

Lumbar Disc Herniation Presenting Cauda Equina Syndrome

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Objective : To determine the relationship between the clinical outcome and the extent of surgical laminectomy for adequate decompression on the cases of cauda equina syndrome, the authors review and analyze their cases and compared with those of literatures.

Methods : The authors reviewed 655 patients retrospectively who had underwent surgery on the cases of lumbar disc herniation from January 2000 to December 2004. There were 19 patients (2.9%) who presented for clinical cauda equina syndrome. Among them, we selected and analyzed 15 patients who were treated by unilateral partial hemilaminectomy with discectomy or bilateral partial laminectomy with discectomy, and they had been followed from 5 weeks to 47 months postoperatively (mean, 13.47 months). The levels of the disc herniations were L4-5 in 8 patients, following L5-S1 in 4 patients and 2 levels(L4-5 and L5-S1) in 3 patients. Motor and sensory recoveries were recorded. Postoperative urinary function recovery was defined according to Gleave and Macfarlane⁷⁾.

Results : In 12 months postoperatively, the bladder function was obtained in 14 of 15 patients(93%) with regaining urinary continence. Thirteen of 15 patients(86%) with preoperative motor weakness of lower extremities were recovered. Sensory deficit of lower extremities, perianal and saddle anesthesia were all recovered. Patients had recovered on lumbosciatic pain and saddle hypesthesia, in turn, motor function and urinary incontinence.

Conclusion : In treating cauda equina syndrome, the authors did less extensive surgery, such as unilateral partial hemilaminectomy with discectomy or bilateral partial laminectomy with discectomy for adequate decompression. The outcome is satisfactory and comparable with those of subtotal or total laminectomy.

KEY WORDS : Cauda equina syndrome · Urinary incontinence · Lumbar disc herniation · Laminectomy.

Introduction

More than 95% of uncomplicated herniated lumbar disc can be treated conservatively initially which consists of bed rest, use of nonsteroidal anti-inflammatory drugs, muscle relaxants, heat and ultrasound. Surgery reserved for patients who experience worsening of neurologic symptoms or failure to clinically improve after an appropriate minimum of 6 weeks of conservative medical therapy. In contrast, cauda equina syndrome is a severe neurologic disorder that can result from lumbar disc herniation with excessive compression on the cauda equina, so it was considered one of the few surgical emergencies which requires an acute surgical decompression^{1,2,6,9-11,16,17)}. Though precise understanding of the pathophysiology and optimal treatments including the best timing and the extent of surgery has yet to be elucidated for cauda equina syndrome^{1-3,6,7,9-12,16,17)}, we think that the primary goal in the treatment

of cauda equina syndrome is to detect and diagnosis early, and to surgery with adequate decompression.

We reviewed and analyzed our recent experiences with patients with cauda equina syndrome caused by lumbar disc herniation which were treated by unilateral partial hemilaminectomy with discectomy or bilateral partial laminectomy with discectomy. The results of this study were compared to those of current literatures treated by more extensive subtotal or total laminectomy in the view of the postoperative outcome, especially in improvement of voiding, motor and sensory deficit, and the extent of surgical laminectomy for adequate decompression. This study also provides an overview of this rare but important syndrome.

Materials and Methods

We reviewed 655 patients' records retrospectively which had underwent surgery following lumbar disc hern-

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Table 1. Patient population

Case	Sex	Age	L.O.H.	Other findings	P.D.S.	S. to S.	A. to S.	Op.*	D. of F. (Months)	Preoperative symptoms	Preoperative outcomes
1	M	41	L5-S1	Stenosis O.P.L.L.	None	1 day	1 day	Bi.	26	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
2	F	28	L4-L5	None	None	2 days	2 days	Uni.	4.5	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
3	F	38	L4-L5	None	None	2 days	1 day	Uni.	10	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
4	F	29	L4-L5	None	None	3 days	2 days	Uni.	9.75	LBP /c Uni. Rad. No Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
5	M	57	L4-L5	Stenosis	None	10 days	2 days	Uni.	5.75	LBP /c Bi. Rad. Uni. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
6	M	35	L4-L5	None	None	3 days	2 days	Uni.	1.25	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
7	M	53	L4-L5	None	None	3 weeks	1 day	Uni.	8.25	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
8	M	59	L4-L5	Stenosis	None	5 days	3 days	Uni.	1.25	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
9	M	27	L4-L5	None	None	1 day	1 day	Uni.	20.75	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence & Constipation	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence & Constipation
10	M	54	L4-L5 L5-S1	None	None	2 days	1 day	Uni.	11.75	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
11	M	51	L4-L5 L5-S1	None	None	9 days	1 day	Uni.	6.5	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
12	F	40	L4-L5 L5-S1	None	None	7 days	1 day	Uni.	2.8	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence
13	F	55	L5-S1	None	L3-L4 L4-L5	2 days	1 day	Uni.	40	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence & Constipation	No LBP /s Rad. No Foot drop No Sensory deficit No Incontinence & Constipation
14	M	68	L5-S1	Stenosis	None	4weeks	4days	Uni.	6.5	LBP /c Uni. Rad. Uni. Foot drop Uni. Sensory deficit Incontinence	No LBP /s Rad. Uni. Foot drop No Sensory deficit No Incontinence
15	M	32	L5-S1	None	L2-L4	9weeks	3weeks	Uni.	47	LBP /c Bi. Rad. Bi. Foot drop Bi. Sensory deficit Incontinence	No LBP /s Rad. Bi. Foot drop No Sensory deficit Incontinence

Op.* = Partial hemilaminectomy /c discectomy; Op. = Operation; D. of F. = Duration of Follow up(Postoperatively); /c = with; /s=without; L.O.H. = Level of Herniation; P.D.S. = Previous Disc Surgery; S. to S. = Symptom duration to Surgery; A. to S. = Admission to Surgery; O.P.L.L. = Ossification of Posterior Longitudinal Ligament; Uni. = Unilateral; Bi. = Bilateral; Rad. = Radiating pain

iation at our institution, Department of Neurosurgery, from January 2000 to December 2004. There were 19 patients (2.9%) who presented for clinical cauda equina syndrome. Though

there are numerous etiologies which can cause the cauda equina syndrome^{3,8)}, patients with cauda equina syndrome due to other causes, except lumbar disc herniation, were excluded from this study.

Among them, we selected and analyzed 15 patients who were treated by unilateral partial hemilaminectomy with discectomy (14 patients) or bilateral partial laminectomy with discectomy (1 patient). After delicate removal of the ruptured and migrated disc fragments, the remaining disc materials and soft tissues were removed carefully with preserving nerve roots, but the disc space was not removed aggressively. All 15 patients' population is described in Table 1, (Fig. 1), (Fig. 2).

Data of 15 patients were evaluated. There were 10 men and 5 women, ranging in age from 27 to 68 years (Mean patient's age at surgery was 44.46 years), and they had been followed from 5 weeks to 47 months postoperatively (mean, 13.47 months).

At admission, all 15 patients reported unilateral or bilateral lumbosciatic pain. Symptoms at admission and post-operation was described on Table 2. Seven patients had a chronic onset of symptoms with a progressive lumbosciatic pain (sometimes for weeks) that finally culminated in cauda equina syndrome. The other 8 patients had an acute onset of symptoms of less than 72 hours prior to presentation. Two patients had previous surgery in lumbar area. Urinary incontinence was presented in all 15 patients. Fourteen patients had motor weakness of lower extremities, among them, 8 patients had bilateral foot drop.

Disc herniation was verified using plain radiographs, myelography, computed tomography and magnetic resonance image. Computed tomography and magnetic resonance image findings showed massive disc herniation in all 15 patients that occupied

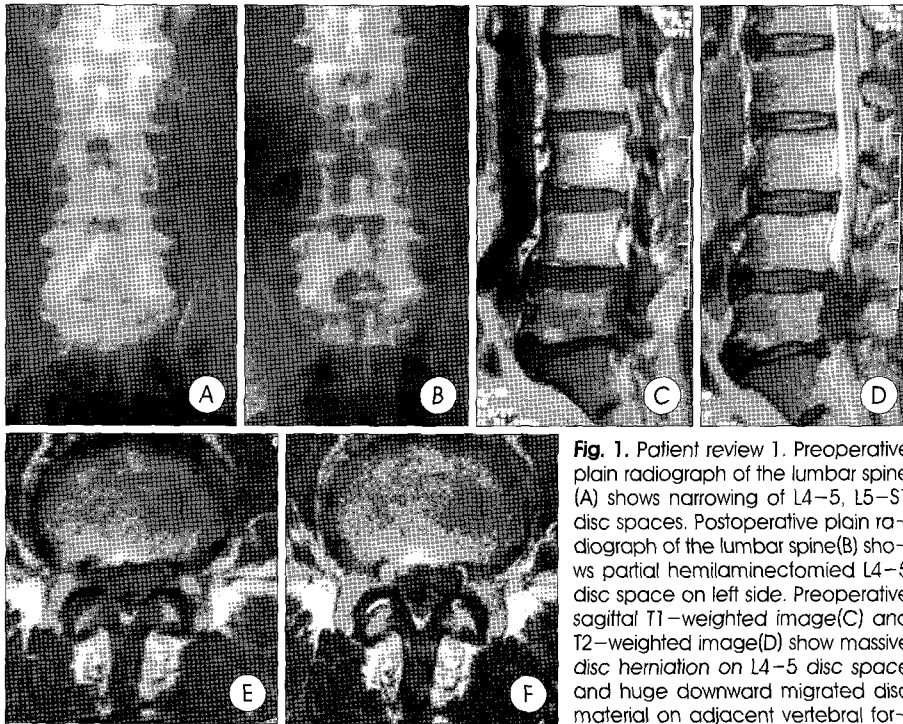


Fig. 1. Patient review 1. Preoperative plain radiograph of the lumbar spine (A) shows narrowing of L4-5, L5-S1 disc spaces. Postoperative plain radiograph of the lumbar spine (B) shows partial hemilaminectomy on left side. Preoperative sagittal T1-weighted image (C) and T2-weighted image (D) show massive disc herniation on L4-5 disc space and huge downward migrated disc material on adjacent vertebral for-

amen(level of L5 body) with compressing the thecal sac severely. Preoperative axial T1-weighted image (E) and T2-weighted image (F) show massive disc herniation that occupied more than two third of the canal diameter with compressing the thecal sac severely.

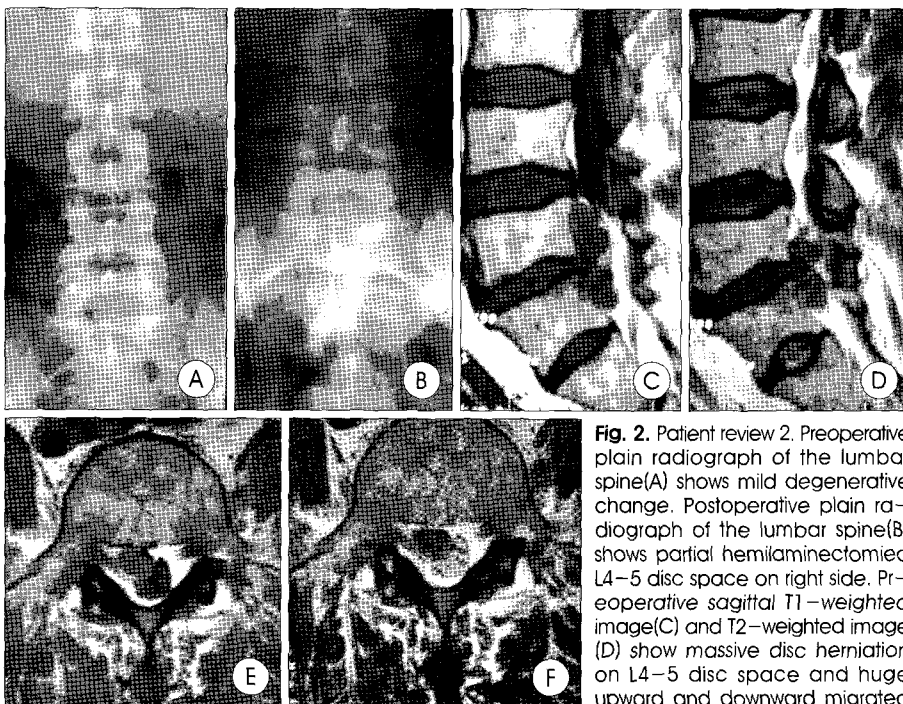


Fig. 2. Patient review 2. Preoperative plain radiograph of the lumbar spine (A) shows mild degenerative change. Postoperative plain radiograph of the lumbar spine (B) shows partial hemilaminectomy on right side. Preoperative sagittal T1-weighted image (C) and T2-weighted image (D) show massive disc herniation on L4-5 disc space and huge upward and downward migrated

disc material on adjacent vertebral foramen(level of L4 and L5 body) with compressing the thecal sac severely. Preoperative axial T1-weighted image (E) and T2-weighted image (F) show massive disc herniation that occupied more than half of the canal diameter with compressing the thecal sac severely.

Table 2. Symptoms At Admission and Post-operation

Symptoms At Admission	No. of Patients (n=15)	No. of Patients of Post-operative recovery
Urinary incontinence	15	14
Fecal incontinence	2	2
Lumbosciatic pain(Unilateral/Bilateral)	7/8	7/8
Radicular sensory loss	15	15
Radicular motor deficit	14	12
Perianal and saddle insensation	8	8

Table 3. Urinary function outcome correlated with time between symptom onset and surgery

Time	Results (n=15)			
	Excellent	Good	Fair	Poor
< 12 hours		-	-	-
12-24 hours	1	-	-	-
24-48 hours	4	-	-	-
3-7 days	4	-	-	-
> 7 days	4	-	1	-

Excellent=full subjective recovery of bladder function within the immediate postoperative inpatient period, Good= full subjective recovery of bladder function during follow-up, Fair=incomplete recovery of bladder function during follow-up (persisting stress incontinence), Poor = permanent urinary incontinence requiring catheterization

more than one third of the canal diameter. Four of 15 patients were associated with preexisting spinal stenosis. The most common levels of the herniations were L4-5 in 8 patients, following L5-S1 in 4 patients and 2 levels(L4-5 and L5-S1) in 3 patients.

Results

Six of 15 patients were emergently taken to surgery, among them, 2 patients were operated within 24 hours of onset, and 4 patients were operated within 24-48 hours of onset. The other 9 patients were taken to surgery after 48 hours of onset. Motor, sensory, rectal and urinary recoveries were recorded as positive only if recovery was shown. An incomplete recovery was recorded as a failure to recover. Postoperative urinary function recovery was defined according to Gleave and Macfarlane⁷⁾ and urinary function outcome correlated with time between symptom onset and surgery was described in Table 3.

In this study, there was no significant differences in subsequent outcome concerning the time between onset of symptoms and surgical decompression, especially in urinary incontinence, motor and sensory function. In 12 months postoperatively, the bladder function was obtained in 14 of 15 patients(93%) with regaining urinary continence. Urinary function recovery in inpatient periods was 3 patients, in 6 months after discharge was 4 patients, between 6 months and 1 year was 7 patients and incomplete recovery was 1 patient. The incompletely recovered patient had a persisting stress incontinence without requiring urinary catheterization. Thirteen of 15 patients(86%)

with preoperative motor weakness of lower extremities were recovered. Sensory deficit of lower extremities, perianal and saddle anesthesia were all recovered. Patients had recovered on lumbosciatic pain and saddle hypesthesia, in turn, motor function and urinary incontinence.

Discussion

The incidence of cauda equina syndrome due to lumbar disc herniation is rare, and is reported approximately 1~10% of all lumbar disc herniations^{1,4,12,15-17)}. In our cases, the incidence was 2.9% who presented for clinical cauda equina syndrome. The generally accepted incidence of cauda equina syndrome is 2~6% of all laminectomies performed for lumbar disc herniation.

Cauda equina syndrome is a presentation of signs and symptoms that indicate nerve compression involving one or more of the nerve roots in the lumbar spine. The nerve roots of the cauda equina provide the sensory and motor innervation of most of the lower extremities, the pelvic floor and the sphincters.

The clinical presentation of cauda equina syndrome consists of low back pain, unilateral or bilateral sciatica, anesthesia or paresthesia on perineum or saddle area, as well as decreased rectal tone and perineal reflexes, bowel and bladder incontinence or dysfunction, and variable amounts of sensory and motor deficit(especially below the knees) in the lower extremities^{8,15,17)}. There was a note that radicular pain may not be present if central herniation occurs at L5-S1 where the motor roots are spared⁸⁾. Also, there was a note that sparing of sensation in sacral dermatomes and of sphincter control¹³⁾ was found in patients of severe cauda equina compression from massive central lumbar disc prolapse. The urinary dysfunction may be characterized by overflow incontinence requiring catheterization, marked bladder distension with insensate bladder so that the patient is unaware of full bladder, and failure to void and to empty the bladder completely in a patient with a partially sensate bladder. Urinary excretion occurs more frequently than bowel evacuation, and it may also consisted of altered urethral sensation, loss of desire to void, urgency, increased frequency, poor stream, feeling of urinary retention, impossibility to micturate, micturition by straining, changed feeling during micturition, feeling of incomplete voiding or residual sense. Bowel dysfunction such as decreased or absent rectal tone, including anal reflex, and hypesthesia or complete anesthesia in the perianal area, and difficulties with defecation²⁾ also can be found with/without combination of sexual dysfunction such as spontaneous priapism. Rectal tone may be diminished in people who

have had rectal disease or in women who have given birth multiple times. It may progress to paraplegia and/or permanent urinary incontinence without adequate and prompt management.

The best timing of surgery or whether the urgent surgical intervention may affect outcomes has yet to be elucidated. There are some reports which suggest emergency operation in treating cauda equina syndrome, which seem to be beneficial to early return of function, and to be capable of reducing late disturbances in bladder function^{6,9,10,12,16}. Many authors^{1-3,9,11,17} reported that surgical intervention within 48 hours of onset of symptoms of cauda equina dysfunction has been shown to improve sensory, motor, urinary, and rectal abnormalities significantly compared with intervention after more than 48 hours. They also state that no difference exists between the effects of an early surgery less than 24 hours compared with a subsequent period between 24 and 48 hours after cauda equina syndrome onset. In the opposite, there are also other reports^{3,7,12,16,17} of no relation of the time between onset of symptoms and surgical decompression in treating cauda equina syndrome.

In this study, six of 15 patients were emergently taken to surgery, among them, 2 patients were operated within 24 hours of onset, and 4 patients were operated within 24~48 hours of onset. The other nine patients were operated after 48 hours of onset, among them, 4 patients were operated within 3~7 days of onset, and 5 patients were operated after 7 days of onset. There was no significant differences in subsequent outcome concerning the time between onset of symptoms and surgical decompression, especially in urinary incontinence, motor and sensory function.

Early detection and early diagnosis of cauda equina syndrome were not always possible, and we tried not to delay surgery when it was identified in the case of there being no problems in patients' medical conditions for operation. But patients' medical conditions were not always good enough, especially in the cases which were operated after 48 hours of onset.

Though there were some delay between onset of symptoms and surgical decompression, 14 of 15 patients had recovered full motor, sensory and urologic function after 1 year from operation. We think that adequate decompression is critical when cauda equina syndrome is suspected to minimize permanent nerve damage.

In the literature studies, surgical decompression which was performed in patients with lumbar disc herniation presenting as cauda equina syndrome was varied. Aho et al¹ performed a hemilaminectomy in 19 patients. Kostuik et al¹² performed wide laminectomy and bilateral decompression in 30 of 31 patients. Choudhury et al⁵ performed wide laminectomy with excision of the overhanging facet joints in 42 patients, and adequate visualization of the lumbar nerve roots has been found to be the ideal procedure for disc removal and for relief of the

symptoms. Buchner et al³ performed surgery in 21 of 22 patients with cauda equina syndrome. Surgery was consist of bilateral decompression and additional hemilaminectomy or laminectomy. One patient underwent a laminectomy with additional spondylolysis. Bartels et al² reported 10 patients with hemicauda equina syndrome from herniated lumbar disc, among them, 5 patients underwent microdiscectomy, 4 patients underwent laminectomy, 1 patient refused operation. Shapiro¹⁷ did not advocate a microdiscectomy. His surgery consisted of laminectomy and discectomy in 14 patients. And after removal of the fragments, the remaining materials in the disc space was removed aggressively. In the patients with stenosis, foraminotomies were performed as well. Dinning and Schaeffer⁶ reported that intradural surgery was necessary in 18% of patients. Shapiro¹⁷ and Jennett¹⁰ did not enter the dura in any of their patients in their separate series.

Regarding postoperative outcome of cauda equina syndrome and postoperative bladder function recovery, results are encouraging^{2,3,5,7,12,14}. Choudhury et al⁵ reported in their study of 42 patients with "good to excellent" results in 95% of patients, and "fair" results in the other 5%. Gleave and Macfarlane⁷ (26 of 33 patients), Bartels et al² (9 of 10 patients), Kostuik et al¹² (23 of 30 patients), O'Laoire et al¹⁴ (18 of 29 patients) and Buchner et al³ (17 of 21 patients) also reported good result of regaining subjective urinary capacity postoperatively.

In this study, we performed unilateral partial hemilaminectomy (14 patients) and bilateral partial laminectomy with discectomy (1 patient), and fourteen of 15 patients had recovered full motor, sensory and urologic function after 1 year from operation.

There is the possibility of postoperative urinary function recovery in further follow up. Hellstrom et al⁹ and Jennett¹⁰ suggested nervous tissue repair may take several years. Chang et al⁴ reported that although the recovery process of bladder function was very slow, taking months to years, all their patients achieved almost normal voiding with no major impairment of daily activities.

Problems arise regarding objective assessment of postoperative urinary function recovery. Many authors emphasize the discrepancy of subjective patient satisfaction and objective urodynamic findings^{1,7,9}. In the study by Hellstrom et al⁹, 10 of 17 patients reported subjective urinary improvement, whereas only 4 of 17 patients had negative cystometric studies. In the study by Aho et al¹, 11 of 16 patients did not show satisfactory objective cystometric results, whereas the same number of patients subjectively did not indicate problems with their urinary function. Lumbar laminectomy, with removal of a ruptured intervertebral disc and cauda equina decompression, resulted in return of normal urination and normal cystometry and electromyogram of the perineal muscles¹⁸. Though some authors still insist on preoperative and postoperative urodynamic mea-

surements^{1,7,9,12}), the use of preoperative urodynamic investigations has created controversy regarding timing of surgical decompression following cauda equina syndrome.

In this study, there is a lack of cystometrograms in most preoperative and postoperative patients. Nevertheless, even in the absence of objective results, we think that the subjective well-being sense of the patients plays an important role in the assessment of results and represents the ultimate evaluation of therapeutic outcome.

Conclusion

Recent studies generally have reinforced that early surgical decompression for cauda equina syndrome with better clinical outcome, especially bowel and bladder dysfunction. But in this study, there was no significant differences in subsequent outcome concerning the time between onset of symptoms and surgical decompression.

We did lesser extensive unilateral partial hemilaminectomy with discectomy or bilateral partial laminectomy with discectomy in treating patients with cauda equina syndrome caused by lumbar disc herniation, and the results were compared with those studies which used more extensive subtotal or total laminectomy. The results were satisfactory and comparable with those of subtotal or total laminectomy in the view of recovery of motor weakness and bladder function.

We think that the important point in treating cauda equina syndrome is early and accurate diagnosis and adequate decompression if neurologic recovery is to be expected from decompressive laminectomy.

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