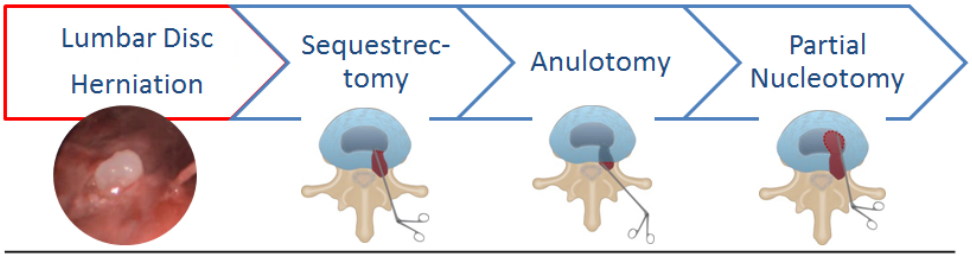
Introduction:
Clinical studies have discussed the outcome of different surgical treatments after lumbar disc herniation. While in one study, partial nucleotomy was superior to sequestrectomy in terms of the risk of recurrent lumbar disc herniation (Carragee 2006), another study showed the opposite result (Thomé 2005). This in vitro study investigated this complex topic using an in vitro model for standardised investigation of lumbar disc herniations. Material and
Methods:
First, in 6 lumbar healthy motion segments (L2/3, L3/4, L4/5, L5/S1; Pfirrmann 1-2) from 4 donors (age: 19-53 years; sex: 3 m:1 n/a) an annulus defect of Ø 4 mm was created in a standardised manner. Then, the motion segments were dynamically loaded with a new physiological loading protocol that simulates activities such as climbing stairs or box lifting (Zengerle 2021). The segments were treated with different surgical techniques and loaded again with the described protocol, regardless of whether or not a recurrence occurred. First, a sequestrectomy was performed, then an anulotomy, in which the remaining nucleus material within the defect was additionally removed. In a last step, a partial nucleotomy was conducted. Between all test steps, the intervertebral disc height (DH), the range of motion (ROM) and intradiscal pressure (IDP) were measured and compared in a Friedman test with a Bonferroni post hoc correction ($\alpha = 0.05$).
Results:
In all specimens, physiological loading resulted in disc herniation through the annulus defect. No recurrence was observed after sequestrectomy alone, whereas after anulotomy one disc and after partial nucleotomy two discs showed recurrences (Fig. 1). The partial nucleotomy, in which significantly more nucleus material was removed (0.38 g (0.27 g - 0.67 g)), resulted in a significant increase in the ROM by about 1° ($p = 0.044$) and a decrease in IDP by 0.14 MPa ($p = 0.035$), however only in lateral bending (Fig. 1). The disc height only decreased after sequestrectomy, while ROM and IDP did not change (Fig. 1).
Discussion:
In this study, the treatment success of lumbar disc herniations by different surgical procedures was investigated with regard to the risk of recurrent disc herniations under realistic conditions. The results of this study could support the clinical findings that the risk of recurrence after sequestrectomy seems to be lower than after partial nucleotomy.



Removed Nucleus Pulposus	**0.06 g**	**0.05 g**	**0.38 g**
Recurrence	0	1	2
DH	↓	→	→
ROM	→	→	↑
IDP	→	→	↓

Fig. 1: Provoked recurrent disc herniations 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, * $p \leq 0.05$.