A new technique for closure of the dura following transsphenoidal and transclival operations

Technical note

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Wetertight closure of the dura following transsphenoidal operations for pituitary adenoma or hypophysectomy and following transclival operations for paraclival tumors has been technically very difficult. This is true both immediately after the initial approach and later for the treatment of delayed cerebrospinal fluid leakage. An innovative practical technique and special suture-tying instruments and needle designed by the principal author for this purpose have greatly facilitated this procedure. This technique has been applied to both direct dural closure and dural patching with watertight dural closure. The technique is also widely applicable for closing (or suturing) the dura following any procedure through a small opening, such as the dural tears occasionally encountered during lumbar or cervical discectomy, or tacking the tentorium during a craniotomy. The technique and suture-tying instruments are described in detail.

KEY WORDS • dural closure • transsphenoidal approach • transclival approach • cerebrospinal fluid leak • suturing • operative technique

Materials and Methods

The instrumentation includes a knot-tying guide, a needle-holder, a knot-tying forceps, a suture-holding ring, and dural closure suture with an "AG" needle.* Standard suturing instrumentation (which functions best in a horizontal plane) is inadequate for use through a narrow, deep operative field due to the restricted horizontal movement. In this setting, the suture application and tying must be reoriented in a vertical plane. The instruments described here are designed for this application.

The knot-tying guide (Fig. 1A) has a bayonet forceps handle. There is a spiral catch along the shaft approximately 5 cm above the tip. This catch is used for holding a loop applied to one end of the suture. The needle-holder (Fig. 1B) resembles a pituitary rongeur with jaws designed for holding a needle. The shaft is 15 cm long in order to reach the depths of a deep operative field.

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The suture needle is short (7 mm) with a tapered point, generally straight but with a slightly angled tip. The holding surfaces of the needle are flat to prevent rotation of the needle during passage. The suture is double-arm 5-0 Nurolon, 24 in. in length.

**Technique**

The bone opening during transsphenoidal and transclival procedures should be performed with subsequent dural closure in mind and should extend beyond the anticipated dural opening to the degree that permits careful suture placement. In addition, the dural opening should be precise to avoid torn margins and coagulation should be avoided if direct closure is anticipated. Approaches resulting in dural gaps can be repaired primarily with a patch graft of the appropriate size and dimensions.

**Patch-Graft Closure**

**Needle-Passing Technique.** The needle is oriented in the needle-holder such that the tip of the needle is almost parallel with the shaft of the needle-holder, pointing back toward the surgeon (Fig. 2A). This permits suturing in a vertical direction as the needle is passed beyond the dural margin, and the dural edge is penetrated from below as the needle-holder is slightly withdrawn. The needle is retrieved from the dural edge again in a vertical direction (Fig. 2B).

![Fig. 1. Drawings showing the knot-tying guide (A), the needle-holder (B), and the knot-tying forceps (C).](image)

![Fig. 2. Drawings to illustrate the needle-passing technique. For a description of steps A to F see text. The numbers indicate the order in which sutures should be placed.](image)

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The outer surface of the superficially accessible patch-graft is pierced through and through with a second needle (double-arm) (Fig. 2C and D). Successive sutures are applied along the dural and patch-graft edges, individually tagged, and placed over the suture-holding ring (Fig. 2E). When all are in place, the sutures are held in tension and the patch-graft is pushed down along them into position. The final position of the patch-graft and dural margin demonstrating the patch beneath the dura (subdural patch) for a more watertight closure is shown in Fig. 2F.

Knot-Tying Technique. A loop is placed at the end of one strand and two slipknots are applied (Fig. 3A). The loop is placed in the spiral catch of the knot-tying guide and the foot-plate of the guide is then used to successively position the slipknots by pushing them along the other strand which is held in constant tension (Fig. 3B). In order to optimize knot placement and tightening, the initial distance between the two knots should be approximately 10 mm, and the distance between the second knot and the footplate should be less than 5 mm. In some circumstances, it may be necessary to apply tension to the attached strand with the footplate to tighten the second knot (Fig. 3C). When both knots are secured, the strand attached to the spiral catch is cut with microscissors (Fig. 3D). To add the third knot, a loop is placed around the angled tips of the knot-tying forceps, outside the speculum, and slid into the wound along the strand held in tension by continuous pulling (Fig. 3E). The tip of the free strand is grasped and pulled through the loop to complete the knot (Fig. 3F).

Direct Closure

The suture retraction technique is illustrated in Fig. 4. The needle is passed through each free dural edge (Fig. 4A and B) and the center loop of the suture is retrieved and tagged to each free end for dural retraction during the procedure (Fig. 4C). At the conclusion of the procedure, the center loop is released and the free ends of the suture are tightened to approximate the dural margins (Fig. 4D). Knots can then be applied as previously described to complete the closure.

In some direct closures, a gap may be left between the dural margins. To close this defect, a small piece of muscle can be trapped between the suture strands and secured with tying. Figures 5 and 6 demonstrate actual patch-graft closure of the dura following transsphenoidal and transclival exposures, respectively. Figure 7 demonstrates direct closure of the dura during lumbar microdiscectomy.

Comment

It is possible to obtain a watertight dural closure in many microsurgical operations performed through a small hole and/or into a narrow, deep surgical field using the instruments and techniques described. These techniques can be utilized for both dural retraction and primary dural closure during transsphenoidal and transclival operations. In addition, intentional or inadvertent dural openings during spinal microsurgical approaches can be easily closed. Either direct closure (when dural edges can be approximated) or patch-graft
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FIG. 5. Photographs showing closure of the dura following a transsphenoidal exposure in a cadaver: dural opening (A); patch-graft closure (B).

FIG. 6. Photographs showing closure of the dura following a transclival exposure in a cadaver: dural opening (A); patch-graft closure (B).

FIG. 7. Photographs showing closure of the dura during a microdisectomy exposure in a cadaver: dural tear (A); dural closure (B).
closure can be used to achieve a watertight closure. In our experience, due to the loss of dura during transsphenoidal operations it is usually necessary to perform the patch-graft technique rather than a direct closure. These techniques can also be applied during a secondary closure procedure following development of a postoperative CSF leak.

These techniques eliminate total dependence on fascia lata, fat, muscle, and surgical and cartilage packs; the use of tissue adhesives; and the application of lumbar puncture and/or lumbar drainage for the prevention and treatment of CSF leaks following transsphenoidal and transclival operations. While simple and easy to learn, as with most new neurosurgical procedures, these techniques require practice in the laboratory setting before clinical application.

References


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