Surgical Technique

Bone wax technique for full-endoscopic lumbar laminotomy

Tatsushi Inoue[1,2], Masahiro Joko[1], Fumiaki Saito[3], Jun Muto[1], Hiroki Takeda[2], Shinjiro Kaneko[2], Yuichi Hirose[1]

[1]Department of Neurosurgery, Fujita Health University, Toyoake, Japan; [2]Department of Spine and Spinal Cord Surgery, Fujita Health University, Toyoake, Japan; [3]Section of Fujita Nurse Practitioner, Fujita Health University, Toyoake, Japan

Correspondence to: Tatsushi Inoue, MD, PhD. Department of Neurosurgery and Department of Spine and Spinal Cord Surgery, Fujita Health University, 1-98 Dengakugakubo, Kutsukake-cho, Toyoake 470-1192, Japan. Email: spine_expert@mac.com.

Abstract: Hemostatic procedures in endoscopic spine surgery have not yet been established, especially in full-endoscopic spine surgery (FESS) performed under continuous irrigation, which has been a major concern for surgeons. Chu *et al.* had previously reported a technique to convey bone wax during full-endoscopic cervical spine surgery via intracorporeal route by using ball tip of the drill in 2018. However, to the best of our knowledge, there has been no report by surgeons to adopt bone wax as a hemostatic material in full-endoscopic lumbar surgery to date, probably because of difficulty in handling bone wax under continuous irrigation and through a narrow and long working channel in endoscope. We have renewed the bone wax technique (BWT) for hemostasis in FESS, improving its handling by introducing a nozzle applicator, without which the bone wax would stick to the working channel of the endoscope on the way to the bleeding target. This would result in significant loss of bone wax and repeated bone-wax contact would cause dirt build-up on the endoscope lens, which would then be pushed out from the wall of the working channel, thereby disturbing the laminectomy procedure and obfuscating the visual field. Technical details using nozzle-loaded bone wax have been demonstrated.

Keywords: Bone wax; full-endoscopic spine surgery (FESS); hemostasis

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Introduction

Full-endoscopic spine surgery (FESS) is gaining popularity; however, the control of bleeding is often problematic as it may affect the course of the surgical procedure. Typically, bipolar coagulation, application of thrombin, and other techniques are performed to control bleeding in endoscopy (1). However, they may be insufficient, especially for copious amounts of bleeding from the veins and arteries in the lamina. Under microscopic procedures, bone wax is used to stop the bleeding from the bone structures. However, it is not commonly used in endoscopy because it sticks to the endoscope working channel and lens while being conveyed to the bleeding point. We solved this problem by using a nozzle to deliver the bone wax and a drill to spread it under irrigation control. We present the following article in accordance with the CARE reporting checklist (available at https://jss.amegroups.com/article/view/10.21037/jss-22-64/rc).

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Representative case description

A 72-year-old female patient with L4/5 stenosis presented with right sciatic pain. An endoscopic right-side approach was performed for bilateral decompression. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

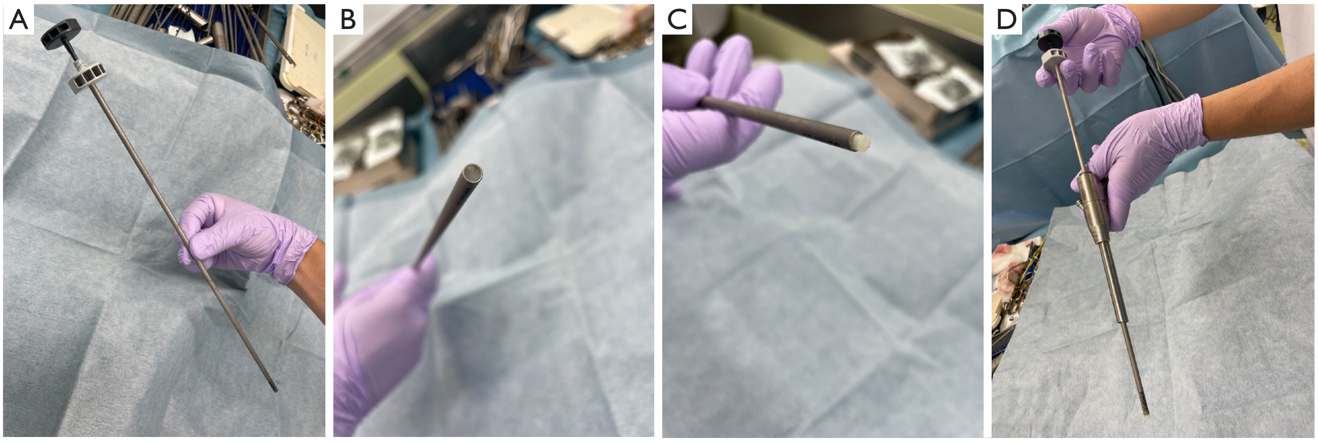

Figure 1 Bone wax applicator. (A) The endoscopic applicator for SURGIFLO® (Ethicon, Inc., Raritan, NJ, USA) was used as a nozzle. (B) The bone wax was loaded and tamped, avoiding leakage from the nozzle. (C) The appropriate amount of wax was ejected by pushing the rod. (D) Handling of the applicator in combination with the endoscope.

Video 1 Handling of bone wax applicator under the endoscope. Scene 1: continuous bleeding from an interosseous vein. Scene 2: the irrigation was stopped to identify the bleeding point. Scene 3: the bone wax was ejected from the nozzle. Scene 4: rotating the shaft, the bone wax was detached. Scene 5: the drill burr was placed on the wax and driven at low speed. Scene 6: irrigation was restarted. Scene 7: the bone wax was spread by the drill burr on and in proximity to the bleeding point. Scene 8: another bleeding (green arrow). Scene 9: additional bone wax was applied. Scene 10: the bone wax was spread widely. Scene 11: the rotating drill head sealed up an interosseous vein effectively.

Step-by-step description of the bone wax technique (BWT)

The BWT performed during FESS for laminotomy is as follows (*Figure 1* and *Video 1*):

(I) Step 1: the bone wax was loaded into the tip of the nozzle, which was 34 cm in length, with an outer diameter of 2 mm (Ethicon). Therefore, the nozzle could be inserted into a 4-mm or larger working channel of the endoscope. Irrigation was stopped to identify the bleeding point. The nozzle was placed over the bleeding point, and the wax was ejected by pushing the rod. The nozzle was removed while rotating the shaft, and the bone wax was detached and left precisely on the target.

(II) Step 2: the drill burr was placed on the wax, and irrigation was restarted to wash the bleeding while the bone wax was held onto the bone. The drill was driven at low speed, spreading bone wax on and around the bleeding point.

Comments

Surgical results

From Feb 2020 to Sep 2022, 121 cases of FESS for laminotomy were performed. In the initial 41 cases, BWT was not applied (non-BWT group). In the next 80 cases, BWT was applied (BWT group). These two groups were compared by χ^2 analysis for sex and the event ratio of dural tear (DT) including a case of non-cerebrospinal fluid leakage with an intact arachnoid membrane. The Student's *t*-test was used to analyze age and operation time. SPSS version 28 (IBM, Armonk, NY, USA) was used for the analysis. The event ratio of DT during surgery was significantly higher in the non-BWT group (29.2%) than in the BWT group (2.5%), although no significant differences

Table 1 Comparison between the non-BWT and BWT groups based on demographic and event ratios on DT

Characteristics	Non-BWT (n=41)	BWT (n=80)	P value
Age (years), mean ± SD	70.6±11.3	72.5±11.3	0.35
Sex: female (%)	30.9	69	0.61
Operation time (min), mean ± SD	173.2±53.4	167.7±62.1	0.62
DT (%)	29.2	2.5	<0.001

BWT, bone wax technique; DT, dural tear; SD, standard deviation.

in age, sex and operation time between the two groups (*Table 1*) were noted. In all cases, preoperative symptoms improved postoperatively.

Surgical nuances of BWT

Hemostatic procedures were described systematically by Hofstetter (1). According to the paper, the bleeding point should be identified, and bipolar cautery was considered most effective when compressing the bleeding vessel with the tip and simultaneously activating coagulation. However, in the case of bone bleeding, bipolar cautery was deemed ineffective. Hofstetter's alternative suggestion was to seal the area of bone bleeding using the diamond burr or by compression with a Kerrison rongeur. If this method failed, he suggested increasing the irrigation pressure and advancing the endoscope toward the bleeding source for better visualization of the bleeder. As a last resource, he proposed the injection of thrombin, followed by applying FLOSEAL (Baxter) into the working channel.

Initially (in the non-BWT group), we followed Hofstetter's hemostatic step-by-step algorithm. However, we noticed that compression using the Kerrison rongeur was unable to cover some bony bleeders, whilst the injection of thrombin stopped the bleeding. However, many blood clots covered the endoscopic surgical view, which slowed down the operation. Therefore, we needed another method to achieve hemostasis. We developed BWT, which can cover various bony bleeding cases, even with issues arising from the use of the bipolar or Kerrison rongeur. We subsequently (in the BWT group) applied BWT to maintain a clean surgical field and DT diminished significantly. Care should be taken when the epidural vein is the origin of bleeding, because it is sometimes indistinguishable from the bone, especially when releasing lateral recess stenosis. In these cases, we used Bemsheets to press around the bleeding and moved to another site. For example, in case of epidural bleeders under the edge of the lateral recess, typically caused by bites with the Kerrison rongeur during the decompression of the contralateral recess (1), we placed Bemsheets on the bleeding area, moved to the approach side, and removed the side of the hypertrophied ligamentum flavum without stopping the operation. After some minutes of those procedures, we returned to the original point of Bemsheets, and removed the Bemsheets when hemostasis was achieved and continued the contralateral decompression.

Chu *et al.* introduced the use of bone wax in endoscopic cervical intracorporeal drilling for discectomy (2). Bone wax was smeared on the endoscopic burr as described in the paper. However, it strongly adhered to the working channel with significant wax loss, and repeated delivery was burdensome.

Our delivery method using a nozzle solved this problem, providing a smooth and significant hemostatic effect, and notably improved the endoscopic surgical view, thereby allowing safe and effective procedures.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at https://jss.amegroups.com/article/view/10.21037/jss-22-64/rc

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jss.amegroups.com/article/view/10.21037/jss-22-64/coif). The authors

have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

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