



Iatrogenic dural tear in endoscopic lumbar spinal surgery: full endoscopic dural suture repair (Youn's technique)

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Abstract

Background With the advancement of minimally invasive spinal surgery, endoscopic lumbar decompression has been widely used for the treatment of degenerative lumbar spinal diseases. Iatrogenic dural tear is a relatively common complication in endoscopic lumbar spinal surgery. The golden standard of treatment for iatrogenic dural tear is immediate open conversion and direct repair under microscopic visualization. Recently, most of endoscopic spinal surgery is performed under local anesthesia. So, conversion to open surgery is very embarrassing situation because of the need of additional general anesthesia. But, direct endoscopic dural repair is very difficult procedure due to the limitation of manipulation. No report showed direct dural suture under full endoscopic situation.

Purpose The purpose of this surgical technique is to provide a method of full endoscopic dural suture repair without conversion to open surgery.

Keywords Full · Endoscopic · Dural repair · Technique · Iatrogenic dural tear

Introduction

Iatrogenic dural tear is a relatively common complication in lumbar spinal surgery. The incidence of iatrogenic dural tears during lumbar decompression surgery varies and ranges from 1 to 17% [1–4]. Direct consequences from a dural tear include headache, meningeal pseudocyst formation, dural cutaneous fistulas leading to arachnoiditis, delayed wound healing and wound infection. Indirect consequences associated with prolonged bed rest that is often required include pneumonia, pressure ulcers, deep vein thrombosis, pulmonary embolism and aspiration. The treatment of iatrogenic dural tear remains challenging, especially in endoscopic spinal surgery. Recently, most of endoscopic spinal surgery is performed under local anesthesia. The golden standard of treatment for iatrogenic dural tear during endoscopic surgery is immediate open conversion and direct repair under microscopic visualization.

However, conversion from endoscopic to open surgery is very embarrassing situation because of the need of additional general anesthesia. Direct endoscopic dural suture repair is very difficult procedure due to the limitation of manipulation. So, there are various sealants for the treatment of dural tear such as fibrin glue, hydrogel, cyanoacrylate, bioabsorbable staples and various types of grafts and patches [5]. But, in most of the cases intraoperative attempt to shielding the defect under endoscopic visualization is ineffective. Moreover, various sealants were associated with complications such as neurotoxicity, allergic reaction, anaphylaxis and transmission of viruses [6]. No reports showed direct dural suture under full endoscopic situation. So, we introduce the novel direct dural suture repair technique under full endoscopic situation without conversion to open surgery.

Surgical technique (Youn's technique)

Initially, dural tear or defect site must be cleaned for the direct dural repair procedure. We attempted to do watertight closure of the dural tear, whenever possible, by using simple interrupted suture with 6–0 prolene thread (round-bodied double-arm needle, Ethicon, Johnson and Johnson, SL, USA). It is difficult to do the primary suture repair

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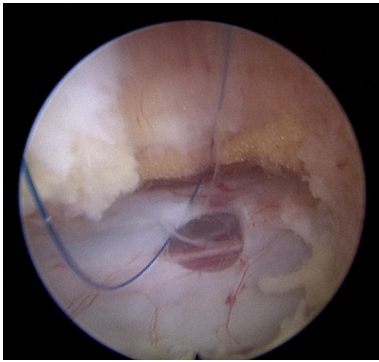


Fig. 1 A double-arm needle

procedure on a dural defect or tear site using only the endoscopic instruments. In particular, the behavior of sewing up both sides of dural membranes at once by manipulation of a suture needle is not easy due to the gap in the dural tear site. Furthermore, if the procedure of sewing up the dural membrane is not properly performed, it can cause punctures by suture needle on the dural membrane, which may lead to problems such as CSF leakage. Attempts to stick through the two dural membranes at one time, especially in uneasy manipulatory situations, are at risk of entrapment of the rootlet. For that reason, the authors used a double-arm needle to pass one needle through one dural membrane (Fig. 1) and then pulled out the two needles through the working channel of the endoscope (Fig. 2). After single knotting of the suture thread at the outside the endoscope, one needle was passed through the hole of the endoscopic currette (Fig. 3) like putting a thread through a needle. Although the authors used an endoscopic currette for pushing a knot, any device that has a hole and can pass through the working channel can be used (Fig. 4). When the endoscopic currette is pushed gently into the working channel (Fig. 5), the knotted thread can be observed in the endoscope. And the currette can be used to tighten the knot by applying a little tension, like a knot pusher used in a shoulder arthroscopic surgery (Fig. 6). At this time, the suture thread is thin and the tissue of the dural membrane is very weak, so too much tension should not be applied to the suture thread. Because the suture thread is very thin, the knot can be pushed into the surgical field with endoscopic vision only by gentle pushing of the instrument. After repeating the same knotting procedures 2–3 times, we can cut the thread using an endoscopic cutter (Fig. 7). Once the first knot is completed, the gap of the dural defect becomes narrower, making it easier to do the rest of the suture. Therefore, we recommend to use a suture thread with double-arm needle for the first suture in the repair process. By using a double-arm needle, we can save operation time and make suture much easier. After the interval of the dural tear site has narrowed, the second needling can be performed

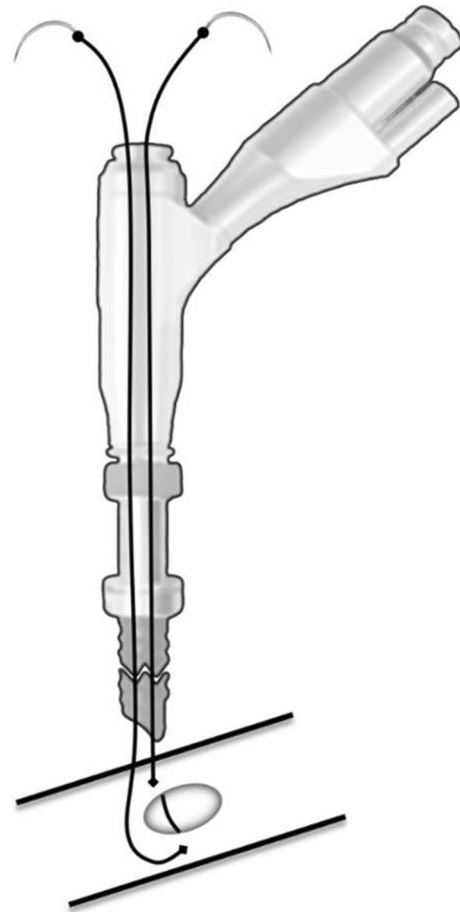


Fig. 2 The two needles were pulled out through the working channel of the endoscope

by passing bilateral membranes at the same time (Fig. 8a, b). After direct dural repair in a full endoscopic guide, endoscopic posterior lumbar decompression was performed as planned (Fig. 9).

Discussion

Endoscopic spinal surgery is considered to be a good way to meet the demands of the current time requiring minimally invasive surgery for the body and has made great progress in recent years. As many spinal endoscopic surgeries are performed, surgical complications are naturally increased. One of the most important complications during the endoscopic spinal surgery is an incidental dural tear. And its treatment remains challenging, especially in endoscopic procedures.

During the open lumbar spinal surgeries, primary dural suture repair is accepted as the gold standard for the management of a dural tear [7]. Some authors believe that it is inevitable to repair the dural tear to prevent the occurrence of a pseudomeningocele or even spinal fluid leak [8, 9].

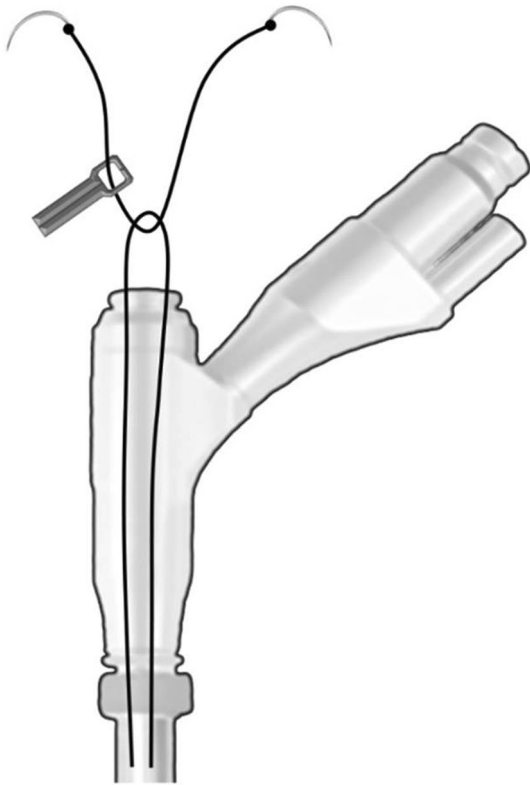


Fig. 3 After single knotting of the suture thread at the outside the endoscope, one needle was passed through the hole of the endoscopic curette



Fig. 4 An endoscopic curette which was used for pushing a knot

Other techniques also have been employed to deal with the occurrence of a dural tear including the use of fat, muscle or facial grafts, use of fibrin glue [10–13].

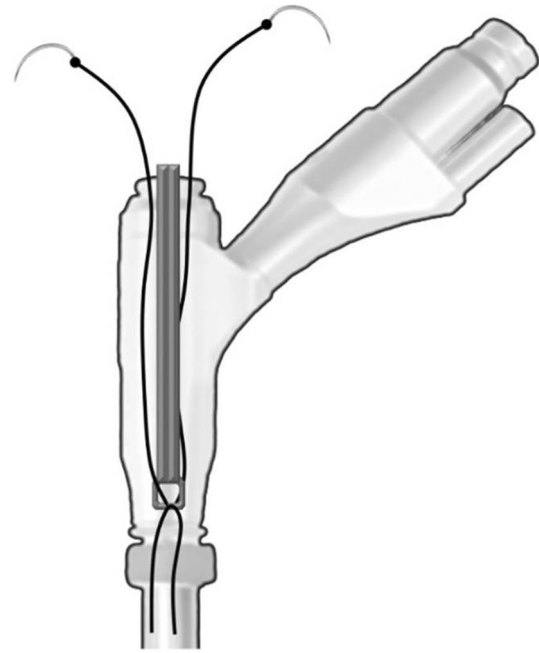


Fig. 5 When the endoscopic curette is pushed gently into the working channel, the knotted thread can be observed in the endoscope

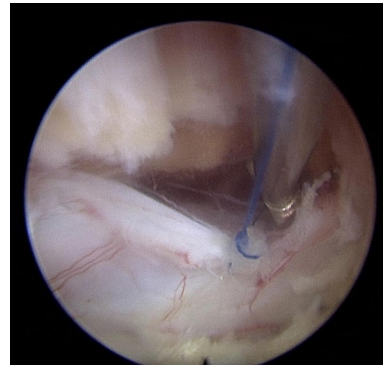


Fig. 6 The curette can be used to tighten the knot by applying a little tension, like a knot pusher

In endoscopic lumbar spinal surgery, direct repair via suturing was impossible due to inaccessible location of dural tear and limited working space. Operating through a small working channel may not allow the manipulation of instruments as accustomed in conventional surgery which could then force the surgeon to convert the procedure to open surgery. There have been several studies on the repair of dural tear using tubular assisted endoscopic procedures, but the study of full endoscopic dural suture repair technique through small working cannula under full endoscopic situation has not been reported yet [14–18].

If a dural tear occurs during spinal endoscopic surgery, the treatment method can be determined according to the

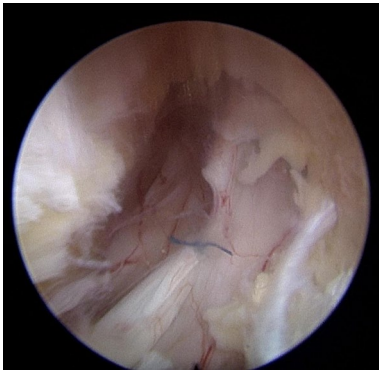


Fig. 7 After repeating the same knotting procedures 2–3 times, we can cut the thread using an endoscopic cutter

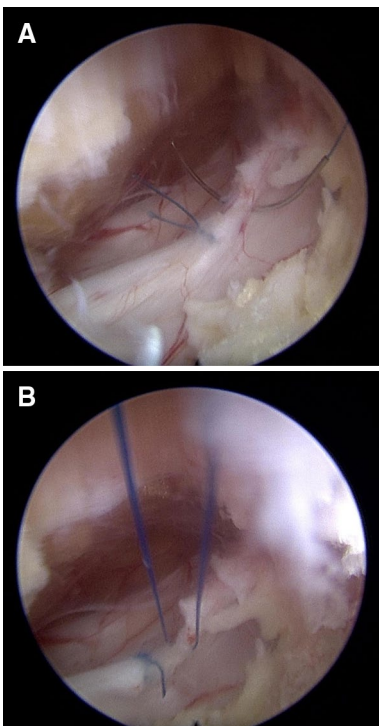


Fig. 8 a, b After the interval of the dural tear site has narrowed, the second needling can be performed by passing bilateral membranes at the same time

size of the tear. If the size of the tear is small, a sealant such as a surgicel collagen matrix or a fibrin glue can be used to seal the hole [19]. However, if the size of the tear is large, primary suture repair is needed. In such cases, the procedure has been carried out by conversion to open spinal surgery [20]. This course of treatment has created an uncomfortable situation for both the patient and the surgeon. Furthermore, because of the high incidence of lumbar spinal endoscopic surgery under local anesthesia in recent years, the sudden conversion to general anesthesia may undermine the rapport

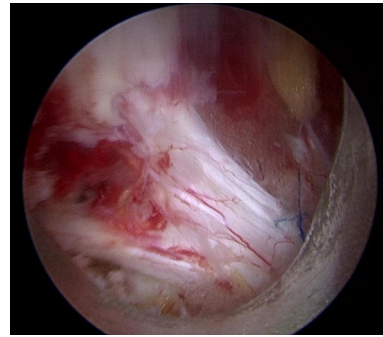


Fig. 9 After direct dural repair in a full endoscopic guide, endoscopic posterior lumbar decompression was performed as planned

between the patient and the surgeon. Therefore, we aimed to introduce primary dural suture repair technique through full endoscopic procedure for dural tear occurred during the endoscopic lumbar spinal surgery under local anesthesia.

In open lumbar spinal surgeries, many surgeons perform primary closure of dural tear with or without the additional fibrin glue [21–23]. Those authors recommend direct suturing of the dural tear, and if a subsequent primary closure is not possible, a muscle patch with or without additional closure aids (e.g., fibrin glue, Spongostan, TachoSil, or Gelform) should be considered [21].

Dural repair without direct suturing is also a well-known technique in conventional spine surgery, and about 80% of spine surgeons reported good experience with this technique [24]. There have been also some reports of dural tear treatment without primary dural suture in endoscopic lumbar spinal surgery [7, 14]. However, such treatments seem to be of value as an alternative to treating dural tear without open conversion surgery. Ahn et al. [20] reported that the intraoperative attempt to repair the defect by shielding materials under the endoscopic visualization was ineffective and the proper management option was immediate open conversion and direct repair under microscopic visualization. We authors also believe that direct repair via suturing is the definite treatment method of dural tear if possible. Furthermore, endoscopic dural suture was possible using only suture thread and basic endoscopic instruments prepared in the operating room without specially designed instruments for the suture procedure through our technique.

Similar to open spinal surgery, dural tears affecting the nerve root sleeve or axilla, or lying anteriorly, present a significant challenge to primary suture repair through the endoscopic technique and, therefore, are often managed without suture repair. Suturing root sleeve may theoretically result in stenosis of the affected root, while another potential risk of suture repair is ‘lassoing’ of the underlying cauda equine roots [7]. However, endoscopic dural suture surgery can provide more detailed view of the border between dura and

nerve roots compared to open spinal surgery, reducing the fatal accidents of tying the dura and nerve root in a bundle.

Reported failure rates for watertight suture repair range from 5 to 9% [10, 25]. The pin holes created by passage of the suture needle may convert a low pressure dural defect to a high pressure defect resulting in persistent leakage and possible accounting for the 5–9% rate of persistent leakage [26–28]. Although we authors believe that watertight suture repair through this full endoscopic technique can produce satisfactory results for dural tears, in cases where CSF leakage due to needles is concerned, an additional sealant such as fibrin glue may be better for the pin holes created by the passage of the suture needle. In addition, even if the size of the defect is too large to achieve watertight repair through a direct suture, dural suturing to reduce the size of the tear and then using ancillary products may increase the healing potential rather than treating the defect with only the sealant.

Conclusion

Endoscopic dural suture repair for dural tear lesion during endoscopic lumbar spinal surgery can be prohibitively difficult. Using Youn's technique, primary endoscopic dural suture repair can be accomplished after dural tear only with basic endoscopic instruments including an endoscopic ring currette and a 6–0 prolene suture.

Compliance with ethical standards

Conflict of interest None of the authors has any potential conflict of interest.

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