

Flexed lumbar spine postures are associated with greater strength and efficiency than lordotic postures during a maximal lift in pain-free individuals

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Abstract

Background

In spite of common lifting advice to maintain a lordotic posture, there is debate regarding optimal lumbar spine posture during lifting. To date, the influence of lumbar posture on trunk muscle recruitment, strength and efficiency during high intensity lifting has not been fully explored.

Research question

How do differences in lumbar posture influence trunk extensor strength (moment), trunk muscle activity, and neuromuscular efficiency during maximal lifting?

Methods

Twenty-six healthy participants adopted three lumbar postures (maximal extension (lordotic), mid-range (flat-back), and fully flexed) in a free lifting position. Motion analysis and force measurements were used to determine the back extensor, hip and knee moments. Surface electromyography (EMG) of three trunk extensors and the internal obliques were recorded. Neuromuscular efficiency (NME) was expressed as a ratio of normalised extensor moment to normalised EMG.

Results

Significantly higher back extensor moments were exerted when moving from an extended to mid-range, and from a mid-range to fully flexed lumbar posture. This was accompanied by a decrease in activity across all three back extensor muscles ($P < 0.001$) resulting in a higher NME of these muscles in more flexed postures. Change in lumbar posture did not influence hip or knee moments or internal oblique activation.

Significance

A flexed-back posture is associated with increased strength and efficiency of the back muscles compared to a lordotic posture. These findings further question the manual handling advice to lift with a lordotic lumbar spine.

Introduction

Low back pain is the leading cause of disability in the world [1], and lifting is one of the known risk factors for LBP in manual workers [2]. Clinicians and manual handling advisors commonly recommend lifting with a “straight” or extended, rather than a flexed lumbar spine [3,4]. However this practice has been recently questioned due to a lack of *in vivo* research demonstrating a clear relationship between a flexed lumbar spine when lifting and low back pain [5]. Furthermore, manual handling interventions advising people to minimise lumbar flexion when lifting have failed to reduce the incidence of LBP [6]. Indeed people with and without LBP, and physiotherapists report being fearful of lifting with a flexed lumbar spine [7]. Together this highlights the uncertainty regarding current lifting advice.

Lumbar posture has been shown to influence trunk muscle activation, although observations appear conflicting. For example, during maximal trunk exertions Nordin et al. [8] and Roy et al. [9] showed increased erector spinae (ES) activation and NME when moving from upright standing to a flexed lumbar posture, whereas Marras et al. [10] found muscle activity decreased. A potential limitation of these studies is that they only measured muscle activity of the lower erector spinae (LES), which neglects the complex functional role played by the different paravertebral (e.g. upper erector spinae (UES); LES; and multifidus) and abdominal muscles

of the lumbar spine during functional lifting activities [8,9,[11], [12], [13]].

Considering the limitations of previous studies, this study investigated the influence of lumbar posture on trunk muscle recruitment, strength and neuromuscular efficiency during high intensity lifting.

Section snippets

Design

An experimental, repeated measures study design was undertaken to investigate the effects of three lumbar postures (fully flexed, mid-range and maximal extension) during maximal voluntary isometric force exertions in a symmetrical lifting posture. The muscle activity of three paravertebral (UES, LES and multifidus) and one abdominal (internal oblique (IO)) muscle was measured when performing maximal trunk extension in a lifting position.

Participants

Thirteen males and 13 females participated in the study.

Lumbar curvature

In the lifting position with the lumbar spine maximally flexed, participants adopted a mean peak flexion of 56.2° (95 % confidence intervals (CI) = 51.4° - 61.1°). This was similar to that measured when fully flexing the lumbar spine from an upright standing position (57.2° ; 95 % CI = 52.7° - 62.8°). In the extended posture, participants maintained some lumbar flexion (mean angle = 22.7° ; 95 %CI = 18.3° - 27.2°).

Back extensor moment

A main effect of gender was found, with males exerting significantly higher peak

Discussion

This is the most comprehensive study to date exploring the influence of lumbar posture on trunk muscle recruitment, strength and efficiency during high intensity lifting. The study found that flexed lumbar spine lifting postures increased the body's ability to generate a trunk extensor moment and significantly improved NME. Conversely the lordotic / straight lumbar spine posture resulted in the lowest extensor moment and poorest NME. These findings are in contrast to previous studies which have

Conclusions

This study demonstrated that flexed lumbar spine lifting postures increased the body's ability to generate a trunk extensor moment and significantly improved NME. Conversely, the lordotic / straight lumbar spine postures resulted in the lowest extensor moment and poorest NME. These findings may have implications for the lifting advice given to manual workers who undertake heavy lifting tasks throughout the day.

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