Higher preoperative Oswestry Disability Index is associated with better surgical outcome in upper lumbar disc herniations

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Abstract To evaluate the surgical outcome in terms of functional and subjective recovery, patients who needed discectomies at L1–L2, L2–L3 and L3–L4 levels were compared with an age and sex-matched group of patients who required L4–L5 and L5–S1 discectomies. We prospectively enrolled 50 consecutive patients, referred to our center, who had L1–L2, L2–L3 and L3–L4 herniations and required surgical intervention. Likewise, a comparative group of 50 consecutive patients with herniations at L4–L5 and L5–S1 were selected. All 100 patients were treated and followed for a 1 year period. Physical examination findings as well as Oswestry Disability Questionnaire before surgery were recorded. After 1 year, patients were requested to fill the same questionnaire. Significant decline in the Oswestry Disability Index (ODI) scores was considered to be a measure of functional improvement and recovery. The mean age of patients with upper lumbar disc herniation (L1–L2, L2–L3, L3–L4) was 45.7 years and patients with lower lumbar disc herniation (L4–L5, L5–S1) had a mean age of 41.2 years. There was no statistically significant difference in age between the two groups. The preoperative Oswestry Disability (ODI) Index score had a statistically significant impact on ODI score improvement after surgery in both lower and upper lumbar disc groups. All 100 patients with either lower or upper lumbar disc herniation had statistically significant ODI change after surgical intervention ($P < 0.0001$ for both groups). However, patients with upper disc herniations and moderate preoperative disability (ODI of 21–40%) did not show significant

improvement, while patients with ODI greater than 40% had significant reduction ($P = 0.018$). Surprisingly, as many as 25% of the former had even an increase in ODI scores after surgery. Gender was also a conspicuous factor in determining the surgical outcome of patients with upper lumbar disc herniation, and male patients had more reduction in ODI score than female patients ($P = 0.007$). Since the functional recovery in patients with herniated lumbar disc, especially upper lumbar herniation, is influenced by preoperative ODI scores, the use of ODI or any other standard pain assessment tool is a sensible consideration as an inherent investigative method to preclude unfavorable surgical outcome.

Keywords Upper lumbar disc ·
Oswestry Disability Index · Surgical outcome

Introduction

NO consensus exists on which intervertebral levels constitute the so-called “upper lumbar” disc herniations. Some authors consider this category to include only L1–L2 and L2–L3 intervertebral discs [3, 4, 8], while in other studies, T12–L1, L1–L2 and L3–L4 levels have been coined as “upper lumbar” [12]. However, the majority of authors have deemed intervertebral disc herniations of the L1–L2, L2–L3 and L3–L4 to be “upper lumbar” [1, 2, 5, 6, 13, 16, 19].

Previous studies have confirmed the objective sensory and motor improvement of patients undergoing upper lumbar discectomies [1, 5, 16]. Sanderson et al. [18] retrospectively studied both the objective and subjective improvement of patients with lumbar disc herniation at L1–L2, L2–L3 and L3–L4 levels. Employing the Prolo

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Economic and Functional grading scale, they showed a significant difference in the outcome of surgery in terms of herniation level at the upper part of the lumbar spine. In our study, the use of the standard modified Oswestry Disability Questionnaire Ver^{2.0} (ODQ) for spinal disorders [7, 9, 10] has been emphasized to determine whether preoperative ODI is crucial to determine the outcome of patients in terms of functional improvement and pain relief.

Patients and methods

We prospectively followed 50 consecutive patients with unilateral upper lumbar herniation at L1–L2, L2–L3 and L3–L4, requiring surgery. As a comparative group, 50 patients with unilateral herniation at L4–L5 and L5–S1 level were selected consecutively in order of referral to our center. Conventional surgical indications (progressive neurological deficit, refractory or recurrent pain after 6–12 weeks of medical treatment) associated with MRI findings, consisting of unilateral extrusion and/or herniations at the lumbar levels, were considered to include patients in both groups. The involved roots were confirmed with electrodiagnostic study. Simultaneous upper and lower lumbar disc involvement frequently takes place as reported by other studies [12]. Those having significant concomitant upper and lower herniations on MRI exams or concomitant upper and lower lumbar root involvements confirmed clinically and/or electrodiagnostically were excluded from the study. Also, those with spinal bony involvement in systemic disease, bone specific disease, simultaneous discectomies on both upper and lower lumbar discs and loss to follow-up were excluded.

All 100 patients were treated as inpatient in a 2-year-period and were followed for 1 year. Obviously, the selection period for the lower lumbar group was shorter owing to its higher prevalence. The same technique was employed in all patients, i.e., macroscopic ipsilateral hemi-laminectomy under the guidance of a C-arm image intensifier. The patients received parenteral antibiotics and analgesics overnight and were discharged on the following 1–2 days. No significant postoperative complication was observed.

A thorough history and physical examination was performed by one clinician and the interviewed patients filled the translated and validated copy of ODQ [15] (with the kind permission of the authors). The duration of follow-up of all patients was 12 months, functional recovery and pain relief took place within 6 weeks of operation, and beyond this point, further improvement was marginal [11]. During the 1 year follow-up, patients were periodically interviewed and were asked to pick one of the answer choices to questions in the ODQ. The interviewing physician was unaware of the preoperative scores of the patients.

Many studies have demonstrated a satisfactory surgical response in terms of ODI score reduction [10, 11, 14], yet optimal ODI score reduction has not been universally accepted. We avoided making any conventional measure of surgical response and searched for statistically significant change in ODI score percentage reduction among the subgroups studied. The statistical methods employed were Chi square and non-parametric Kruskal–Wallis, Mann–Whitney tests. The percentage of ODI reduction was utilized to eliminate the effect of absolute value of the preoperative ODI score. When needed, correlation was assessed by the eta coefficient. The efficacy of surgery was evaluated with the Wilcoxon and Sign tests.

Results

The frequency of lumbar discectomies in our patients is shown in Table 1. The mean age of patients with upper lumbar disc herniation and lower lumbar disc herniation were 45.7 years (23–70) and 41.2 years (20–63), respectively.

Male to female ratio was 1.08 and 1.14 in the upper and lower lumbar disc herniations, respectively. These differences between upper and lower lumbar disc herniation groups had no statistical significance ($P > 0.05$). For statistical convenience, the patients were categorized into equal age groups and were compared in terms of reduction in ODI. No statistically significant difference in surgical outcome was seen among these age categories in either the upper or the lower lumbar discectomies. Both the lower and the upper lumbar disc herniation groups had statistically significant ODI change after surgical intervention ($P < 0.0001$ for both groups).

In the upper lumbar disc category, 20% of patients (ten patients) had a history of prior lumbar disc surgery; of these, eight patients had undergone surgery due to upper lumbar disc herniation and one patient due to previous lower lumbar disc herniation. Also, 5 years earlier, one patient

Table 1 The frequency of lumbar disc herniations at various levels in patients with corresponding gender and history of previous surgery

Level	No. of patients	Category	Gender	History of previous surgery
L1–L2	8	Upper, 50	Females, 25	10 (7 males vs. 3 females)
L2–L3	14		Males, 25	
L3–L4	28			
L4–L5	29	Lower, 50	Females, 24	5 (3 males vs. 2 females)
L5–S1	21		Males, 26	
Total	100			

had a history of instrumentation because of compression fracture at L2. In comparison, 10% of patients (five patients) with lower lumbar disc herniation had previous discectomies at the lower lumbar disc herniations (Table 1). The prevalence of prior surgeries did not differ significantly in those with upper and lower lumbar herniations. The mean preoperative ODI score in patients with previous surgery was 61 ± 19 in the upper and 56 ± 13.2 in the lower group as opposed to preoperative ODI of 45.4 ± 18.5 and 52.5 ± 12.7 in the upper and lower herniation patients without previous surgery, respectively. These figures did not reveal statistically significant differences ($P > 0.05$). None of our patients required repeat procedures in the follow-up period. The difference in ODI reduction percentage between patients with prior spine surgery and the ones without surgery in either the upper or the lower lumbar disc herniation group was not statistically significant ($P > 0.05$). There was a trend toward better surgical outcome in terms of ODI reduction in patients with upper lumbar disc herniation, who were operated within 12 months of back or extremity pain initiation, but this was not statistically significant ($P = 0.06$). Moreover, 52% of patients with upper lumbar disc herniation and 42% of patients with lower lumbar disc herniation reported a history of significant previous trauma, or had strenuous vocations, yet the role of these conditions in determining change in ODI scores was insignificant in both the upper and the lower lumbar disc herniation groups ($P > 0.05$). Likewise, the results demonstrated a weak correlation between the herniation level and the decrease in the ODI score (eta coefficient: 0.28). There was no statistically significant difference in the decline in the ODI scores of patients with herniated discs at diverse lumbar levels ($P > 0.05$).

The mean preoperative ODI scores in the upper and lower lumbar disc herniation groups were 54 and 47%, respectively, and the difference between the scores of the two groups was insignificant ($P > 0.05$). In contrast, the postoperative ODI scores were 26 and 15% in patients with upper lumbar and lower lumbar disc herniations, respectively, which differed significantly ($P = 0.001$). No significant difference was found in the decrease in the ODI score of the upper (28%) and lower (32%) lumbar levels ($P > 0.05$). It can be emphasized that there was a significant difference in the change in ODI among patients with various preoperative ODI scores, in both the upper ($P = 0.017$; Fig. 1a) and the lower lumbar disc herniation ($P = 0.001$) groups (Fig. 1b). Additionally, another effectual factor on surgical response was gender; in upper lumbar disc herniation, more reduction in ODI scores was noted in men than in women and this reached statistical significance ($P = 0.007$; Fig. 2). However, there was not such a significant difference between men and women in the lower lumbar disc herniation category ($P > 0.05$).

Fig. 1 Box plot of Oswestry Disability Index reduction in patients with upper (a) and lower (b) lumbar disc herniations

Discussion

There has been varying incidences of upper lumbar discectomies in literature (<1 to 10.4% of all disc surgeries; [18]). At our center, it was found to be 11.7%. There are contradictory remarks on the prognosis of surgical intervention in patients with L1–L2, L2–L3 and L3–L4 disc herniation. Some studies have reported satisfactory surgical outcome in these patients. According to Albert et al. [1], good or excellent surgical outcome was noted in 80% of 141 patients with upper lumbar disc herniation. Pasztor and Szarvar [16] reported a good or excellent surgical outcome in 93% of patients with upper disc herniations in the early postoperative period, and the crippled, with the exception of two patients, could be ambulatory again. Dinakar et al. [5] found excellent prognosis in 73% of patients, and the rest of the patients with bad prognosis were paraplegic before surgery. In the above studies, the surgical outcome was evaluated in terms of objective clinical improvement, and the subjective and functional status of patients before and after surgery was neglected.

In contrast, Sanderson et al. [18] reported that patients with L1–L2 or L2–L3 discectomies had significantly worse surgical outcome than the ones with L3–L4, L4–L5 and L5–S1 discectomies. The extent of improvement in radicular

Fig. 2 Box plot of Oswestry Disability Index reduction in terms of gender in patients with upper (a) and lower (b) lumbar herniations

pain, back pain and functional and economic status were found to be 58, 53 and 33%, respectively. On the other hand, the surgical outcome in the L3–L4 group was favorable and similar to L4–L5 and L5–S1 group. Most of their patients with L1–L2 and L2–L3 disc herniation had previous lumbar disc surgeries. The mode of assessment at follow-up consisted of the Prolo Functional and Economic Grading scale that evaluates the overall degree of daily pain and working status (indoors and outdoors) of patients. Considering that the Prolo Grading scale delineates preoperative and postoperative state of patients on a semi-quantitative basis [17], it would be more suitable to take into account routine and daily activities of the patient, which are more responsive to surgical treatment [11].

Our results show that the preoperative disability as well as gender of patients is much more crucial determinants of surgical outcome than the herniation level. Some studies have indicated that lower preoperative ODI and female gender had an independent, significant, negative correlation with surgical outcome [14]. Our results are in concordance with theirs; the sum of ranks of ODI score decrements in male patients with L1–L2, L2–L3 and L3–L4 herniation is larger than that of female patients with the same herniated lumbar discs. This finding could not be

attributed to previous surgery, since previous surgery was more common in males (Table 1), nor could it be the result of difference in preoperative ODI between men and women in the upper lumbar group, since the difference was not statistically significant ($P > 0.05$). Sociodemographic factors have been blamed to be the culprit by some authors [11]. Nevertheless, being a questionnaire-based study, the effect of gender should be interpreted with caution.

Surprisingly greater surgical response in terms of ODI score reduction occurred in patients with higher degrees of preoperative disability in the upper lumbar as well as lower lumbar categories (eta coefficient: 0.72 and 0.78 respectively). As depicted in Fig. 1, patients with moderate preoperative disability (ODI: 21–40%) in both upper and lower lumbar disc herniation had significantly worse surgical outcome than patients with more preoperative disability (ODI > 40 , $P < 0.05$). Also, two out of eight patients with upper lumbar disc herniation and moderate disability had even an increase in their postoperative ODI score. Statistical correction to eliminate the effect of these two cases yielded the same results.

Concurrent radiological abnormalities are noteworthy in discussing upper lumbar disc herniations. Isolated degenerative disc at these levels are rare entities and often disc herniation at lower lumbar levels accompany them [12]. This fact may account for the “polyradiculopathy” described in the literature [1, 13, 16, 18]. Our data show that 28 patients (56%) of those with upper lumbar disc herniation had MRI findings of concomitant lower lumbar disc protrusions. Finally, the use of ODQ as a part of preoperative investigation may be recommended to enhance the classical clinical indications in selecting patients for surgical intervention.

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