PAIN CATASTROPHIZING MODERATES CHANGES IN THE LOCAL DYNAMIC STABILITY OF THE SPINE IN RESPONSE TO NOXIOUSLY INDUCED LOW BACK PAIN

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INTRODUCTION

It is generally accepted that spine stability is relevant for the prevention and rehabilitation of low back pain (LBP) [e.g 1-2]. However, there are conflicting results in the literature, in regards to how stability is modified in the presence of LBP [e.g. 3-4]. The aims of the present work were twofold: 1) to use noxious stimulation to induce LBP in healthy individuals to assess the direct effects of pain on stability (quantified by the time-dependent behavior of kinematic variance), and 2) to assess whether the relationship between pain and stability is moderated by psychological features (i.e. kinesiophobia).

METHODS

Sixteen participants (8M, 8F), with no history of LBP were recruited for this investigation. Participants completed two valid questionnaires related to psychological aspects of pain prior to study onset: 1) Tampa Scale for Kinesiophobia (TSK), and 2) The Pain Catastrophizing Scale (PCS) [5].

Participants then completed three conditions (baseline, pain, recovery) of a task involving 35 cycles of repetitive unloaded spine flexion and extension [4]. Nociceptive stimulus (i.e. pain) involved an anaesthesiologist injecting hypertonic saline (5%, 0.2 mL) into the L_4/L_5 interspinous ligament using ultrasound imaging (Vivid I, GE Healthcare, UK) (Figure 1). Lumbar spine motion was tracked during each condition using two 3-D electromagnetic sensors (trakSTAR, Acension, VT, USA), and pain was recorded using the 100mm VAS [3]. Local dynamic spine stability was calculated using maximum finite-time Lyapunov exponents (λ_{max}) [4].

Figure 1: Injection of hypertonic saline into the L_4/L_5 interspinous ligament with ultrasound imaging.

Differences in VAS pain responses and stability between experimental conditions were assessed using repeated-measures ANOVAs. To investigate any moderating effects of pain psychology (i.e. PCS and TSK scores) and demographics (i.e. age, height, weight, and sex) on the (de) stabilizing responses to pain, these variables were added as covariates into the R-M ANOVA. Last, binary logistic regression was applied to assess the predictive effects of these same variables on determining whether a participant would increase or decrease their stability in response to the injection/pain.

RESULTS

Nociceptive stimulus elicited pain that was greater than baseline or recovery ($p<0.001$). When the whole group was included in the statistical analysis without co-variates, λ_{max} was not different between conditions ($p=0.564$). However, after adding PCS as a covariate into the ANOVA, the main effect of condition on stability became significant ($p= 0.044$), and there was a significant condition x PCS interaction ($p= 0.048$). No other covariates significantly moderated the effect of condition on stability ($p>0.05$). Because of this moderating effect of pain catastrophizing, we further explored our data, and discovered that there were two distinct responses to the pain; individuals who increased stability during pain (lower λ_{max} - stabilizers) (n=6) and those who reduced stability during pain (higher λ_{max} - destabilizers) (n=10). In both groups, the modified movement characteristics with pain returned to the baseline strategy during the recovery condition. As a complementary analysis, binary logistic regression was able to successfully predict group membership in 87.5% of cases (5/6 stabilizers, and 9/10 destabilizers) using only PCS scores.

DISCUSSION AND CONCLUSIONS

This work might help explain why varying responses are observed in studies looking at the effects of pain on stability. Here we have provided evidence that individuals' beliefs and attitudes towards pain are related to individual-specific motor behaviours (e.g. stabilize versus destabilize), even if they subjectively report experiencing the same amount of pain. Pain catastrophizing and kinesiophobia must be considered when studying motor behaviours (e.g. stability and neuromuscular control) in response to pain (induced or chronic).

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