

CAN INTERVERTEBRAL KINEMATICS PREDICT CLINICAL OUTCOME OF LUMBAR DISCECTOMY?

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INTRODUCTION

Discectomy has been used for the treatment of lumbar disc herniation for more than 50 years, but it still remains controversial due to the residual or recurrent low back pain (LBP) following the surgery. Retrospective clinical studies have suggested some reasons (young patient with preoperatively advanced disc degeneration, postoperatively decreased disc height), but it is not definitive.

Kinematic effects of lumbar discectomy have been investigated *in vitro*. Previous biomechanical studies have demonstrated significant increases in motion when comparing discectomy to an intact spine. However, there is limited clinical information published in the literature to support *in vitro* findings due to the lack of accuracy of standard radiographs.

The purpose of this prospective study was to determine the progress of *in vivo* segmental motions during lumbar sagittal and axial plane movements following discectomy using radiostereometric analysis (RSA) and examine if there was a relationship to clinical outcome.

Two questions were examined with this study: 1) what is the amount of motion that occurs *in vivo* in relation to the lumbar discectomy over time; 2) would this change be related with the clinical outcome?

METHODS

Following approval by the Institutional review board, eight patients (4 males & 4 females, ages: 40.9 ± 5.7 yrs) with lumbar disc herniation were scheduled to undergo lumbar discectomy at either L4/L5 or L5/S1 and enrolled in the study. Informed consent was obtained. The standard lumbar microdiscectomy procedure was performed by the three different surgeons. Following the discectomy, three or four tantalum beads were inserted into the upper and lower vertebrae adjacent to the involved disc.

The patients were followed post-operatively at 1 month (8 patients) and 1 year (4 patients). Standardized standing neutral, flexion, extension, left/right axial rotation biplanar films were collected at each time point of follow-up. Three dimensional segmental motions were determined for each position relative to neutral using RSA. In addition to the kinematic analysis, Oswestry Disability Index (ODI) was collected at each follow-up time point.

The three dependent variables (segmental sagittal rotation (SR), superior/inferior (SIT), and anterior/posterior (APT) translations) for each sagittal motion (neutral (N) to flexion, N to extension, and extension to flexion) were submitted to a 3×2 (sagittal motions \times time points) MANCOVA with repeated measures on both factors and ODI criteria (ODI at 1 year $< 50\%$, ODI $\geq 50\%$) as a covariate. Due to the limited number at follow-up, the three dependent variables (axial rotation, APT, right/left translation) for the right or left

axial motion were submitted to one-way (2 time points) MANCOVA with ODI criteria as a covariate.

RESULTS AND DISCUSSION

MANCOVA and follow-up tests demonstrated that SIT ($p=0.001$) and APT ($p=0.041$) significantly decreased from 1 month to 1 year, and SIT from extension to flexion was significantly greater than that from N to extension ($p=0.014$) (Table 1).

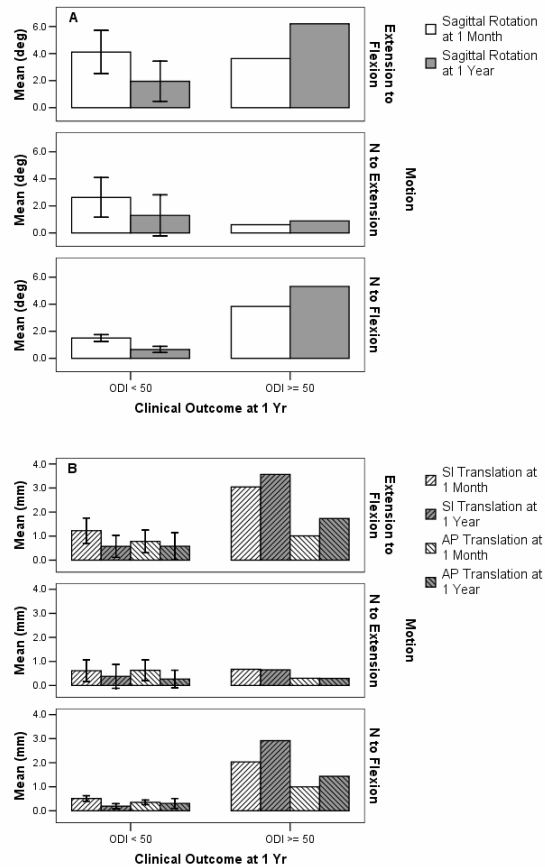


Figure 1: Intervertebral kinematics of lumbar discectomy over time, grouped with

ODI at 1 year. **A:** sagittal rotation, **B:** sagittal translations.

There were significant interactions on time \times covariate for SIT ($p=0.001$) and APT ($p=0.043$) and motion \times covariate for SR ($p=0.047$) and SIT ($p=0.015$). Contrast procedures identified that SIT and APT decreased at 1 year time point in low ODI group, but those increased in high ODI group (Figure 1). And SR and SIT from extension to flexion were greater than those from N to extension in high ODI group, while those were not in low ODI group.

Analysis of axial rotation showed there was no significant difference over time. Absolute amount of one sided (right or left) axial rotation was measured at $0.2 \pm 0.2^\circ$ at 1 month and $0.3 \pm 0.2^\circ$ at 1 year.

SUMMARY/CONCLUSIONS

In vivo kinematics of the lumbar motion segment following microdiscectomy can accurately be measured using the RSA technique. In our small sized sample, the segmental motion decreased over time up to the 1 year time point following lumbar discectomy. The only exception was in the patient who reported a worse clinical outcome. A larger patient group is needed to conclude the distinct relationship between segmental motion and clinical outcome.

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Table 1: Dependent variables with significant main effects for time (*) and motion factor (+) (mean \pm SD).

Time	1 Month			1 Year		
	N to Flex	N to Ext	Ext to Flex	N to Flex	N to Ext	Ext to Flex
Motion						
SR ($^\circ$)	2.1 ± 1.2	2.1 ± 1.6	4.0 ± 1.3	1.8 ± 2.3	1.2 ± 1.3	3.0 ± 2.4
SIT (mm)	0.89 ± 0.77	$0.63 \pm 0.37^{*+}$	$1.68 \pm 1.01^{*+}$	0.87 ± 1.36	$0.45 \pm 0.43^{*+}$	$1.32 \pm 1.54^{*+}$
APT (mm)	0.51 ± 0.33	$0.55 \pm 0.39^*$	$0.84 \pm 0.4^*$	0.59 ± 0.59	$0.28 \pm 0.3^*$	$0.87 \pm 0.74^*$

SR (sagittal rotation), SIT (sup./inf. Translation), APT (ant./post. Translation), N (neutral), Flex (flexion), Ext (extension)