Chapter |25|

Neurodynamics

Monika Lohkamp, Lee Herrington and Katie Small

INTRODUCTION

In 1864, Lasegue first described the straight leg raise test (SLR) as an assessment for lower back problems with nerve involvement (Butler 1991). This concept was further developed by Goddard and Reid in 1965 who described the SLR as movement of the sciatic nerve. Also, in the 1960s Alf Breig investigated the biomechanics of the nervous system in more detail and showed that nerves move independently from other tissues. This formed the basis of the concept of 'neurodynamics'. Earlier terms for this concept were 'neural tension' (Breig 1978) or 'adverse mechanical tension of the nervous system' (Butler 1989). However, the actual term 'neurodynamics' was first introduced by Gifford in 1989. The concept of neurodynamics has been further developed by Grieve, Butler, Maitland and Shacklock over the last 30 years. Nowadays, although neurodynamics remains a relatively new concept within musculoskeletal clinical assessments, it is becoming more widely used and accepted as an important aspect for injury assessment and treatment.

Mechanics of the peripheral nervous system

In general terms, the nervous system can be divided into the central nervous system (CNS; brain and spinal cord), peripheral nervous system (all nerves after leaving the nerve roots within the spinal vertebrae) and autonomic nervous system (sympathetic and parasympathetic division) (Michael-Titus et al. 2007). The central and peripheral nervous system are closely connected through meninges (Butler 1991). The mechanical and physiological properties of peripheral nerves are crucial in their ability to function well.

The peripheral nerves are not only involved in conducting impulses and chemical traffic, but are also considered as dynamic tissue in the same way as muscles and joints. Along with the CNS, the peripheral nerves are designed to function while stretching and sliding (longitudinal and transverse motion) as a result of a wide variety and range of body movements (Shacklock 1995). When nerves are sliding they always slide towards the joint where movement takes place (Coppieters and Butler 2008). During movements of the body, nerves can undergo extremes of elongation, for example the spinal canal is 5–9 cm longer in flexion than extension, thus leading to an increased tensile load on the spinal cord (Breig 1978; Louis 1981 cited in Butler and Gifford 1989). Another example is the median nerve which has to adapt to a nerve bed nearly 20% longer if the shoulder is 90 degrees abducted, and the wrist and elbow are moved from flexion to extension (Millesi et al. 1986).

The nervous tissues are able to tolerate large tensile and compressive forces during movements associated with daily living and sporting activities. Nerves are strong structures owing to the surrounding connective tissue sheath helping them withstand large compressive and tensile forces (Shacklock 1995). If nerves are loaded by movement they react by moving and absorbing some of the pressure. During normal movement, as the nerve elongates the perineurium tightens, intraneural pressure increases and intrafasicular capillaries stop flowing. This occurs at 8% elongation, with intraneural microcirculation ceasing completely at 15% elongation (Ogata and Naito 1986). As the nervous system is dynamic, forces that cause a temporary disruption are easily tolerated. However, if the load becomes too excessive or persists, the maintenance of the increased local pressure to the nerve can cause local tissue ischaemia and injury.

Pathophysiology of the nervous system

Injuries involving nervous structures can either be caused by direct or indirect mechanics. A direct injury can occur from over-stretching or irritation from a repetitious