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Original article

Analysis of clinical characteristics and surgical results of upper lumbar disc herniations



İ. Yüce^{a,*}, O. Kahyaoğlu^b, P. Mertan^c, H. Çavuşoğlu^a, Y. Aydın^b

^a Acıbadem Mehmet Ali Aydınlar University, Vocational School of Health Services, Kayışdağı Caddesi No 32, Ataşehir, İstanbul, Turkey

^b Acıbadem Healthcare Group, Fulya Hospital, Dikilitaş Mahallesi, Hakkı Yeten Cd. No 23, Beşiktaş, İstanbul, Turkey

^c Ruprecht-Karls University of Heidelberg, Medical Faculty, Heidelberg, Germany

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ABSTRACT

Background. – Upper lumbar disc herniation (ULDH) is described mostly in levels L1-2, L2-3 and L3-4 of the lumbar spine in the literature and accounts for less than 10% of all disc herniations. The aim of our study was to evaluate the clinical characteristics and surgical results of ULDH.

Methods. – In all, 367 patients treated for upper lumbar disc herniation and 2137 treated for lower lumbar disc herniation (LLDH) between January 2008 and January 2017 were included. They were followed up postoperatively at 12 months by radiological investigations, back and leg pain Visual Analogue Scale (VAS), and Oswestry Disability Index (ODI). Preoperative data comprised age group (20–40, 40–60, 60–80 years), gender (male, female), lumbar level (L1-2, L2-3, L3-4), side of disc herniation (left, right) and symptom duration (0–3, 3–6, 6–9 months).

Results. – ODI and VAS scores improved significantly postoperatively for all patients. Of the 367 ULDH patients, 169 were female (54%) and 198 male (46%), with a mean age of 55.8 ± 10.1 years (range, 35–71). In 174 (47.4%) patients symptom duration was 3 months, in 99 (27.0%) 3–6 months, and in 94 (25.6%) 6–9 months. At 12 months, ODI, back and leg pain VAS scores showed a significant difference in improvement according to ULDH symptom duration < 3 months and to LLDH symptom duration < 6 months.

Conclusion. – Microdiscectomy in ULDH provided sufficient and safe decompression of neural structures, with significant reduction in symptoms and disability. We suggest that early surgical treatment is an important factor for good outcome in ULDH.

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1. Abbreviations

LLDH	Lower lumbar disc herniation
ODI	Oswestry disability index
ULDH	Upper lumbar disc herniation
VAS	Visual Analogue Scale

2. Introduction

Upper lumbar disc herniation (ULDH) is described mostly in levels L1-2, L2-3 and L3-4 of the lumbar spine in the literature and accounts for less than 10% of all disc herniations [1–5]. The upper

levels of the lumbar spine show fewer cases of spondylosis and disc degeneration and herniation. Lumbar microdiscectomy is mostly preferred for ULDH by neurosurgeons. Short lamina length and the narrowness of the spinal canal, which are anatomical specificities of the upper lumbar levels, cause difficulty for surgery, with less favorable outcome [6]. These anatomical difficulties and poor surgical outcome are one reason for surgeons to prefer conservative treatment. Indications for surgical treatment need to be determined for ULDH. The present retrospective study investigated the clinical characteristics, surgical results and predictive factors for outcome in ULDH and lower lumbar disc herniation (LLDH).

3. Patients and methods

The study analyzed 367 patients with ULDH refractory to well-conducted conservative treatment, who underwent single level lumbar microdiscectomy between January 2008 and January 2017. Most were operated on by the senior author (Y.A.). All patients who had one or more of the following criteria were included:

* Corresponding author.

E-mail addresses: dr.ismailyuce@gmail.com (İ. Yüce), drokinova@hotmail.com (O. Kahyaoğlu), pepinmertan@yahoo.com.tr (P. Mertan), anhcavusoglu@yahoo.com (H. Çavuşoğlu), ynaydin@gmail.com (Y. Aydın).

- back pain or radicular symptoms implicating the lumbar spine;
- radiological/neuroimaging evidence of ULDH (neurologic compression by disc herniation);
- failure of a minimum 3 months' conservative treatment;
- absence of associated pathology such as instability, inflammation or malignancy;
- no history of surgery for lumbar disc herniation, stenosis or lumbar fusion.

Patients presenting with mild degenerative spondylolisthesis were not excluded. Neurological status was assessed by physical examination and preoperative radiological investigations: magnetic resonance imaging (MRI) with or without X-ray and computed tomography (CT) scan. At admission to the neurosurgery department, patients filled out back and leg pain Visual Analogue Scales (VAS), and Oswestry Disability Index (ODI) questionnaires administered by the medical secretary. Interview was face to face with the patient, or with relatives if the patient had communication problems due to a regional dialect. Preoperative data also included age group (20–40, 40–60, 60–80 years), gender (male, female), lumbar level (L1–2, L2–3, L3–4), symptom duration after conservative treatment (0–3, 3–6, 6–9 months), and disc herniation side. Minimum 12 months' follow-up included radiological investigations, back and leg pain VAS and ODI. Imaging studied recurrent disc herniation at each microdiscectomy level. The relationship between radiological data and VAS and ODI scores was assessed.

All authors waived the need for local review board approval for present study.

To compare ULDH and LLDH, 3,700 patients treated for classical LLDH were assessed retrospectively, and 2137 who had one or more of the study criteria were included in this part of the study, with preoperative and 12-month follow-up VAS and ODI.

3.1. Surgical procedures

A microsurgical discectomy approach was used for surgery. Under general anesthesia, the patient was positioned prone on an operating frame. The target level was checked by a C-arm fluoroscope pre- and intra-operatively. A midline incision was made, limited to the underlying region of the disc as documented on MRI. A 2 cm skin incision was made for single-level disc herniation. A linear median fascial incision was then made on the more symptomatic side. The paraspinal muscles were released from their bony attachments on the spinous process and lamina to expose bone detail. A modified mini-Taylor retractor was then used to obtain a full view of the ipsilateral interlaminar space, and the microscope was introduced. Using Kerrison Rongeurs or a high-speed burr, the ipsilateral cephalad and then caudad hemilamina were partially resected. Flavotomy, rather than flavectomy, was performed, sequentially until the nerve root at the operative level was seen exiting freely through the foramen. After safely retracting the compressed dural sac and nerve root, the posterior longitudinal ligament was opened and microdiscectomy was performed. The nerve root and dura were decompressed. Aspiration drains were not routinely placed.

The patient was allowed out of bed without a lumbosacral corset 4–5 h after surgery and was discharged within 24 h. An exercise program was started after 2 weeks to strengthen the paravertebral muscles, and the patient was advised to resume daily activities.

3.2. Statistical analysis

Data were recorded on Microsoft Excel-2013. Results were reported as mean and standard deviation. SPSS 21 (Statistical Package for Social Sciences) software for Windows was used for data analysis. One-way Anova was used for comparison of groups. Paired

and independent sample tests were used to compare treatment values. Statistical significance was set at $P < 0.05$, with 95% confidence interval.

4. Results

In all, 367 of the 4072 patients with lumbar disc herniation underwent lumbar microdiscectomy for single-level ULDH. In 367 of all patients, 169 were female (54%) and 198 male (46%), with a mean age of 55.8 ± 10.1 years (range, 35–71). Symptom duration ranged from 2 to 19 months. Mean follow-up was 27.2 ± 14.6 months (range, 12–78). Preoperative clinical symptoms and signs comprised back pain in 322 patients (87.7%) and leg pain in 327 (89.1%). Femoral stretch test was positive in 87% of patients, and most had L1–2 or L2–3 disc herniation. Disc herniation was right side in 204 patients (55.6%) and left side in 163 (44.4%). Disc herniation involved L1–2 in 57 patients (15.5%), L2–3 in 109 (29.7%), and L3–4 in 201 (54.8%). Preoperative symptom duration was 0–3 months in 174 patients (47.4%), 3–6 months in 99 (27%), and 6–9 months in 94 (25.6%). 50 patients (13.6%) were aged 20–40, 155 (42.2%) 40–60, and 162 (44.1%) 60–80 at surgery (part A of Table 1). Demographic data for the LLDH series are shown in part B of Table 1.

Seven recurrent ULDHs (1.9%) were reoperated on by microdiscectomy. One patient had contralateral and 6 had ipsilateral recurrence. Two patients had a second recurrence, but surgery was not required. Mean time to recurrence was 17 months (range, 9–37).

Fifty-two recurrent LLDHs (2.4%) were reoperated on by microdiscectomy. Nine patients had contralateral and 43 had ipsilateral recurrence. Thirteen patients had a second recurrence, but surgery was not required. Mean time to recurrence was 29 months (range, 6–51).

4.1. Follow-up

Mean follow-up was 27.2 ± 14.6 months (range, 12–78). VAS and ODI questionnaires, validated for Turkish-speakers, were administered to 367 of the 372 patients [7]. Five patients were excluded: 1 died from an unrelated cause, and 4 refused follow-up controls. In all, 2137 of the 3700 LLDH patients had one or more of the study criteria and were included retrospectively.

4.2. Clinical analysis

There were no perioperative deaths. Accidental durotomy occurred in 3 patients (0.8%) for ULDH and 41 (0.2%) for LLDH; primary repair was not performed except for fat graft cover, and the patients were admitted to hospital for 48 h bed-rest. Durotomy not significantly associated with postoperative morbidity and no subsequent postoperative cerebrospinal fluid fistulae were observed. There were no neural injuries or other intraoperative complications. No revision surgery was required. There was 1 wound infection in ULDH and 5 in LLDH, treated with adapted antibiotic therapy.

4.3. Assessment of outcome

In ULDH, ODI scores decreased significantly from a mean 33.66 ± 7.79 preoperatively to 21.08 ± 3.85 at 12 months. ODI score was < 20 for 309 patients at follow-up. VAS back pain scores decreased significantly postoperatively, from a mean preoperative 4.19 ± 1.46 to 2.65 ± 1.16 at 12 months, and VAS leg pain scores from 7.19 ± 1.46 to 2.78 ± 1.12 ($P = 0.001$). In LLDH, ODI scores decreased significantly from a mean 33.91 ± 5.28 preoperatively to 14.56 ± 2.96 at 12 months. VAS back pain scores decreased significantly from a mean 1.66 ± 0.68 preoperatively to 0.56 ± 0.49 at

Table 1
Demographic data.

	Age (years)	Gender F/M	Side of disc R/L	Back pain ±	Leg pain ±	Total
A						
Level of disc						
L1-2	55.2 ± 10.9	28/29	34/23	49/8	50/7	57
L2-3	56.0 ± 9.8	47/62	64/45	95/14	97/12	109
L3-4	55.8 ± 10.1	94/107	106/95	178/23	180/21	201
Symptom duration (months)						
0-3	55.8 ± 9.8	97/77	92/82	152/22	154/20	174
3-6	55.1 ± 10.7	43/56	53/46	85/14	87/12	99
6-9	56.4 ± 9.9	29/65	59/35	85/9	86/8	94
Age group (years)						
20-40	35.9 ± 1.2	22/28	19/31	44/6	44/6	50
40-60	53.4 ± 4.4	70/85	96/59	136/19	139/16	155
60-80	64.2 ± 3.8	77/85	89/73	142/20	144/18	162
B						
Level of disc						
L4-5	55.7 ± 10.2	485/458	543/400	772/171	830/113	943
L5-S1	55.9 ± 10.1	571/623	711/483	981/213	1051/143	1194
Symptom duration (months)						
0-3	56.0 ± 9.9	388/386	465/309	603/171	688/86	774
3-6	55.8 ± 10.2	593/215	462/346	722/86	981/127	808
6-9	55.7 ± 10.3	173/382	327/228	428/127	512/43	555
Age group (years)						
20-40	36.3 ± 7.2	152/137	145/144	233/56	254/35	289
40-60	53.9 ± 5.5	484/419	548/355	740/163	793/110	903
60-80	63.0 ± 6.1	518/427	561/384	780/165	834/111	945

12 months, and VAS leg pain scores from 7.68 ± 1.28 to 1.59 ± 1.07 ($P=0.001$).

Analysis of pre- to post-operative changes in ODI and back and leg pain VAS scores showed that disc herniation level and side, gender and age group did not have a significant impact on improvement in ULDH or LLDH ($P > 0.05$) (Tables 2–5).

In ULDH, pre- to post-operative changes in ODI and back and leg pain VAS scores showed significant improvement: ODI, $P=0.005$; back pain VAS, $P=0.001$; leg pain, VAS $P=0.016$) (Table 6) (Fig. 1). ODI and VAS scores of patients with symptom duration < 3 months showed greater improvement.

In LLDH, pre- to post-operative changes in ODI and back and leg pain VAS scores showed significant improvement: ODI score, $P=0.001$; leg pain VAS, $P=0.001$; back pain VAS, $P=0.043$) (Table 6). ODI and VAS scores of patients with symptom duration < 6 months showed greater improvement.

4.4. Radiologic analysis

MRI demonstrated change in ULDH after surgery (Fig. 2).

5. Discussion

ULDH surgery is rather difficult because of low incidence and absence of specific clinical characteristics [5]. Surgical outcome is less satisfactory for ULDH than for lower levels of the spine [1,5,6].

Incidence of upper lumbar discectomy is 1% to 10.4% [5]. In our center, 9% of patients who were treated for lumbar disc herniations had ULDH. This rate is similar to that in the literature.

Upper levels of the lumbar spine have smaller range of motion and a narrower spinal canal, accounting for the different characteristics of the upper compared to the lower lumbar spine. Cauda equina and conus medullaris compression by ULDH in these levels of the spine cause polyneuropathy which is not localized by exact nerve root [1,5,8–11]. Neurosurgeons may prefer conservative treatment for ULDH because of these characteristics, which incur a high risk of intraoperative neural injury. The L1-2 and L2-3 levels are considered the most at risk.

ULDH cannot be clearly identified in terms of any specific muscle group weakness, dermatomal sensory deficit or reflex deficit [5]. Most ULDH patients present with back pain, buttock pain and radiating pain in the posterior thigh, but these symptoms are non-specific. The femoral stretch test is a good diagnostic method, detecting 84–94% of ULDHs in the literature [1,9,11,12]. In the present study, this test was positive preoperatively in 87% of patients and postoperatively in 4 (1%). However, it is not adequate for evaluating the outcome of upper lumbar disc surgery.

There are several anterior and posterior approaches and techniques for treatment of ULDH [4,8,12,13]. The posterior approach is usually preferred. ULDH is treated by microdiscectomy in our center.

Good or excellent surgical outcome was reported in 80% of 141 patients by Albert et al. [2], in 53% of patients by Senderson et al. [5], and in 93% and 73% of patients in the other two studies [10,14]. In the present study, ODI scores decreased significantly and outcome was good (postoperative ODI score < 20) in 84.2% of patients.

ULDH patients show no significant age-related difference in outcome on ODI [6]. In the present study, age group (20 to 40 years, 40 to 60 years and 60 to 80 years) was not significantly related to outcome on ODI or VAS. LLDH likewise showed no significant age-related difference in outcome on ODI.

Some studies indicated that female gender has an independent significant negative correlation with surgical outcome [15]. In the present study, however, gender did not have a significant correlation with outcome in ULDH or LLDH.

Age is reported in literature as a factor for disc herniation in upper levels [5,16,17]. In the present study, however, mean ages in ULDH and LLDH were similar.

Sanderson and colleagues [5] reported that surgical outcome was worse for L1–2 and L2–3 than for L3–4 herniations. In the present study, 367 patients treated for L1–2, L2–3 or L3–4 disc herniation showed no significant difference in outcome on ODI or VAS according to level. ULDH side also had no significant effect on outcome. In LLDH likewise, level and side did not have a significant effect on outcome.

One prognostic factor for outcome after microdiscectomy for ULDH did emerge: symptom duration. This factor has not been

Table 2
Preoperative and postoperative VAS and ODI scores in upper and lower lumbar disc herniation.

Variable	ULDH			LLDH		P1 value	P2 value
	L1-2	L2-3	L3-4	L4-5	L5-S1		
Preop VAS back pain	3.64 ± 1.64	4.08 ± 1.31	4.41 ± 1.45	1.50 ± 0.64	1.80 ± 0.67		
Postop VAS back pain	2.45 ± 1.18	2.48 ± 1.18	2.81 ± 1.13	0.41 ± 0.49	0.69 ± 0.46		
Preop VAS leg pain	6.64 ± 1.64	7.08 ± 1.31	7.41 ± 1.45	7.50 ± 1.35	7.84 ± 1.20		
Postop VAS leg pain	2.63 ± 1.27	2.63 ± 1.10	2.91 ± 1.08	1.83 ± 0.94	1.38 ± 1.14		
Preop ODI	33.87 ± 7.63	33.56 ± 7.88	33.65 ± 7.82	33.31 ± 5.62	34.46 ± 4.89		
Postop ODI	19.45 ± 3.19	20.46 ± 4.16	21.88 ± 3.65	13.82 ± 2.15	15.24 ± 3.42		
Change in VAS back pain	1.19 ± 1.85	1.59 ± 1.47	1.60 ± 1.64	1.08 ± 0.81	1.11 ± 0.84	0.224 ^a	0.547 ^a
Change in VAS leg pain	4.01 ± 1.79	4.44 ± 1.27	4.50 ± 1.57	5.67 ± 1.92	6.45 ± 1.59	0.104 ^a	0.262 ^a
Change in ODI	14.42 ± 8.82	13.10 ± 8.56	11.77 ± 8.61	19.48 ± 6.59	19.22 ± 6.93	0.094 ^a	0.371 ^a

P1: ULDH P value. P2: LLDH P value. ULDH: upper lumbar disc herniation; LLDH: lower lumbar disc herniation.

^a Non-significant.

Table 3
Preoperative and postoperative VAS and ODI scores according to age group.

Variable	ULDH			LLDH			P1 value	P2 value
	20–40 years	40–60 years	60–80 years	20–40 years	40–60 years	60–80 years		
Preop VAS back pain	4.36 ± 1.53	4.19 ± 1.40	4.14 ± 1.51	1.68 ± 0.68	1.64 ± 0.67	1.66 ± 0.68		
Postop VAS back pain	3.04 ± 1.47	2.50 ± 1.04	2.68 ± 1.14	0.54 ± 0.48	0.56 ± 0.47	0.55 ± 0.49		
Preop VAS leg pain	7.52 ± 1.43	7.22 ± 1.39	7.06 ± 1.53	7.66 ± 1.29	7.68 ± 1.27	7.67 ± 1.28		
Postop VAS leg pain	3.24 ± 1.40	2.65 ± 0.99	2.77 ± 1.12	1.66 ± 1.07	1.57 ± 1.07	1.60 ± 1.08		
Preop ODI	33.62 ± 6.74	33.65 ± 7.74	33.06 ± 8.08	33.47 ± 5.16	34.03 ± 5.29	33.92 ± 5.32		
Postop ODI	21.08 ± 3.95	21.09 ± 3.78	21.08 ± 3.90	14.78 ± 3.02	14.52 ± 2.90	14.53 ± 3.01		
Change in VAS back pain	1.40 ± 1.61	1.70 ± 1.52	1.41 ± 1.72	1.13 ± 0.83	1.08 ± 0.81	1.10 ± 0.84	0.221 ^a	0.599 ^a
Change in VAS leg pain	4.28 ± 1.41	4.57 ± 1.46	4.29 ± 1.63	6.01 ± 1.84	6.10 ± 1.81	6.08 ± 1.78	0.222 ^a	0.718 ^a
Change in ODI	14.54 ± 8.44	12.56 ± 8.57	11.98 ± 8.79	18.69 ± 6.71	19.50 ± 6.70	19.39 ± 6.85	0.191 ^a	0.197 ^a

P1: ULDH P value. P2: LLDH P value. ULDH: upper lumbar disc herniation; LLDH: lower lumbar disc herniation.

^a Non-significant.

Table 4
Preoperative and postoperative VAS and ODI scores according to gender.

Variable	ULDH		LLDH		P1 value	P2 value
	Female	Male	Female	Male		
Preop VAS back pain	4.30 ± 1.36	4.10 ± 1.55	1.67 ± 0.68	1.64 ± 0.69		
Postop VAS back pain	2.62 ± 1.15	2.69 ± 1.17	0.56 ± 0.49	0.55 ± 0.50		
Preop VAS leg pain	7.27 ± 1.37	7.13 ± 1.54	7.67 ± 1.29	7.68 ± 1.28		
Postop VAS leg pain	2.71 ± 1.07	2.84 ± 1.16	1.61 ± 1.06	1.58 ± 1.08		
Preop ODI	33.89 ± 7.67	33.46 ± 7.90	33.84 ± 5.27	33.97 ± 5.31		
Postop ODI	20.51 ± 3.93	21.57 ± 3.72	14.64 ± 3.02	14.49 ± 2.91		
Change in VAS back pain	1.66 ± 1.64	1.42 ± 1.61	1.10 ± 0.83	1.09 ± 0.82	0.172 ^a	0.593 ^a
Change in VAS leg pain	4.56 ± 1.53	4.28 ± 1.53	6.05 ± 1.79	6.10 ± 1.82	0.083 ^a	0.503 ^a
Change in ODI	13.37 ± 8.71	11.89 ± 8.59	19.20 ± 6.83	19.48 ± 6.71	0.102 ^a	0.347 ^a

P1: ULDH P value. P2: LLDH P value. ULDH: upper lumbar disc herniation; LLDH: lower lumbar disc herniation.

^a Non-significant.

Table 5
Preoperative and postoperative VAS and ODI scores according to herniation side.

Variable	ULDH		LLDH		P1 value	P2 value
	Right	Left	Right	Left		
Preop VAS back pain	4.20 ± 1.49	4.18 ± 1.44	1.64 ± 0.67	1.67 ± 0.68		
Postop VAS back pain	2.67 ± 1.19	2.64 ± 1.12	0.56 ± 0.50	0.55 ± 0.49		
Preop VAS leg pain	7.19 ± 1.51	7.20 ± 1.41	7.69 ± 1.28	1.66 ± 1.29		
Postop VAS leg pain	2.80 ± 1.18	2.75 ± 1.04	1.58 ± 1.06	1.61 ± 1.09		
Preop ODI	33.81 ± 7.70	33.47 ± 7.92	33.94 ± 5.29	33.8 ± 5.29		
Postop ODI	21.05 ± 3.80	21.12 ± 3.92	14.58 ± 2.91	14.53 ± 3.04		
Change in VAS back pain	1.52 ± 1.70	1.55 ± 1.54	1.08 ± 0.82	1.12 ± 0.83	0.872 ^a	0.301 ^a
Change in VAS leg pain	4.38 ± 1.56	4.44 ± 1.49	6.10 ± 1.79	6.04 ± 1.81	0.686 ^a	0.498 ^a
Change in ODI	12.75 ± 8.30	12.34 ± 9.12	19.35 ± 6.74	19.32 ± 6.82	0.653 ^a	0.916 ^a

P1: ULDH P value. P2: LLDH P value. ULDH: upper lumbar disc herniation; LLDH: lower lumbar disc herniation.

^a Non-significant.

Table 6
Preoperative and postoperative VAS and ODI scores according to symptom duration.

Variable	ULDH			LLDH			P1 value	P2 value
	0–3 months	3–6 months	6–9 months	0–3 months	3–6 months	6–9 months		
Preop VAS back pain	3.98 ± 1.43	4.65 ± 1.62	4.10 ± 1.24	1.61 ± 0.67	1.57 ± 0.59	1.84 ± 0.76		
Postop VAS back pain	2.20 ± 0.75	3.08 ± 1.29	3.06 ± 1.33	0.51 ± 0.50	0.52 ± 0.49	0.69 ± 0.46		
Preop VAS leg pain	6.96 ± 1.40	7.66 ± 1.64	7.12 ± 1.28	7.83 ± 1.25	7.63 ± 1.26	7.53 ± 1.34		
Postop VAS leg pain	2.43 ± 0.74	3.10 ± 1.30	3.11 ± 1.30	1.61 ± 1.06	1.73 ± 1.06	1.38 ± 1.07		
Preop ODI	33.68 ± 7.56	33.46 ± 7.65	33.84 ± 8.41	35.58 ± 5.01	34.21 ± 4.94	31.12 ± 5.02		
Postop ODI	19.55 ± 3.10	22.48 ± 4.08	22.44 ± 3.80	14.89 ± 2.99	13.38 ± 1.97	15.82 ± 3.46		
Change in VAS back pain	1.79 ± 1.50	1.58 ± 1.62	1.00 ± 1.74	1.11 ± 0.73	1.05 ± 0.68	1.15 ± 1.09	0.001 ^a	0.043a
Change in VAS leg pain	4.53 ± 1.33	4.56 ± 1.62	4.02 ± 1.72	6.22 ± 1.80	5.89 ± 1.80	6.15 ± 1.79	0.016 ^a	0.001 ^a
Change in ODI	14.12 ± 8.40	10.97 ± 8.45	11.39 ± 8.96	20.69 ± 6.62	20.83 ± 5.65	15.29 ± 6.84	0.005 ^a	0.001 ^a

P1: ULDH P value. P2: LLDH P value. ULDH: upper lumbar disc herniation; LLDH: lower lumbar disc herniation.

^a Statistically significant.

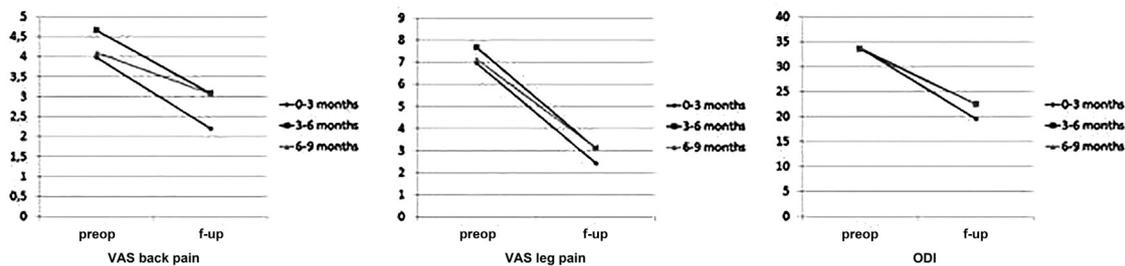


Fig. 1. Preoperative and postoperative mean back and leg pain VAS and ODI scores according to symptom duration.



Fig. 2. A, C preoperative and B, D postoperative MR images, 1–2–3 preoperative and postoperative MR images in L1–2, L2–3, L3–4 disc herniation.

examined in upper lumbar disc surgery in the literature. ULDH patients with symptom duration < 3 months had better outcome than those with 3–6 months or 6–9 months, as did LLDH patients with < 6 months' symptom duration.

5.1. Study limitations

We investigated the clinical characteristics and surgical results prospectively for upper lumbar disc herniation, and then retrospectively in lower lumbar disc herniation, in order to compare outcomes. This retrospective component of the study constitutes a limitation.

6. Conclusion

ULDH has clinical and anatomical specificities: the upper lumbar level is reputed to be risky and surgeons may prefer to abstain from surgical treatment during the early period of disc herniation. Although other approaches and techniques have been described, microdiscectomy for ULDH allows sufficient and safe decompression of neural structures and significantly reduces symptoms and disability. The principal conclusion from the present study is that early surgical treatment (< 3 months) is an important factor for good outcome in ULDH. Neurosurgeons may prefer surgical treatment by lumbar microdiscectomy in the early period of ULDH.

Ethical approval

This study was performed with clinical data collected from patient files collected retrospectively. For this type of study, formal consent is not required. All patients are informed for this type of study and procedure before treatment.

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Informed consent

Informed consent was obtained from all individual participants included in the study.

Disclosure of interest

The authors declare that they have no competing interest.

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