
原 著

Percutaneous Discectomy in Treatment of Herniated Lumbar Disc using Nucleotome Flex II under Computed Tomography Guidance: A Preliminary Report

SADAOKI OKI, YOSHIRO MATSUDA and TAIHOH SHIBATA

Department of Orthopaedic Surgery, Ehime University School of Medicine, Ehime, Japan

Received for Publication, Jan. 27., 1998

Abstract

Six patients with lumbar herniated discs were treated using the Nucleotome Flex II system under computed tomography (CT) guidance. Excellent results were obtained in patients whose intraoperative CT showed that the tip of the nucleotome was located at the posterior part of the disc. The nucleotome flexed within the area where the dye had spread during the preoperative computed tomographic discography (CTD). On the other hand, in both good and poor cases, the tip of the nucleotome could not flex posteriorly because of strong resistance. In these cases, preoperative CTD showed disc protrusion with a narrow dye base. The findings following open discectomies of poor cases showed that the dye lacking area consisted of a relatively intact annulus fibrosus. A relatively intact annulus fibrosus may obstruct the flexion of the nucleotome, resulting in a poor outcome in such cases.

Introduction

Percutaneous discectomy is widely used as a procedure for the treatment of herniated lumbar discs. But the efficacy of percutaneous discectomy by conventional procedures has been reported to range from 53 to 94%, which is not as good as that of open discectomy¹⁾.

To improve the operative result, *Castro et. al*²⁾ suggested that candidates for percutaneous discectomy should be selected who show a broad dye base disc protrusion on CTD. On the other hand, *Murata and Ojima*³⁾ reported that in order to improve the efficacy of the percutaneous discectomy, it should be carried out at the posterior part of the disc. However, to insert the tip of the nucleotome into the posterior part of the disc using a straight nucleotome, a far lateral approach must be chosen, which carries a risk of bowel puncture. To resect the posterior part of the disc safely, we used a new

Present address: Department of Orthopaedic Surgery, Ehime University School of Medicine, Shigenobu, Ehime, 791-0295, Japan

索引用語: 腰椎, 椎間板ヘルニア, 椎間板切除, 経皮的整形外科手術

Key words: lumbar vertebrae, disk/herniated, discectomy, percutaneous orthopedic surgery

automated percutaneous lumbar discectomy system named Nucleotome Flex II (Surgical Dynamics, Inc., Alameda, California, USA) (Note: The authors have no direct financial interest in the device).

The tip of the Nucleotome Flex II flexes posteriorly to resect the area near the herniation. It is suggested that this new system can achieve better results than the conventional system. This study shows the postoperative results and CT findings during the procedure.

Materials and Methods

Patients were assessed for candidacy for this study using 1) a major complaint of sciatica 2) failure of conservative treatment over a period of at least 2 months 3) no sequestrum visualized by MRI 4) no spinal stenosis 5) no cauda equina syndrome 6) no recurrent herniation after open discectomy.

From October 1993, 6 patients were treated with the Nucleotome Flex II. The mean patient age was 24.3 years (range 15 to 39 years). There were 5 men and 1 woman. The treated disc spaces were: 2 at L3-L4, 1 at L4-L5, and 3 at L5-S1.

Preoperative CTD

Preoperative CTD were performed for all cases. The distribution pattern of the dye inside the disc was documented and recognized as disc protrusion with a narrow dye base or with a broad dye base²⁾.

Operative technique

The procedure was carried out in the CT room under C-arm fluoroscopic and CT control. Local anesthesia was used. The guide was inserted into the central part of the affected disc following insertion of the nucleotome. First, the central part of the disc was resected, and then the nucleotome was flexed posteriorly to resect the posterior part of the disc (next to the herniated disc).

Assessment of the operative results

The operative results were evaluated according to *Macnab's* criteria⁴⁾. Excellent means no pain and no restriction of activities. Good means occasional back or leg pain of insufficient severity to interfere with the patient's ability to do his normal work or his capacity to enjoy himself in his leisure hours. Fair means improved functional capacity, but handicapped by intermittent pain of sufficient severity to curtail or modify work or leisure activities. Poor means no improvement or insufficient improvement to enable increase in activities, requiring further operative intervention required. The results were estimated by a doctor who was not involved with the operation.

Results

The clinical results are shown in Table 1. Three patients showed excellent results, one patients showed a good result and two showed poor results. The poor cases required open discectomy because they were dissatisfied with the result of the percutaneous discectomy. The amount of disc material removed varied from 0.6 to 3.7 g. All patients with successful results of percutaneous discectomy were followed between 30 and 47 months postoperatively. We considered the effects of factors including age, level of the affected disc, and amount of disc material removed. There were no significant differences between results due to any of these factors.

In the excellent cases (Cases 1, 2, 3), the intraoperative CT showed that the tip of the nucleotome flexed posteriorly to resect the area near the herniation (Fig. 1b). By comparing the

Table 1. Age, sex operative level, dye pattern on CTD, follow-up, and operative results of the cases.

Case	Age	Sex	Operative level	Dye pattern on CTD	Duration of follow-up (months)	Operative results
1	31	Male	L3-L4	Broad Dye Base	44	Excellent
2	17	Male	L5-S1	Broad Dye Base	45	Excellent
3	39	Male	L3-L4	Broad Dye Base	47	Excellent
4	27	Female	L5-S1	Narrow Dye Base	30	Good
5	17	Male	L4-L5	Narrow Dye Base	—	Poor*
6	15	Male	L5-S1	Narrow Dye Base	—	Poor*

* Subsequent open discectomies were needed in these two poor cases.

preoperative CTD (Fig. 1a), it was confirmed that the nucleotome flexed within the area where the dye had spread. Namely, in cases where preoperative CTD showed disc protrusion with a broad dye base.

On the other hand, in the good and poor cases (Cases 4, 5, 6), the tip of the nucleotome could not flex posteriorly because of strong resistance (Fig. 2b). In these cases, preoperative CTD (Fig. 2a) showed disc protrusion with a narrow dye base. The nucleotome was obstructed by the area where the dye had not spread. The findings following open discectomies (Cases 5, 6) showed that the dye lacking area consisted of a relatively intact annulus fibrosus. It is suggested that the flexion of the nucleotome was obstructed by the relatively healthy annulus fibrosus.

No complications occurred in any of these cases.

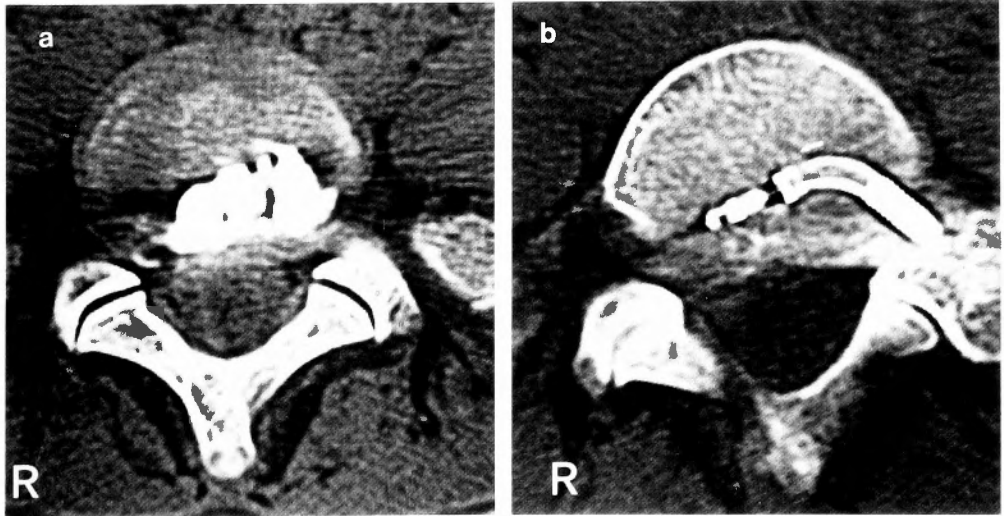


Fig. 1-a, b a; Preoperative CTD of Case 2. A 17-year-old man reported back and right lower leg pain. Conservative therapy before percutaneous discectomy was followed for 2 months. CTD showed disc protrusion with broad dye base at L5-S1. b; Intraoperative CT of Case 2. The tip of the nucleotome flexes posteriorly to resect the area near the herniation. By comparing the preoperative CTD (Fig. 1-a), it was confirmed that the nucleotome flexed within the area where the dye had spread.

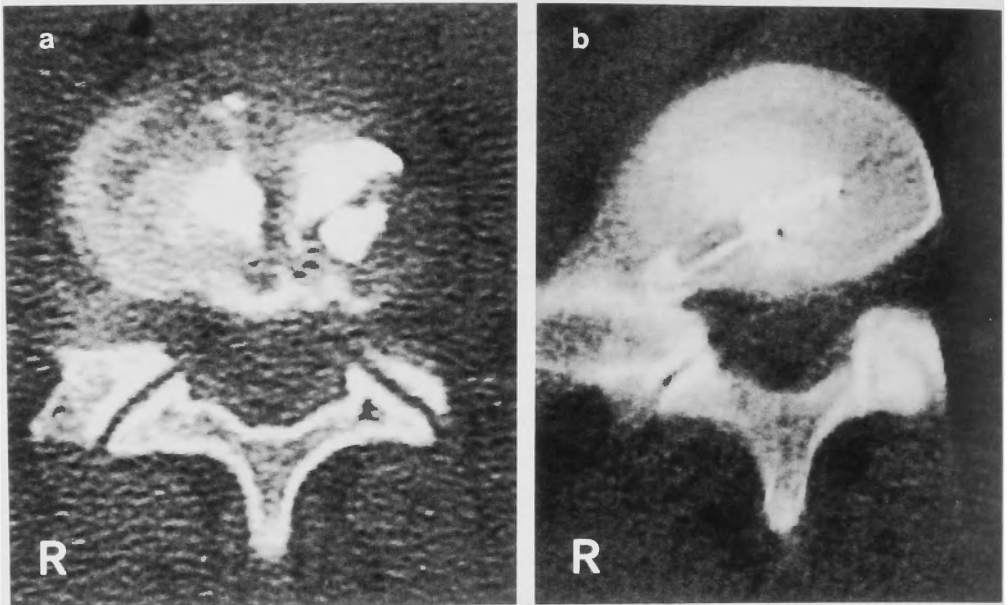


Fig. 2-a, b. a; Preoperative CTD of Case 6. A 15-year-old man reported back and left lower leg pain. Conservative therapy before percutaneous discectomy was followed 4 months. CTD showed disc protrusion with narrow dye base at L5-S1. b; Intraoperative CT of Case 6. The tip of the nucleotome could not flex posteriorly. The nucleotome is obstructed by the area where the dye has not spread in Fig. 2-a.

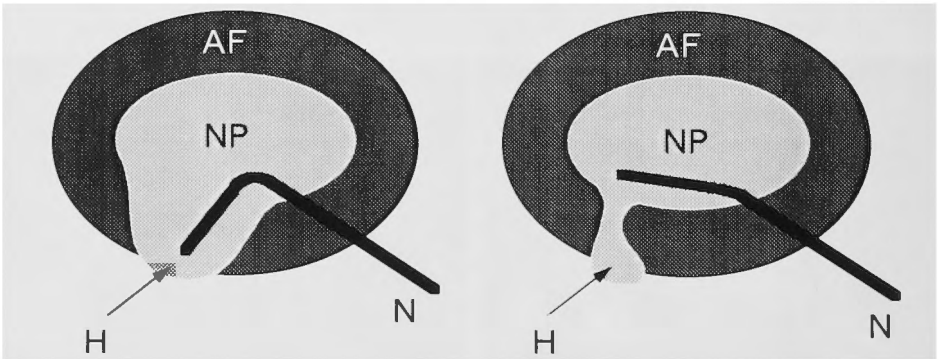


Fig. 3. The schema of the mechanism of the flexion of the Nucleotome Flex II. In the good and poor cases, the relatively intact annulus fibrosus may interfere with the flexion of the nucleotome (Left Figure). On the other hand, in the excellent cases, the nucleotome flex within the area where the dye has spread (Right Figure).: AF=annulus fibrosus; NP=nucleus pulposus; H=Herniated disc; N=Nucleotome

Discussion

*Hijikata*⁵⁾ hypothesized that the mechanism of percutaneous discectomy involves the reduction of the intradiscal pressure and relief of irritation of the nerve root or the pain receptors around the disc. *Murata and Ojima*³⁾ reported that in order to improve the efficacy of the percutaneous discectomy, it

should be carried out at the posterior part of the disc. It was suggested that the depression of the posterior part of the disc is effective to relieve of irritation of the nerve root. In this study, CT findings during the operation showed that the nucleotome flexes enough to resect the area near the herniation in the excellent cases. Although, the number of the cases that we treated was low, our result showed that the depression of the posterior part of the disc leads to an excellent outcome.

But in the good and poor cases, the degree of flexion of the nucleotome was limited in the intraoperative CT. Preoperative CTD and the following open discectomies suggested that the relatively intact annulus fibrosus may interfere with the flexion of the nucleotome (Fig. 3). On the other hand, the nucleotome flexed within the area where the dye had spread in the excellent cases (Fig. 3). This suggests that the nucleotome can resect only the nucleus and the degenerated disc in the area where the dye has spread.

According to the results of this study, patients should be selected by CTD for treatment using the Nucleotome Flex II. As this study was a preliminary one, further studies are being undertaken in our institution.

References

- 1) Onik G, Helms CA: Automated percutaneous lumbar discectomy. *AJR* 156: 531-538, 1991.
- 2) Castro WHM, Jerosch J, Hepp R, Schulitz KP: Restriction of indication for automated percutaneous lumbar discectomy based on computed tomographic discography. *Spine* 17: 1239-1243, 1992.
- 3) Murata M, Ojima T: Method of percutaneous nucleotomy for L4-5 disc herniation (in Japanese). *Cent Jpn J Orthop Traumat* 37: 33-34, 1994.
- 4) Macnab I: Negative disc exploration. An analysis of the causes of nerve-root involvement in sixty-eight patients. *J Bone Joint Surg* 53-A: 891-903, 1971.
- 5) Hijikata S: Percutaneous nucleotomy: A new concept technique and 12 year's experience. *Clin Orthop* 238: 9-23, 1989.

和文抄録

腰椎椎間板ヘルニアに対する CT ガイドのもとでの Nucleotome Flex II による経皮的椎間板摘出術

愛媛大学 整形外科

沖 貞明, 松田 芳郎, 柴田 大法

6例の腰椎椎間板ヘルニアの症例に対して、CT ガイドのもとで Nucleotome Flex II による経皮的椎間板摘出術を施行した。優の成績が得られた症例においては、術中の CT 所見において、nucleotome の先端が椎間板の後方部分（ヘルニアに近い部分）に到達していた。これらの症例では術前の CT 椎間板造影像において、造影剤の充満されている部分の中で nucleotome が屈曲していた。他方、良と不可の症例においては、nucleotome は強い抵抗のため後方へ屈

曲できなかつた。これらの症例の術前の CT 椎間板造影像では、Castro のいう narrow dye base という所見であった。不可の症例では、引き続き open discectomy が行われたが、narrow dye base において認められた造影剤が入りこまない部分は比較的健常な線維輪であった。比較的健常な線維輪が nucleotome の屈曲を妨げ、その結果としてヘルニアに近い椎間板の後方部分が切除されなかつたため、成績が不良となつたと考えられた。