# PARASPINAL REFLEX BEHAVIOR AS A FUNCTION OF TRUNK POSTURE

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## INTRODUCTION

Prolonged use of flexed postures during manual materials handling is associated with high incidence rates of low back pain (LBP). Spinal instability has recently been considered a potential risk factor for LBP. Previous work indicates that spinal stability is influenced by posture. The ability to accurately assess and reposition the lumbar spine has been shown to decrease with trunk flexion angle[1]. The ability to sense and control spinal curvature is important to spinal stability. Total stability in flexed postures must take into account changes in neuromuscular control, these being important factors in preventing injury during unexpected loading. However, spinal reflex response has not been measured as a function of posture.

Position-dependent reflex behavior has been exhibited in the elbow and the ankle, but not in the trunk. Reflex behavior may depend on anatomical architecture and mechanical advantage of the joint as well as differences in tonic firing rates associated with changes in muscle length. Evidence suggests that a fully flexed spine results in a reduced moment arm for the trunk extensor muscles and load redistribution to passive tissues and deeper spinal muscles. We hypothesize that trunk flexion will reduce paraspinal reflex behavior. The specific aim of this project was to evaluate trunk reflex behavior using data recorded in various trunk flexion angles.

## METHODS

Paraspinal reflexes were assessed at four trunk angles (0º, 30º, 60º, and 90º) on twenty-six subjects with no history of low back pain. Subjects were attached to a servomotor via a harness and cable system such that anteriorly directed horizontal loads were applied at the T10 level of the trunk. The servomotor applied a constant isotonic preload. The subject maintained an unsupported upright trunk posture throughout the experiment with their pelvis restrained; trunk angle was achieved via an apparatus that rotated the lower body to the desired angle in order to reduce confounding factors due to changes in spinal load in flexed postures. Each trunk angle was maintained for approximately 3 minutes, to limit exposure to ligament strain. Superimposed on the preload were force perturbations of ±70 N applied in a pseudo-random stochastic fashion with a flat bandwidth from 0-50 Hz. Lumbar paraspinal EMG were measured throughout the trial.

To quantify paraspinal reflex dynamics, the EMG response to a force perturbation was modeled as the closed loop transfer function of the system. Reflex gain was identified as the peak value of the impulse response function relating input force to EMG response using time-domain deconvolution analyses[2].

## RESULTS AND DISCUSSION

Reflex gain decreased significantly ($p < 0.0003$) with trunk angle. From upright posture (0º trunk angle) $G_R$ decreased 13.4% at 30º ($p = 0.36$), 24.2% at 60º ($p < 0.02$), and 29.9% at 90º ($p < 0.05$). A significant gender-by-trunk angle interaction indicates possible gender differences in position-dependent reflex behavior. From upright females exhibited a 24.7% reduction in $G_R$ at 60º ($p < 0.02$) and a 31.7% reduction in $G_R$ at 90º ($p < 0.0003$). However in male subjects there was no significant change in $G_R$ due to trunk flexion (Figure 1).

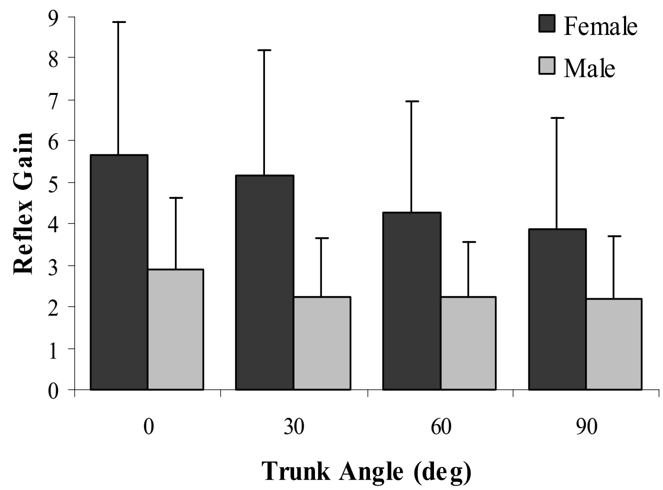


Figure 1. Reflex gain decreased significantly ($p < 0.0003$) with trunk angle.

It has previously been demonstrated that paraspinal reflex gain is altered following prolonged static and cyclic flexion[3]. It is interesting that brief periods of trunk flexion caused an inhibition of reflexes similar to the effects of prolonged flexion. Baseline EMG was also found to decrease with trunk flexion. In response to a perturbation muscles are therefore less excitable and produce a smaller reflex gain.

## CONCLUSIONS

Reduced reflex response in flexed postures, even brief periods, can contribute to reduced stability, making unexpected loading events particularly risky. Prolonged flexed posture work is a known risk factor for LBP; possibly even brief flexed postures should be considered a risk factor.

## REFERENCES

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