

Muscle fibre type characteristics of the lumbar multifidus and erector spinae in persons with non-specific chronic low back pain and healthy controls.

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INTRODUCTION

Low back pain (LBP) is the most common musculoskeletal cause of disability and has a major socio-economic impact on today's western society [1]. In 39.5% of all persons with LBP, pain persists longer than 12 weeks and is referred to as chronic LBP. In the majority of cases, chronic LBP is due to a non-assignable cause, classified as non-specific chronic low back pain (NSCLBP) [2]. Both chronicity and lack of etiology impede the effective treatment of NSCLBP. On a macroscopic level, there is accumulating evidence that NSCLBP is associated with dysfunction of the lumbar multifidus (MF) and the erector spinae (ES) [3]. However, knowledge on a microscopic level, more particular on muscle fibre type, is very limited. The aim of this study is to investigate the structural muscle fibre type characteristics of the MF and ES, in order to further elucidate their functional capacity and their involvement in LBP.

METHODS

A cross-sectional study was performed in the Rehabilitation Research Centre, Hasselt University, Diepenbeek, Belgium. Muscle fibre type characteristics of 20 persons with NSCLBP and 18 healthy controls were investigated. Biopsy samples of the MF and the ES were taken at the level of vertebra L4 with a percutaneous fine needle biopsy technique [4]. These muscle samples were analyzed with an immunofluorescence staining of the myosin heavy chain (MHC) isoforms. In each sample, the percentage and cross-sectional area (CSA) of type I, IIa, IIx and IIX were quantified. From these data, the relative cross-sectional area (RCSA) was calculated. These outcomes were analyzed using JMP® Pro 14.1.0 software (SAS Institute Inc, Cary, NC, 1989-2007). A repeated measure analysis of variance (ANOVA) was performed.

RESULTS

Both, in the MF as well as in the ES, type I muscle fibres are predominantly present (Figure 1). In healthy controls, the RCSA of type I muscle fibres is 63.54% for the ES and 68.8% for the MF. Type I muscle fibres were significantly larger ($p=0.0053$) in the MF ($7439.31.11\mu\text{m}^2$) compared to the ES ($6279.48\mu\text{m}^2$). The mean muscle fibre type percentages were not significantly different between the lumbar ES and MF for all muscle fibre types.

A comparison between the muscle fibre type characteristics of persons with NSCLBP with healthy subjects, showed no significant between group differences for CSA in the ES. However, persons with NSCLBP displayed a higher ($p=0.0978$) number of type I muscle fibres, and a significant lower ($p=0.0019$) number of type IIx muscle fibres in the ES. This resulted in a higher ($p=0.0596$) RCSA for type I fibres, and a significant lower RCSA for type IIx fibres ($p=0.0411$). There were no significant between group differences in the MF.

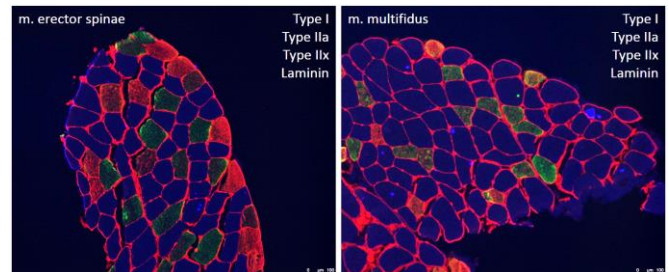


Figure 1: Representative immunofluorescence image of the lumbar ES and MF muscle. Muscle cross-sections were incubated with primary antibody against laminin (red), MHCIIa (green) and MHCIIx (red).

DISCUSSION

The significant larger type I muscle fibres in the lumbar MF compared to the ES, could possibly indicate that the MF seems to display muscle fibre type characteristics that are slightly more appropriate to maintain stability of the spine. However, because we did not demonstrate significant differences in RCSA between ES and MF, we cannot firmly state that there are functional differences between these two muscles only based on structural characteristics.

In contrast to current knowledge on muscle fibre typing in LBP [3], we found that the paraspinal muscles of persons with NSCLBP display a larger oxidative potential based on an increase of the number type I fibres at the expense of type IIx. However, this was the first study comparing muscle fibre type characteristics between persons with NSCLBP and healthy controls, for both the ES and MF. The larger oxidative capacity, and the decline in glycolytic capacity of the ES in persons with NSCLBP found in this study could have implications for physical rehabilitation.

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