



Lower Limb Overuse Injuries and Orthotic Prescription: A Clinical Viewpoint

by Bill Vicenzino (PhD, MSc, BPhy, Grad Dip Sports Phy)
Senior Lecturer, Director of the Musculoskeletal Pain & Injury Research
Unit, Physiotherapy Department, University of Queensland.
(e-mail: b.vicenzino@shrs.uq.edu.au)

Overuse injuries are a significant problem to society and the individual (see Table 1). Overuse injuries of the lower limb result from a predominantly intrinsic mechanism of injury in which repetitive activities create forces and stress beyond the body's ability to cope. However the risk factors for overuse injuries are multifactorial, including both intrinsic and extrinsic factors. The intrinsic risk factors that are usually considered clinically are the bone alignment, joint motion and aspects of muscle function and motor control, which to some extent determine the ability of the individual to cope with repetitive loading. The extrinsic factors relate to the footwear and equipment, the nature of the physical activity and the surfaces on which the injuries were noticed to occur. These extrinsic factors when identified in the clinical examination are dealt with through consultation, advice and education. The intrinsic features are the focus of this article.

Table 1: Overuse injuries

- **Leading cause of musculoskeletal healthcare expenditure**
- **Occur with walking, jogging, cycling and aerobics**
- **Activities that prevent diseases of sedentary lifestyle (e.g. heart disease)**
- **Compromise participation in active lifestyle**
- **Challenge and sometimes difficult to treat**

The contemporary approach to the clinical management of overuse injuries as outlined in Table 2 is predicated on the identification of musculoskeletal abnormalities, which then become the focus of the treatment program. A major problem with this paradigm is encountered when attempting to identify

and classify normal and abnormal muscle function, joint function and bone alignment, especially the latter two in disorders of the foot (McPoil and Cornwall 1996). This paper will briefly outline a contentious issue in orthotic prescription and a clinical viewpoint to its resolution. To illustrate the clinical viewpoint reference will be made to a case example of patellofemoral pain syndrome.

Table 2: Contemporary physical therapy paradigm

- **Evaluation of muscle function and motor control**
- **Physical inspection of joint mobility and stability**
- **Clinical examination of bone alignment (e.g. varus)**
- **Management focused on treating physical findings**

To use or not to use orthotics?

A point of contention exists in the treatment of overuse injuries, centred predominantly on the role of orthotic therapy. There appears a polarization of views with some practitioners who use orthotic therapy almost exclusively and those who do not. The latter tend to use therapeutic modalities and exercise programs extensively. The traditional approach to orthotic therapy was modelled on publications of Root et al (Root et al. 1971; Root et al. 1977). Simply put, these publications listed normative values of joint movement and bone alignment and introduced a concept of the neutral sub-talar joint position about which it was proposed that the rear foot should function in gait. For example, it was pos-



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tulated that if a person had a forefoot varus that they were prone to developing compensatory and excessive pronation in stance phase. Excessive pronation has been implicated as a risk factor in some overuse injuries (*Clement et al. 1984; Taunton et al. 1988; Tiberio 1987*). Hence the clinical rationale that inserting into a shoe an orthotic that balanced the forefoot varus abnormality would remove the need for the foot to undergo excessive pronation and result in an alleviation of signs and symptoms (*Eng and Pierrynowski 1994*).

This approach is widely used in clinical practice to underpin much of the assessment and treatment of foot and lower limb overuse injuries.

Recently, Root's line of reasoning was challenged when research identified that the foot probably does not function around the sub-talar neutral position (*McPoil and Hunt 1995; McPoil and Cornwall 1996*). Furthermore many of the clinical tests developed by Root have been shown to be unreliable and their validity questioned (*McPoil and Hunt 1995; McPoil and Cornwall 1996*). *McPoil and Hunt (1995)* proposed an alternative model, the 'Tissue-Stress Model', in which abnormal movement and stress were responsible for the breakdown of tissues involved in the overuse injury and that orthotic therapy, which appears to be of benefit in appropriate circumstances (*eg, patellofemoral pain (Eng and Pierrynowski 1993)*) should be used to relieve the excessive tissue stress and allow healing or resolution of the condition to take place.

Clinically, if the identification of bony and joint abnormalities is not a valid and reliable approach on which to base orthotic prescription, then how does a practitioner determine if orthotic therapy is warranted?

One approach to addressing this question is the clinical biomechanics diagnostic tape test. This test is best explained through a description of an exemplar case, such as in patellofemoral pain syndrome. In brief, patellofemoral pain syndrome is a term reserved for anterior knee pain that is usually insidious in onset or related to some overuse activity. The

anterior knee pain is usually exacerbated by weight-bearing activities such as stair walking (especially down), squatting, and hill walking or running. In advanced stages sustained flexion aggravates anterior knee pain and there may also be crepitus with movement (*Fulkerson and DS 1990; McConnell and Fulkerson 1996*). Clinical examination reveals a positive Clarke's sign, and pain with palpation around the patella.

The current best evidence indicates that patellofemoral pain syndrome is associated with abnormal tracking and joint surface pressures (*McConnell and Fulkerson 1996; Shellock et al. 1999*). The abnormal lateral tracking of the patella is thought to result from an increased valgus vector at the patella. Biomechanical abnormalities such as excessive internal rotation of the femur, excessive or prolonged pronation, and muscle imbalances (*eg, inhibition of vastus medialis obliquus, tightness of iliotibial band*) have all been associated with patellofemoral pain syndrome (*Eng and Pierrynowski 1993; McConnell and Fulkerson 1996; Woodall and Welsh 1990*) and could feasibly contribute to the lateral deviation in patella tracking.



Fig. 1(a)



Fig. 1(b)

For example, consider figure 1 (a) through (c). Figure 1(a) shows a patient's unaffected lower limb in a hop test and figure 1(b) shows the limb with patello-femoral pain. Note the increased hip adduction, pronation of the foot, and valgus angle of the knee compared to the unaffected side (Fig 1(a)). The hop test in this case reproduced the patient's anterior knee pain. (Cont'd on Page 3)



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Fig. 1(c)

The clinician, on observing the motion exhibited in Figure 1(b) during the physical examination, should consider what would be the most efficient way to manage this condition:

- Should the focus be on the knee, hip, or foot?
- What decision making process should the clinician employ?

The application of a clinical biomechanics diagnostic tape test would require the clinician to make a judgement on which of the three areas is likely to respond most favourably and then to apply a taping technique that would prevent abnormal motion to that area. Once the tape is applied the hop test would be re-evaluated for both quality of movement and pain response. In this case, taping the foot resulted in most improvement of movement (see Figure 1(c)) and an alleviation of the anterior knee pain. Generally a greater than 50-60% reduction in pain is required for a positive clinical biomechanics diagnostic test.



Fig. 2(a)

The taping technique used in this case was an augmented low dye technique, which has been shown to be more effective in controlling foot pronation than a low dye technique or double X technique (Ator *et al.* 1991; Griffiths *et al.*

1998; Hadley *et al.* 1999; Vicenzino *et al.* 1997). The augmented antipronation tape involves the application of a low dye (Figure 2(a)) with the addition of several reverse sixes (Figure 2(b)) and calcaneal slings (Figure 2(c)). Its impact on pronation is similar to that of an orthotic (Vicenzino *et al.* 2000).

The single leg hop test (on the spot) is a clinical test that usually highlights issues pertaining to control of motion of the lower limb, especially the hip but also the entire lower kinetic chain. This test magnifies movement abnormalities that occur during normal walking or running gait. It should only be used where pain, and the patient's general condition allows it.

In this case (Figure 1) with such a positive response to the foot tape the prescription of an orthotic would appear to have a high likelihood of a successful outcome compared to if the anti-pronation diagnostic tape test was negative. A negative response to the anti-pronation tape would require the therapist to evaluate the effect of tape on the hip or knee. An essential follow up to the diagnostic tape test is to evaluate the reasons for any abnormal motion at the hip, knee or foot as a prerequisite to instituting the most appropriate intervention, whether it is orthotic, exercise or manual therapy, or a combination of these therapeutic approaches.



Fig. 2(b)



Fig. 2(c)

Overview:

- **Orthotic therapy appears indicated when a biomechanical diagnostic tape test is positive and possibly ineffective when the tape test is negative.**
- **Patellofemoral pain syndrome may result from motion dysfunction at the hip, knee or foot and highlights the need for a sound clinical reasoning process in determining the most effective treatment approach.**
- **Clinicians most frequently deal with the intrinsic biomechanical causes of lower limb overuse injuries but should not ignore extrinsic risk factors. #**

