Physical diagnostic tests for assessing ruptures of the anterior cruciate ligament

Description

**Anterior drawer test:** This test is performed with the knee flexed to approximately 90 degrees. Ideally, the patient’s foot should point straight ahead and be secured by sitting directly on the toes of the patient. The examiner’s hands are placed around the proximal tibia with the thumbs placed on the tibial tubercle. A gentle to and fro rocking motion is performed to determine the degree of anterior translation of the tibia compared to the femur. It is essential to ensure that the patient has completely relaxed the hamstrings to prevent a potential false negative result. Increased anterior translation of the injured knee (compared to the normal contralateral knee) would be indicative of a potential anterior cruciate ligament (ACL) rupture, deficient posterior horns of the menisci, or meniscocapsular tears (or any combination of these).

**Lachman test:** This test is performed in the same way as the anterior drawer test, but with the knee flexed to 20 degrees. Again, it is important to ensure that the patient’s hamstrings are completely relaxed to reduce the chance of a false negative test result. The examiner should pay attention to two aspects. 1) In a knee with an intact ACL one should feel a solid thud, or an endpoint, at the end of the force application to the tibia, which indicates that the ACL is intact and has not been torn. This solid thud should be felt in both knees. 2) If the ACL has been ruptured, a subjective increase of the translation of the tibia compared to the distal femur will be felt which is soft and in effect has no ‘endpoint’. Also, in this test it is important to compare the injured knee to the uninjured knee to ensure that the patient doesn’t have a normal variant of increased anterior translation.

**Pivot shift test:** The pivot shift test is a dynamic test which also tests the integrity of the ACL. In this test, the examiner stretches the patient’s knee and lifts the leg with the hip and knee in full internal rotation. The knee is gently flexed to about 40 degrees. In a patient with an ACL tear, the joint starts out subluxed in full extension and then is forced back into its normal position by the action of the iliotibial band pulling the anterolaterally subluxed tibia back against the femur when the knee courses through approximately 30 degrees of flexion. This test is quite difficult to perform, making it less attractive for an inexperienced examiner, eg a primary care physician.

Commentary

The diagnostic accuracy of these physical diagnostic tests was assessed in a systematic review (Scholten 2003). 17 studies met the inclusion criteria. None of the studies was conducted in general practice, none of them assessed the index test and reference test independently (with blinding), and all but two displayed verification bias (ie patients whose physical test results were abnormal were more likely to undergo the gold standard reference test – a factor that inflates sensitivity and decreases specificity). Summary estimates of sensitivity and specificity were 62% (95% CI 42 to 78) and 88% (95% CI 83 to 92) for the anterior drawer test, 86% (95% CI 76 to 92) and 91% (95% CI 79 to 96) for the Lachman test. No summary estimates could be calculated for the pivot shift test (due to a lack of available studies). Data from four studies show that the sensitivity and specificity ranged from 0.18 to 0.48, and 0.97 to 0.99, respectively. The pivot shift test had the highest positive predictive value, and the Lachman test the highest negative predictive value. The anterior drawer test was of little diagnostic value.

It was concluded that physical diagnostic tests may be useful in the diagnosis of ACL ruptures. The clinical relevance of the test results, however, depends on the prior probability of the presence of such a rupture and is therefore different for general practitioners and specialists/physiotherapists. If the prior probability is low (say 10%, eg in general practice), a negative Lachman test will almost rule out an ACL rupture (probability decreasing from 10% to 2%), whereas a (difficult to perform and, therefore, less suitable) positive pivot shift test will result in referral to secondary care for further investigation (probability increasing from 10% to more than 60%). If the prior probability is high (say 50%, eg in secondary care or physiotherapy practice), a positive pivot shift test will almost confirm the clinical diagnosis of ACL rupture without further imaging investigation (probability increasing from 50% to more than 90%), whereas a negative Lachman test cannot rule out an ACL rupture (probability decreasing from 50% to 10%).

Obviously, elements from the medical history (eg, type of trauma, nature of the complaints) will increase the prior probability and, therefore, improve the predictive values.

In summary, in general practice a negative Lachman test almost rules out an ACL rupture, whereas in specialised care a positive pivot shift test will practically confirm the clinical diagnosis of an ACL rupture.

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References

Quantitative Ultrasound (QUS)

Description

Quantitative Ultrasound (QUS) is a non-invasive adjunct tool applied to the appendicular skeleton for diagnosing osteoporosis and identifying fracture risk (FDA, 1998). Dual-energy X-ray absorptiometry (DXA) remains the ‘gold-standard’ for assessment of at-risk populations such as postmenopausal women, particularly in the absence of clinically evident fractures (Nelson 2002). However, interest persists in ultrasound techniques because they: are cheap, portable and non-ionising; predict fractures and; correlate moderately with the findings of DXA. The most widely used system employs gel-coupling of twinned transducers to the medial and lateral calcaneus. This bone is weightbearing, has a high trabecular content, and is metabolically sensitive to systemic effects on the skeleton of ageing, nutrition, physical activity, disease, or therapy (Vogel 1988). The theoretical basis of QUS is the variation in the speed of the ultrasound wave (SOS, in units of m/s) and its attenuation along its transmission path, at frequencies between 0.4 and 1.0 MHz. Ultrasound waves travel faster in bone with higher density. In addition, as ultrasound passes through bone, it undergoes attenuation, with a consequent loss of transmitted acoustic energy. The slope of attenuation as a function of frequency (the broadband ultrasound attenuation [BUA], in units of dB/MHz) is lower in more porous and less microstructurally intact bone.

Aside from SOS and BUA, the most common derived variable is ‘stiffness’, a linear combination of SOS and BUA. Collectively these indices indirectly describe bone microarchitectural features such as trabecular spacing, orientation, and connectivity as well as density. However unlike DXA, QUS does not directly measure bone mineral density (BMD).

Precision: Precision expressed as the standardised coefficient of variation ranges from 2.8% to 6.9% for BUA, and 4.3% to 8.4% for SOS (Njeh 2000). This is generally inferior to DXA and compromises longitudinal measurements of QUS (eg, charting treatment response), but has less effect on cross-sectional measurements (eg, predicting risk of future fractures).

Validity: Associations between calcaneal QUS and BMD: Weak to moderate associations are observed between QUS and DXA, with correlation coefficients ranging from 0.20 to 0.64, indicating that calcaneal QUS has little value in predicting DXA BMD. This may be due to the effect of skeletal heterogeneity on bone mass and that QUS and DXA in part address different bone properties (Njeh 2001). Predicting fractures: Prospective epidemiological studies have shown that calcaneal QUS can predict hip fractures in elderly women as effectively as DXA BMD (Schott 2004). A recent meta-analysis of prospective studies concludes that QUS is generally a valid predictor of fracture risk at non-spinal sites (Marin 2006).

Commentary

QUS as an adjunctive modality for estimating bone fragility is gaining recognition; however, it is still not widely accepted for the assessment of fracture risk, mainly due to the diversity of QUS devices and measurement sites, and lack of standardisation of thresholds of risk. Current diagnostic thresholds defined by the WHO (1994) and based on the T-score concept cannot validly be extended to QUS. Despite these limitations, QUS has been shown in prospective studies to be valid in predicting non-spinal fractures (Marin 2006); the inclusion of other clinical risk factors such as age and history of fracture, further increases the predictive power (Diez-Perez 2007).

There would be merit in focusing on calcaneal QUS because of its supporting clinical literature and its superior precision. QUS has several operational advantages over DXA; it is 1) non-ionising; 2) portable and relatively inexpensive, and; 3) influenced by aspects of bone strength such as microstructure not addressed by DXA. However the most cost-effective use of QUS may be as an adjunct to DXA in preliminary assessment. A recent study reported that the use of QUS as a pre-screening modality followed by DXA assessment for those with low QUS readings incurred lower costs and would prevent more hip fractures than DXA alone (Kraemer 2006). The role of QUS in management of the patient following diagnosis is more problematic. The relatively poor long-term precision and restriction to appendicular sites reduces its power to reflect treatment-induced changes at sites of clinical interest. Therefore it is likely that DXA will maintain its central role in the management of osteoporosis treatment and in the ongoing assessment of the untreated patient.

As the average age of Australians increases, fracture-risk assessments in primary health care and community settings (eg, in pharmacies) will increase. Clinicians should be aware of the potential role of QUS, particularly its possible synergistic role with DXA in initial assessment, as well as its proven capacity to predict hip fractures in the elderly.

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References