Skeletal muscle fiber characteristics of the lumbar multifidus muscle in patients undergoing microdiscectomy for unilateral lumbar disc herniation

Sjoerd Stevens, MSc[1] [3], Anouk Agten, PhD[1] [4], Tim Snijders, PhD[3], Mark Plazier, MD, PhD[2], Sven Bamps, MD[2], Thorben Assieker, MSc[3], Milan W. Betz, MSc[3], Annick Timmermans, PhD[1], Luc J.C. van Loon, PhD[3], Frank Vandenabeele, MD, PhD[1]

[1] Hasselt University, Rehabilitation Research Center, Faculty of Rehabilitation Sciences and Physiotherapy, Agoralaan buidling A, 3590 Diepenbeek, Belgium
[2] Jessa Hospital, Department of Neurosurgery, Stadsomvaart 11, 3500 Hasselt, Belgium
[3] Maastricht University, Department of Human Biology, NUTRIM School of Nutrition and Translational Research in Metabolism Faculty of Health, Medicine and Life Sciences, Universiteitssingel 50, 6200 MD Maastricht, The Netherlands
[4] Maastricht University, Department of Anatomy & Embryology, Faculty of Health, Medicine and Life Sciences, Universiteitssingel 50, 6200 MD Maastricht, The Netherlands

BACKGROUND: Lumbar disc herniation (LDH) is the most common diagnosed degenerative pathology in the lumbar spine. Despite surgical treatment long-term disability and pain remains a persistent problem. Because of its role in spinal stability there is an increased interest in the role of the *Lumbar Multifidus muscle* in low back pain research. Degenerative changes of the *Lumbar Multifidus muscle* are observed to be different in various low back pathologies, which may influence long-term disability and pain. Whether change in muscle characteristics can be observed in the *Lumbar Multifidus muscle* following LDH in humans remains unknown.

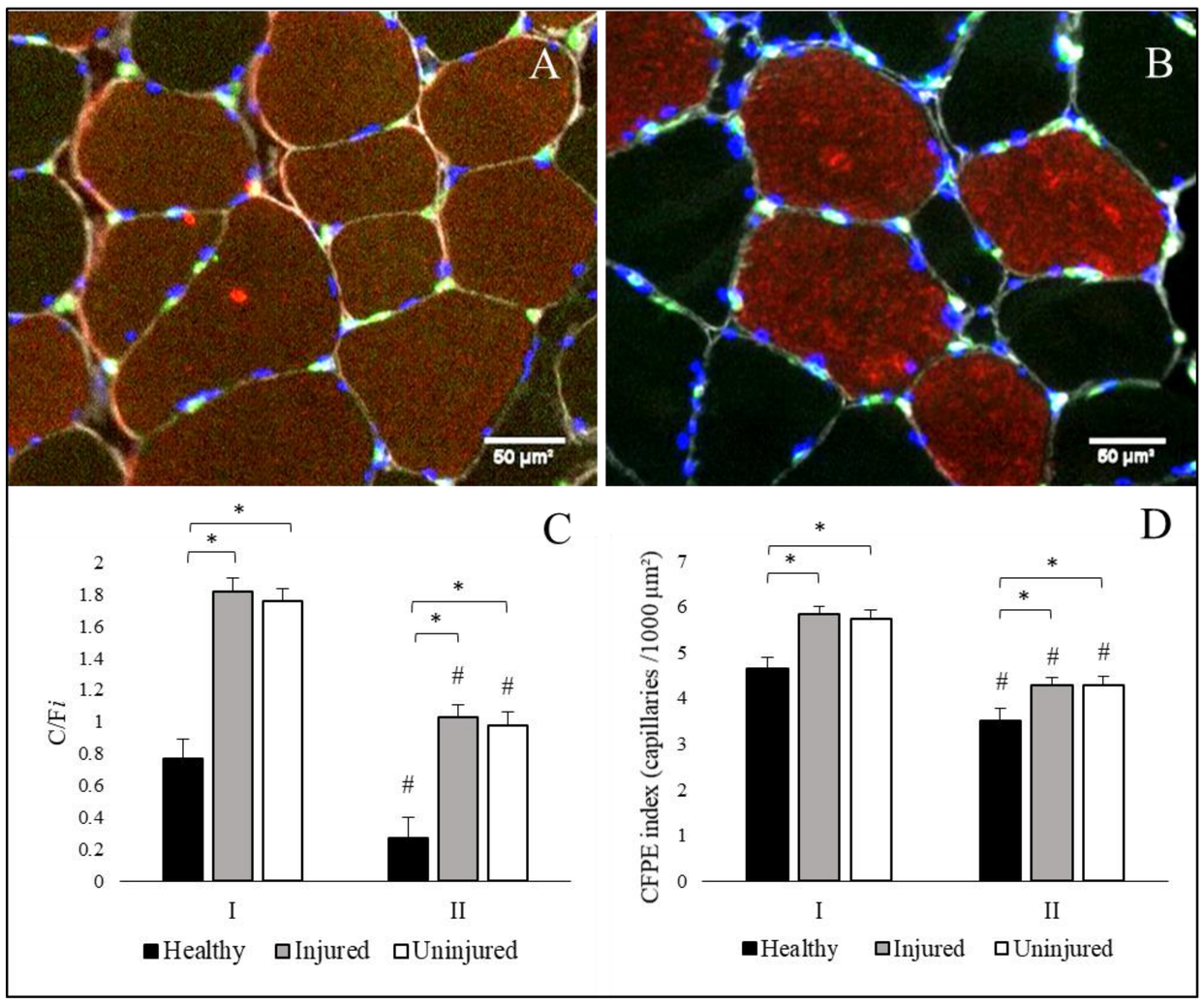

Figure 1. representative image of immunohistochemical analyses of the lumbar multifidus muscle cross-section in healthy control (A) and lumbar disc hernia (LDH) patients (B). A-B: myosin heavy chain I (red), Laminin (white), Dapi (blue), CD31 (green). C-D: Type I and type II muscle fiber capillary to fiber ratio (C/Fi) (C) and capillary to fiber perimeter exchange index (CFPE) (D) in healthy controls, and LDH patient (injured and uninjured side). Data are expressed as mean ± SE. * indicating a significant between group difference $p<0.05$.

METHODS: Thirty patients (*n=17* men and *n=13* women) scheduled for microdiscectomy for unilateral disc herniation and ten healthy controls (n=5 men and n=5 women) were included in this study at the Jessa Hospital and Hasselt University, Hasselt, Belgium. Biopsies were taken from the *Lumbar Multifidus muscle* at the level of surgery (*n=15* L4-L5, *n=14* L5-S1) at both the herniated (injured) and non-herniated (uninjured) side in the patient group. In healthy controls a muscle biopsy sample was taken from the right *Lumbar Multifidus muscle* at level L4-L5.

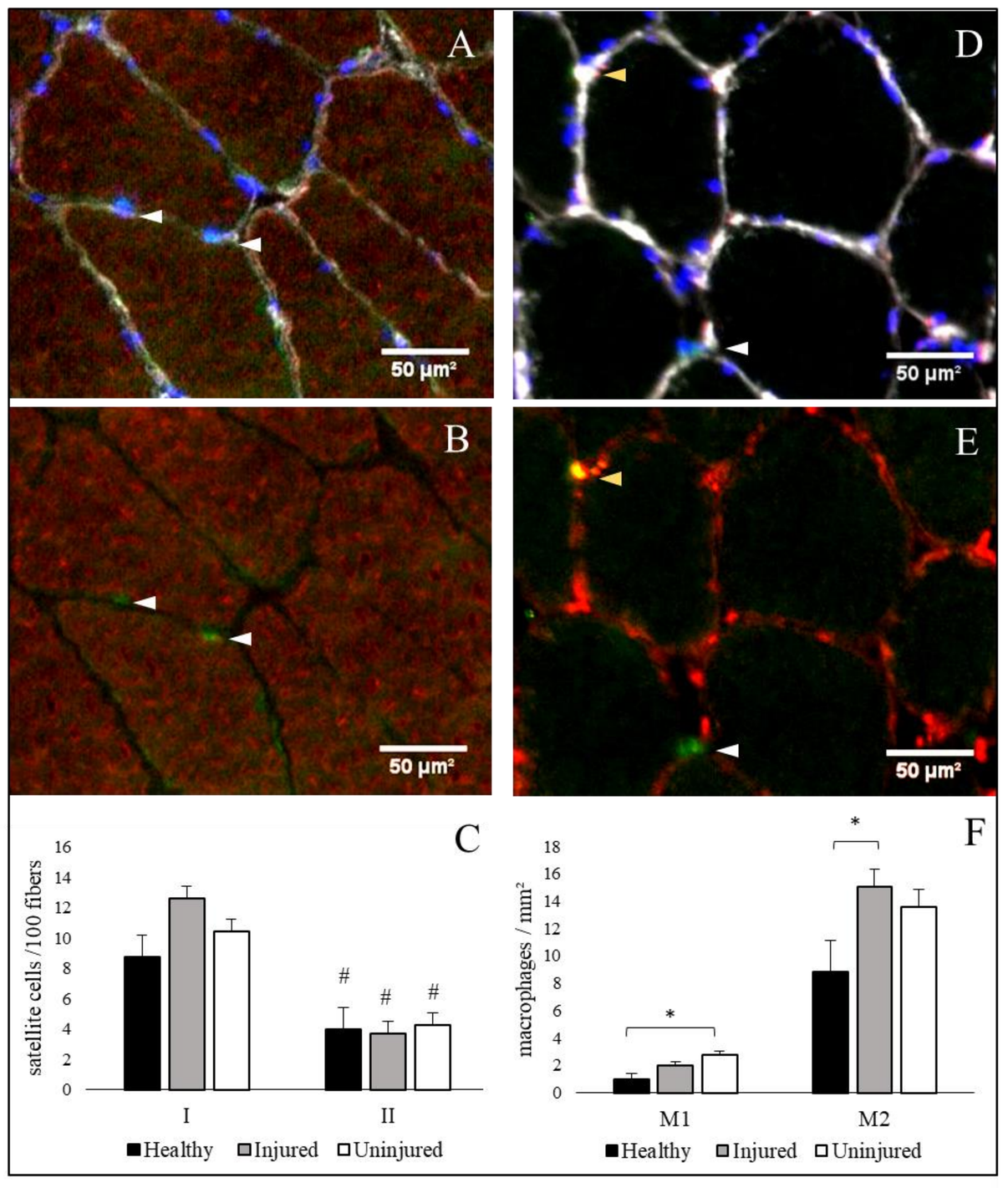

Figure 2. representative image of immunohistochemical analyses of the lumbar multifidus muscle cross-section in healthy control (A) and lumbar disc hernia (LDH) patients (B). A: myosin heavy chain I (red), Pax-7 (green), Laminin (white), Dapi (blue), white arrows indicating pax-7⁺ satellite cells. B: laminin (white), CD206 (red), CD68 (green), Dapi (blue), white arrow indicating CD68⁺ M1 macrophage, yellow arrow indicating CD206⁺ M2 macrophage. C-D: Type I and type II fiber satellite cell content (C) and (mixed fiber) macrophage content (D) in healthy controls, and LDH patient (injured and uninjured side). Data are expressed as mean ± SE. * indicating a significant between group difference $p<0.05$.

RESULTS: Age (40±9 vs 42±8 y) and BMI (26±5 vs 26±4 kg/m²) were not different between LDH patients and healthy controls, respectively. No significant differences were observed for type I or type II muscle fiber size and/or distribution between groups. Various indices of type I and type II muscle fiber capillarization were substantially greater (ranging from +22 to +281%) in LDH patients compared with controls ($p<0.05$; figure 1). Both pro-and anti-inflammatory cell content was significantly higher in the LDH patient group compared with controls ($p<0.05$; figure 2). No differences were observed in type I and type II muscle fiber characteristics between the injured and uninjured side within the LDH patients.

CONCLUSION: This study shows clear differences in *Lumbar Multifidus muscle* fiber characteristics between LDH patients, irrespective of injured or uninjured side, and healthy controls. Additional studies are warranted to establish the clinical significance of these differences in muscle fiber morphology in LDH compared with healthy controls.