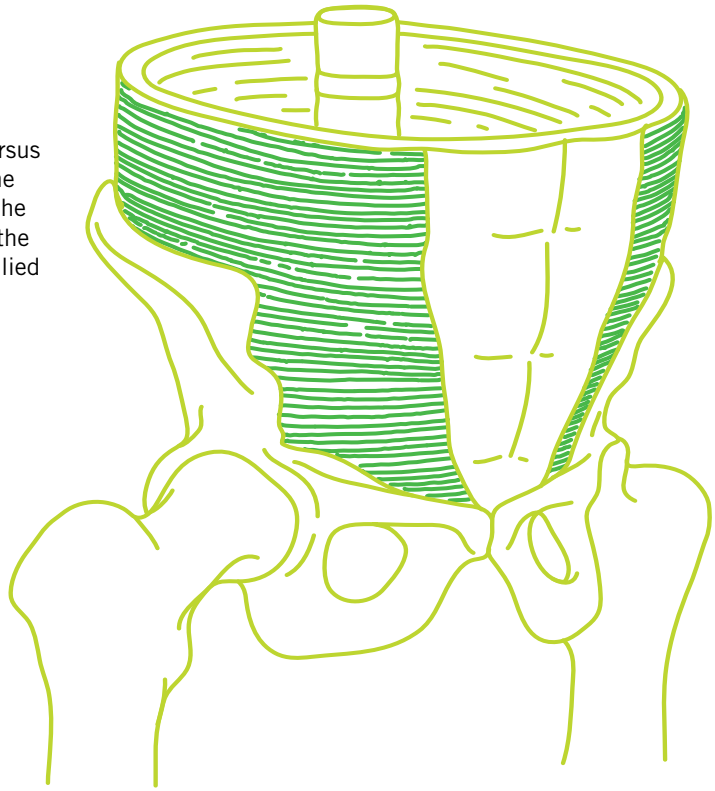

Figure 2: Fibre orientation of transversus abdominus. Notice the similarities between the fibre orientation and the direction of force applied by a pelvic belt.

Using ultrasound imaging, we showed that resting thickness of TA was significantly decreased in athletes with long-standing groin pain, irrespective of the side of complaints, compared to matched athletes[15]. To estimate activity of the abdominal muscles during provocative tasks like ASLR and squeeze test, thickness increases relative to rest were also calculated[16]. No significant differences in thickness increase were found during the squeeze test or ASLR[15]. Although not all results were consistent, there are indications that some abnormalities considering the abdominal muscles exist. As a consequence, specific attention to muscle thickness and motor control for TA and other pelvic stabilising structures (i.e. pelvic floor muscles) might be included in the management of long-standing adductor-related groin pain in athletes.

PHYSICAL THERAPY

Muscular imbalance in relation to groin pain is not new. Hölmich et al[17] described an active rehabilitation programme aiming for increased strength and stability of the hip. Their rehabilitation programme consisted of two modules of strengthening and stabilising exercises for hip and abdominal muscles. This programme was more effective (defined as no pain during adduction/palpation and full asymptomatic return to the same level of sports) compared with passive rehabilitation using passive modalities and stretching[17]. Based on more specialised knowledge developed over the last decade considering the possible role of the pelvis, it could be expected that an even more specific programme that also focuses on specific abdominal and pelvic floor muscle recruitment patterns may improve clinical outcomes.

By including 21 subjects with long-standing adductor-related groin pain, we prospectively evaluated if changes in abdominal muscle thickness or recruitment during ASLR/adduction were associated with recovery[18]. All subjects received a rehabilitation protocol with initial specific attention for abdominal muscle recruitment that was gradually integrated in more complex strengthening and stabilising exercises in later phases of rehabilitation. The only positive significant association between recovery and muscle characteristics was found for TA resting thickness (rho=0.51, P=0.017). For thickness increase patterns during ASLR and squeeze, small and non-significant correlations were found[18]. Similar findings are reported in research in the field of back pain: associations between clinical status and (abdominal) muscle recruitment that seem very evident in cross-sectional research are absent or small and non-significant when tested in a prospective study design[19,20]. Consequently, one should reconsider the need for specific abdominal muscle exercises in rehabilitation protocols for patients with lumbo-pelvic complaints. If altered muscle recruitment is associated with the presence of pain only, the theory that lumbo-pelvic instability is causing groin pain seems to be invalid.

THE CHICKEN OR THE EGG

To study the cause and effect relationship between abdominal muscle characteristics and the presence of groin pain, we performed a study on the effects of experimental groin pain on abdominal muscle thickness during ASLR and squeezing[21]. Fourteen volunteers' groin regions were superficially electrically stimulated to give unbearable pain. Just before the pain was initiated, the abdominal muscle thickness was measured using ultrasound. We showed that abdominal muscle thickness of TA (and obliquus internus) was significantly decreased during both an ASLR task and squeeze test when groin pain was anticipated. Consistent findings are reported in research on the effects of experimentally-induced back pain using EMG abdominal recruitment patterns as outcome[22,23]: similar findings as reported in Cowan's study were identified. Therefore it can be suggested that alterations in abdominal muscle recruitment are the consequence of pain instead of its origin. Moseley and Hodges showed that if acute experimental muscle pain decreases, muscle recruitment patterns measured by EMG gradually return to normal[24]. In subjects with aberrant pain beliefs, variability in motor behaviour appeared to be low and might therefore not lead to recovery of normal muscle recruitment patterns[24].

On the other hand, it is known that habitual movement patterns can vary

highly between subjects. Since performing a Valsalva manoeuvre also leads to a delayed recruitment of TA[25], it can be hypothesised that the subjects using this general abdominal bracing strategy are more likely to develop pain in the pelvic area, since pelvic stability was shown to be suboptimal compared to abdominal hollowing[13]. Proper prospective research on this association is lacking. It must be questioned, however, to what extent an abdominal hollowing strategy could be effective. Compared with the pelvic ring, the intrinsic stability of the lumbar spine is far less and requires more muscular stabilisation. Since several computer modelling studies have shown that a general bracing strategy is more effective for lumbar stability compared with abdominal hollowing[27], it is questionable whether a fully integrated abdominal hollowing strategy in high-load tasks is required for full return to sports after groin injury.

Discussion

Based on the arguments above, there were some indications that adding specific motor control exercises have additional effects when compared to traditional exercises. In 2008, a randomised clinical trial was initiated (unpublished data) from the University Medical Center, Utrecht, The Netherlands, to test whether there would be a clinical benefit for patients if specific exercises for TA and the pelvic floor were added to an active rehabilitation programme as described by Hölmich et al[17]. Early analysis based on small sample size (n=12 per group) showed no indications of better clinical outcome measured as pain during adduction or time to return to sports in this group compared to a usual active rehabilitation programme. Analyses of muscle thicknesses also showed no significant interaction between type of intervention and changes over time: TA resting thickness was increased in both groups, whereas no differences over time were found in thickness increases relative to rest during ASLR and adduction in both groups. Although underpowered, given the amount of research on specific exercise therapy in patients with low back pain, it is plausible that there is limited additional value of specific abdominal recruitment exercises in athletes with long-standing adductor-related groin pain. In 2007, Tsao and Hodges showed similar training effects of regular sit-up training or abdominal hollowing exercises on electromyographic abdominal muscle recruitment patterns during low-load extension-loading of the trunk[28]. This might explain the similar effects of both interventions, since abdominal muscle strengthening is also part of the programme described by Holmich et al[17].

CLINICAL RECOMMENDATIONS AND FUTURE RESEARCH

For athletes with long-standing adductor-related groin pain, conservative intensive active exercise treatment should be considered as the first treatment in this population. Most subjects will experience a successful recovery within 20 weeks. For the abdominal muscles, regular sit-up training will probably result in a similar outcome compared with specific exercises. It must be noted though, that if subjects have aberrant pain beliefs, the proposed transfer of the effects of regular sit-up training on abdominal muscle recruitment to sport-specific exercises might not be that obvious. An intervention aiming at injury coping style combined with specific abdominal muscle exercises might then be indicated.

Compared with the pelvic ring, the intrinsic stability of the lumbar spine is far less and requires more muscular stabilisation.

Although active exercise therapy aimed at strengthening the kinetic chain over the anterior pelvis seems to be very effective for most subjects, it remains difficult to selectively pick out subjects for this therapy. An early analysis on our data from the small randomised controlled trial showed a higher ASLR test score to be positively associated with recovery (unpublished data). Prospective studies with large sample size trying to identify prognostic factors for successful conservative management (i.e. developing clinical prediction rules) for long-standing groin pain could contribute to more specific treatment methods for these athletes.

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