Recapping hemilaminoplasty for spinal surgical disorders using ultrasonic bone curette

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Abstract

Objective: The authors present a novel method of the recapping hemilaminoplasty in a retrospective study of patients with spinal surgical disorders. This report describes the surgical technique and the results of hemilaminoplasty using an ultrasonic bone curette. The aim of this study was to examine the safety and effectiveness of the hemilaminoplasty technique with ultrasonic bone curette.

Methods: Between April 2003 and July 2011, 33 patients with various spinal diseases (17 spinal tumors, 5 dural arteriovenous fistulas, 3 syringomyelia, 2 sacral perineural cysts, and 2 arachnoid cysts) were treated microsurgically by using an ultrasonic bone curette with scalp knife and lightweight handpiece. The ultrasonic bone curette was used for division of lamina. After resection of the lesion, the excised lamina was replaced exactly in situ to its original anatomic position with a titanium plate and screw. Additional fusion technique was not required and the device was easy to handle. All patients were observed both neurologically and radiologically by dynamic plain radiographs and computed tomography (CT) scan.

Results: The operation was performed successfully and there were no instrument-related complications such as dural laceration, nerve root injury, and vessels injury. The mean number of resected and restored lamina was 1.7. CT confirmed primary bone fusion in all patients by 12 months after surgery.

Conclusion: The ultrasonic bone curette is a useful instrument for recapping hemilaminoplasty in various spinal surgeries. This method allows anatomical reconstruction of the excised bone to preserve the posterior surrounding tissues.

Key Words: Recapping hemilaminoplasty, spinal surgery, ultrasonic bone curette

INTRODUCTION

The laminoplasty technique is the most widely used procedure in cervical spinal surgery. Hemilaminoplasty with ultrasonic bone curette SONOPET® (Striker Co. Ltd., Tokyo, Japan) was reported as a bone-cutting device.[3] Since April 2003, we have used an ultrasonic surgical aspirator system, SONOPET® as a novel method of the
recapping hemilaminoplasty that can expose the spinal canal, lateral recess, and foramen. The preservation of the spinous process, lamina, and facet allows the spinal canal to be reconstructed. Here, we discuss the safety and efficacy of ultrasonic bone curette with utilized in spinal surgery.

MATERIALS AND METHODS

Between April 2003 and July 2011, 33 patients with various spinal diseases (17 spinal tumors, 5 dural arteriovenous fistulas, 3 syringomyelia, 2 sacral perineural cysts, and 2 arachnoid cysts) underwent surgeries by the combined use of the ultrasonic bone curette SONOPET® and scalpel blade [Table 1]. They did not need spinal canal enlargement after the intradural procedure was completed. There were 18 men and 15 women with a mean age of 47.1 years (range 4–74 years). The mean follow-up period was 41.0 months (range 7–98 months). Ultrasonic bone curette was used to cut the lamina off for the exposure of the spinal dural sac via a posterior approach. The mean number of resected and restored lamina was 1.7. One-level hemilaminoplasty was performed in 13 patients. Two-level hemilaminoplasty was performed in 17 patients, and three-level hemilaminoplasty was performed in 3 patients. The underlying abnormality was schwannoma in 12 patients, dural arteriovenous fistula in 5 patients, syringomyelia in 3 patients, and intramedullary ependymoma, meningioma, sacral perineural cyst, and arachnoid cyst in 2 patients. We usually selected bilateral recapping laminoplasty for intramedullary tumors to obtain a wider

Table 1: Summary of cases of hemilaminoplasty with an ultrasonic bone curette

| Patient No. | Age (years)/sex | Disease                  | Laminotomy level | No. of laminotomy | Operation Total | Time (min) per lamina |
|-------------|----------------|--------------------------|------------------|-------------------|----------------|----------------------|
| 1           | 60/M           | Syringomyelia            | T12              | 1                 | 341            | 341                  |
| 2           | 39/M           | Dural AVF                | T7               | 1                 | 262            | 262                  |
| 3           | 62/F           | Syringomyelia            | C7, T1          | 2                 | 202            | 101                  |
| 4           | 74/F           | Schwannoma               | T1, T2          | 2                 | 272            | 136                  |
| 5           | 66/F           | Dural AVF                | S1               | 1                 | 166            | 166                  |
| 6           | 66/M           | Intramedullary ependymoma| L1, L2         | 2                 | 314            | 157                  |
| 7           | 42/M           | Schwannoma               | L2, L3          | 2                 | 405            | 203                  |
| 8           | 4/F            | Meningeal cyst           | C3, C4          | 2                 | 254            | 127                  |
| 9           | 32/F           | Thoracic disc hernia     | T12              | 1                 | 232            | 232                  |
| 10          | 25/M           | Schwannoma               | C5, C6          | 2                 | 211            | 106                  |
| 11          | 32/M           | Arachnoid cyst           | T10–T12         | 3                 | 227            | 76                   |
| 12          | 67/F           | Schwannoma               | C7, T1          | 2                 | 201            | 101                  |
| 13          | 30/M           | Intramedullary ependymoma| T12, L1        | 2                 | 300            | 150                  |
| 14          | 43/M           | Schwannoma               | T5               | 1                 | 187            | 187                  |
| 15          | 55/F           | Arachnoid cyst           | L1               | 1                 | 178            | 178                  |
| 16          | 49/M           | Schwannoma               | T12              | 1                 | 284            | 284                  |
| 17          | 48/M           | Dural AVF                | T12              | 1                 | 196            | 196                  |
| 18          | 57/M           | Intradural lipoma        | L1–L3           | 3                 | 344            | 115                  |
| 19          | 37/M           | Schwannoma               | L3, L4          | 2                 | 317            | 159                  |
| 20          | 15/M           | Schwannoma               | C1               | 1                 | 335            | 335                  |
| 21          | 71/F           | Intradural meningioma    | C3–C5           | 3                 | 298            | 100                  |
| 22          | 42/M           | Neurofibroma             | L2, L3          | 2                 | 339            | 170                  |
| 23          | 62/M           | Dural AVF                | T6               | 1                 | 161            | 161                  |
| 24          | 66/F           | Syringomyelia            | T1, T2          | 2                 | 170            | 85                   |
| 25          | 62/M           | Schwannoma               | C2               | 1                 | 199            | 199                  |
| 26          | 56/F           | Sacral perineural cyst   | S1, S2          | 2                 | 172            | 86                   |
| 27          | 38/F           | Schwannoma               | C2, C3          | 2                 | 246            | 123                  |
| 28          | 4/M            | Spinal epidural hematoma | C5, C6          | 2                 | 105            | 53                   |
| 29          | 73/F           | Intradural meningioma    | T10              | 1                 | 228            | 228                  |
| 30          | 74/F           | Schwannoma               | T4, T5          | 2                 | 135            | 68                   |
| 31          | 29/F           | Sacral perineural cyst   | S2               | 1                 | 213            | 213                  |
| 32          | 29/M           | Schwannoma               | L2, L3          | 2                 | 291            | 97                   |
| 33          | 48/F           | Dural AVF                | T12, L1         | 2                 | 244            | 122                  |

Average 1.7 243 162
view compared with extramedullary lesions except in the above two patients. In this study, patients requiring bilateral laminoplasty were excluded. Bone fusion was evaluated by dynamic plane radiographs based on Ray's criteria and by computed tomography (CT) at 3, 6, and 12 months, and then every 12 months to determine the state of the union of the restored lamina.

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Recapping hemilaminoplasty was done safely to obtain an enough wider laminotomy space in 33 patients. The average of the operation time and the operation time per lamina were 243 ± 70.1 and 162 ± 72.5 min, respectively. There were no major complications such as cord injury, root injury, and CSF fistula. Dural laceration did not occur during the manipulation with the ultrasonic bone curette.

Figure 1: Schematic drawings of recapping hemilaminoplasty using ultrasonic bone curette with scalpel blade (axial views). (a) After unilateral separation of the paravertebral muscles, cutting of the lamina just medial to the facet joints and pedicle. (b) Cutting of the lamina obliquely at the base of the spinous process; (c) the intradural procedure can be done; (d) the lamina restored to the original site was fixed with titanium miniplates and screws.

**RESULTS**

Recapping hemilaminoplasty was done safely to obtain an enough wider laminotomy space in 33 patients. The average of the operation time and the operation time per lamina were 243 ± 70.1 and 162 ± 72.5 min, respectively. There were no major complications such as cord injury, root injury, and CSF fistula. Dural laceration did not occur during the manipulation with the ultrasonic bone curette.

Bone CT scans and dynamic X-rays confirmed primary bone fusion in all patients within 12 months after surgery. No signs of spinal column deformity such as kyphosis or sinking of the replaced lamina were noted in any patient during the follow-up period.

**DISCUSSION**

Laminoplasty has been developed to prevent postoperative spinal instability or kyphotic deformity. Laminoplasty might be a useful procedure to decrease postlaminectomy membrane. Several kinds of laminoplasties have been reported by spinal surgeons. These are divided into expansive and nonexpansive methods, depending on the enlargement of the spinal canal after laminoplasty was performed.

We describe a simple method for nonexpansive laminoplasty performed with a scalpel blade type ultrasonic bone curette with scalpel blade. The first report about recapping hemilaminoplasty using the scalpel blade type ultrasonic bone curette was published in 2009. The ultrasonic bone curette is a device for cutting bone with oscillation without rolling movement, which can be applied along the whole spinal regions and cranial base. It has a number of advantages as follows. The SONOPET® is able to scrape and cut the bone tissues without the risk of injuring soft tissues such as the dura and nerve roots or becoming entangled in cottonoids. The width of the scalpel blade type ultrasonic bone curette is thin (0.7 mm) and the tip of the blade is small so that it can be safely inserted into narrow epidural space and cut the lamina off safely as wanted. However, it is important to put cottonoid on the dura mater not to lacerate dura mater and other neural tissue. There were previous reports concerning dural tears while using the SONOPET® in spinal surgery. They also recommend that cottonoid be placed between the ultrasonic bone curette and important structures. An advantage is that it requires only one hand for holding, usually the dominant right hand, but it can also be held with the left hand when absolutely necessary. Another advantage of this method is that the posterior supporting elements such as the supraspinous and interspinous ligament and spinous process can be preserved. Paravertebral muscle from only the affected side needs to be dissected, thus making it less invasive to the soft tissue than conventional laminectomy. With the method we describe, the operative field is wide enough to resect most extramedullary tumors, and
the spinal canal can be reconstructed after intracanal procedure without the need for fusion techniques because the spinous process, lamina, and facet joint are preserved. Additionally, bone loss from cutting lamina can be minimized. All the patients achieved physiological and anatomic reconstruction of the vertebral arch after intracanal procedure. This procedure may be useful in maintaining spinal stability without deformity. In our study, nobody required additional fusion techniques after hemilaminoplasty. There were no CSF leakages during the postoperative course. It is certain that replaced lamina with rigid fixation prevents postoperative CSF leakage from the beginning.

The disadvantages of this method include a somewhat longer operation time during laminotomy as compared with conventional laminectomy, although this did not cause significant complications in the patients we treated. Additionally, we guess it will initially be technically difficult for the beginner to do this procedure. This new method, termed recapping laminoplasty, has several advantages during operation compared with conventional laminoplasty. Therefore, it can be applied widely to various spinal surgeries.

**CONCLUSION**

The ultrasonic bone curette is a useful, safe instrument for recapping hemilaminoplasty while avoiding excessive heat production and mechanical injury. This method provides sufficient exposure for intraspinal canal procedures and allows preservation of posterior spinal elements. This procedure with the ultrasonic bone curette is recommended for various spinal surgeries.

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**REFERENCES**

1. Hadeishi H, Suzuki A, Yasui N, Satou Y. Anterior clinoidectomy and opening of the internal auditory canal using an ultrasonic bone curette. Neurosurgery 2003;52:867-71.
2. Hidaka K, Chiba Y, Takeda H. Clinical application of ultrasonic osteotome for the spinous process-splitting laminoplasty. Spinal Surg (Jpn) 1998;12:19-24.
3. Ito K, Ishizaka S, Sasaki T, Miyahara T, Horiiuchi T, Sakai K, et al. Safe and minimally invasive laminoplasty using an ultrasonic bone curette for spinal surgery: Technical note. Surg Neurol 2009;72:470-5.
4. Kim K, Isu T, Matsumoto R, Isobe M, Kogure K. Surgical pitfalls of an ultrasonic bone curette (SONOPET) in spinal surgery. Neurosurgery 2006;59:390-3.
5. Nakagawa H, Kim S, Mizuno J, Ohara Y, Ito K. Technical advantage of an ultrasonic bone curette in spinal surgery. J Neurosurg Spine 2005;2:431-5.
6. Nakase H, Matsuda R, Shin Y, Park YS, Sakaki T. The use of ultrasonic bone curettes in spinal surgery. Acta Neurochir (Wien) 2006;148:207-13.
7. Sawamura Y, Fukushima T, Terasaka S, Sugi T. Development of a handpiece and probes for a microsurgical ultrasonic aspirator. Neurosurgery 1999;45:1192-6.