General Introduction

Low back pain is a major public health issue, whose prevention and treatment are problematic. The primary focus of this thesis is to contribute to the understanding of motor control issues governing trunk voluntary muscle responses to postural demands of day-to-day life. The investigations are carried out on four themes, each examining specific aspects of neuromuscular activation and postural control of Chronic Low Back Pain (CLBP) population.

1) Preprogrammed Reactions (PPR) appear at a latency of higher than 40 ms, but before the voluntary muscle responds (~120 ms) to postural perturbations (Hammond 1955; MacKinnon et al. 2000). Studies have reported PPR as a strong possible candidate responsible for coordinated response to effectively counter the perturbation through reflex mediated stiffness, which in turn contribute to efficient maintenance of spinal postural control (Gielen et al. 1988). Further PPR response elicited during sudden perturbation trials have been found to act as coordinated functional responses similar to voluntary responses. Hence PPRs essentially contribute to stiffness around the whole joint for the perturbation to be encountered (Gielen et al. 1988).

Although considerable research indicates that PPR response is highly adaptable, more plastic than stretch reflex and fastest possible contribution from primary motor cortex to current task demands, their role on postural or muscle control of chronic low back pain has not been investigated till date (Kurtzer et al. 2009; Shemmell et al. 2010; Chan and Kearney 1982).

Our experimental pilot study with varieties of simulated perturbation methods explores the essential role of PPR response in trunk voluntary responses on stable, unstable and unexpected and expected perturbation tasks in CLBP and normal healthy subjects.

2) Kinesiophobia is a condition in which a patient has a fear of movement/(re)injury, a specific fear believed to cause injury or re-injury (Vlaeyen et al. 1995). Kinesiophobia or pain related fear to movement was reported as one of the important factor which affects the trunk muscle responses in CLBP patients (Thomas et al. 2008). The influence of kinesiophobia on sudden postural demand was scarcely reported till date particularly the extent of influence on trunk muscle responses were unknown in CLBP population. Hence we examined the influence
and association of kinesiophobia on perturbation induced global trunk muscle responses.

3) Impaired postural control of lumbar spine is associated with deficits in neuromuscular activation patterns and strategies (Sung et al. 2010; Radebold et al. 2001). Hence next level of this thesis was focused on commonly used specific functional tasks such as voluntary stepping, standing and stepping with lateral destabilisation. The postural control specific characteristics during above mentioned tasks on CLBP patients were compared with normal healthy population to find out postural control specific dysfunction in CLBP population. Identifying and minimising abnormal postural responses associated with functional tasks of daily life, ought to be taken into consideration when designing and performing rehabilitation programmes.

4) Lumbar segmental stability exercise was reported as effective measure to optimize abnormal muscle responses thus ensuring efficient postural control of lumbar spine (Stevens et al. 2007). Core stability exercises target recruitment of deep trunk muscle and to gradually reduce unwanted over-activity global muscles in CLBP population. These specific exercises reduces pain and disability in chronic and can be helpful in the treatment of acute low back pain by reducing recurrence rate (Ferreira et al. 2006). Despite the popularity and evidences, there is little information on how these specific exercises helps CLBP population during sudden postural demands which induces sudden trunk displacements?, what are the postural control parameters sensitive to this exercises?, and which type of subgroup of CLBP population who are most likely to benefit after segmental core stability exercises are remain unanswered. The present study was undertaken to clarify above issues associated with core stability exercises particularly postural control parameters.

Four studies were conducted to answer questions relating to each of these topics. The thesis work presented here have resulted in several research papers from the Department of Sports Medicine and Physiotherapy, Guru Nanak Dev University, Amritsar, and Srinivas College of Physiotherapy and Research Centre, Mangalore, India, all of which address the issues of identifying, offsetting or optimizing deficits in lumbar neuromuscular activation and postural control of CLBP population. The list of publication is mentioned below:


Specifically four research papers from this thesis were submitted for publication, chapters 2 through 5. Chapters 1 introduce the topic and issues while chapter 6 describes the unifying summary.