

How To Treat Lumbar Disc Herniations In Order To Prevent A Reherniation?

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INTRODUCTION: Clinical papers have discussed the outcome of different treatments after lumbar disc herniations, namely sequestrectomy versus (partial) nucleotomy. While in one study, the partial nucleotomy was superior to the sequestrectomy with respect to the reherniation risk (*Carragee 2006*), another study showed the opposite result (*Thomé 2005*). The aim of this in vitro study was to use a standardized in vitro disc herniation model in order to enlighten this complex issue.

METHODS: First a disc herniation was provoked in 6 cadaveric lumbar motion segments (L2/3, L3/4, L4/5, L5/S1) from four different human donors (age: 19 – 53 years; sex: 3 males, 1 unknown) with low disc degeneration (Pfirrmann 1 - 2). This herniation was provoked by setting a standardized round annular defect of Ø4 mm and then loading the segments dynamically simulating physiological activities, such as bending forward or lifting heavy boxes, according a recently developed test method (*Zengerle 2021*). After the herniation, different treatments were performed. In a first step, a sequestrectomy was carried out and the specimens were loaded again in the same way as above. In a second step, independently whether a reherniation occurred or not, the remaining nucleus material within the annular defect was removed (anulotomy) and the segments were tested and loaded again. Finally, a partial nucleotomy was cautiously performed, again followed by dynamical loading simulating physiological activities. Disc height, range of motion (ROM) and intradiscal pressure (IDP) were evaluated between all test steps and analysed statistically using a Friedman-Test with Bonferroni Post-Hoc correction ($\alpha \leq 0.05$).

RESULTS SECTION: In all specimens, the round 4-mm-defect led to a herniation using the physiological loading protocol. After removing only the sequester with an amount of 0.06 g (0.02 g – 0.11 g), no reherniation could be provoked. However, after the anulotomy (additional removal of 0.05 g (0.02 g – 0.12 g) nucleus material), one reherniation could be observed. After performing a partial nucleotomy, where significantly more nucleus material was dissected: 0.38 g (0.27 g – 0.67 g), two discs reherniated (Fig. 1). This partial nucleotomy also led to a significant increase of ROM of about 1° ($p = 0.044$) and a decrease of the IDP of 0.14 MPa ($p = 0.035$), but only in lateral bending (Fig. 1). Disc height decreased remarkably only after the initial herniation and not gradually after performing the surgical treatments, whereas ROM and IDP did not change noticeably after the (re-)herniation (Fig. 1).

DISCUSSION: In this study, the outcome of different surgical procedures for the treatment of lumbar disc herniations could be investigated regarding the risk of reherniation under realistic dynamic conditions simulating physiological worst-case scenarios, such as lifting heavy weights complete forward flexion. The results of this study may support the clinical findings that the risk of reherniation may be lower when only performing a sequestrectomy compared to a partial nucleotomy. However, it is known from former studies that the initial herniation risk also depends on other parameters, such as size or shape of the annular defect. Hence, those parameters should be considered as potential risk factors for reherniations, as well.

SIGNIFICANCE/CLINICAL RELEVANCE: The optimal surgical intervention after a disc herniation is still controversial. If too much nucleus material is removed, this is biomechanically disadvantageous; if too much is left, there might be a higher risk of reherniation. Clinical studies are controversial. This in vitro experiment lightens that the reherniation risk may be lower if only a sequestrectomy is performed.

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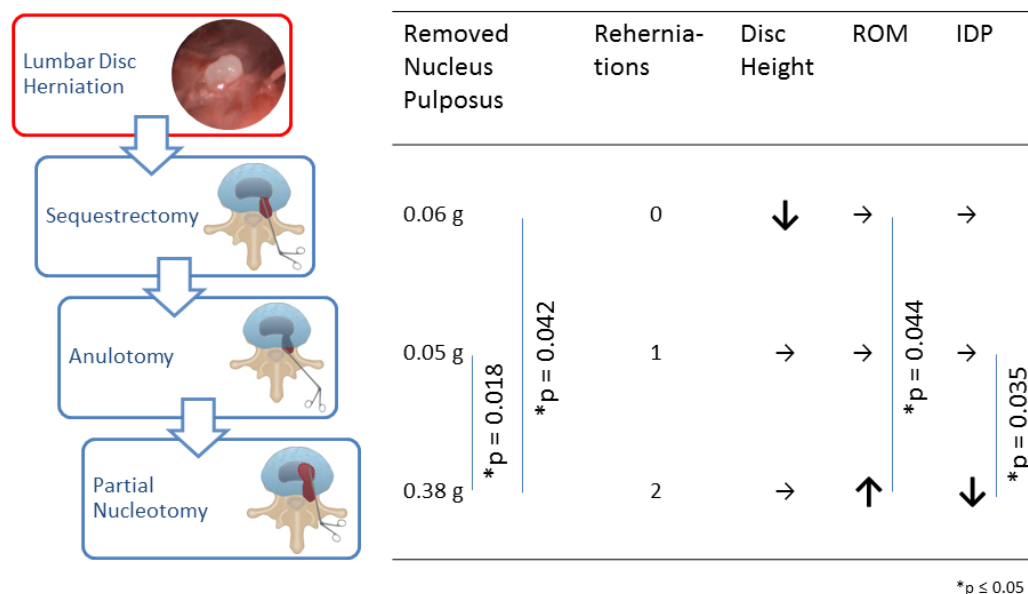


Fig. 1: Provoked reherniations and effect of the removal of nucleus pulposus on the biomechanical parameters disc height, range of motion (ROM) and intradiscal pressure (IDP) after treating the index lumbar disc herniation with a sequestrectomy, anulotomy and partial nucleotomy, * $p \leq 0.05$.