Repair of Lumbar Dural Tears With a Suture Patch: Retrospective Single-Surgeon Case Series

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Abstract

Dural tears traditionally have been treated with repair and then flat bed rest of variable duration. We conducted a study to evaluate the outcome of treating dural tears with a suture patch and immediate mobilization. Fifty patients (28 male, 22 female) had a lumbar dural tear repaired with suture patch and immediate mobilization. Mean age was 58.9 years (range, 31-81 years). Medical records were reviewed to determine the rate of signs and symptoms: headache, photophobia, tinnitus, neck pain, incisional fluctuance, wound drainage, and return to operating room.

No patients reported postoperative headache, photophobia, tinnitus, or neck pain. No patients developed wound fluctuance or drainage. One patient was treated medically for a superficial wound infection. No patients required return to the operating room.

Dural repair with suture patch appears to be effective and allows early mobilization.

Dural tears are a relatively common occurrence during spinal surgery, with an incidence of up to 13.7% among lumbar spinal procedures.[1-4] The risk for dural tears may be increased by certain factors, including revision surgery, synovial cysts, bone-forming conditions, and use of high-speed drills.[5-8] Dural tears may lead to postoperative complications, including headache, nausea, vomiting, neck pain, back pain, dizziness, diplopia, photophobia, tinnitus, blurred vision, meningitis, subdural hematoma, wound swelling, wound drainage, and wound infection.[7-10] The symptoms experienced by patients after dural tears are thought to result from either the direct effects of cerebrospinal fluid (CSF) leakage or the loss of CSF dynamics within the brain.[10] To reduce the risk for postoperative symptoms, surgeons traditionally have recommended flat bed rest after repair of a dural tear.[2,7,11-15] Flat bed rest is thought to reduce hydrostatic pressure at the site of the tear and promote healing while minimizing symptoms, such as headache.[7,10,14,16] Unfortunately, prolonged bed rest is inconvenient for patients and increases the risk of thromboembolism, pulmonary dysfunction, and other complications.

Since 2006, the first author (DGA) has been using a dural repair technique that incorporates a suture patch to the repair site and immediate postoperative mobilization. Compared with suture repair alone, this technique appears to provide more secure repair of dural tears.

In the study reported here, we retrospectively reviewed the outcomes of 50 consecutive patients who sustained a dural tear during lumbar surgery and were treated with suture patch repair and early mobilization.

Materials and Methods

After obtaining institutional review board approval, we searched a prospectively maintained database for all patients who had sustained a dural tear during lumbar surgery between 2006 and 2010. Patients with intradural pathology requiring durotomy and patients with a traumatic dural tear (secondary to a spinal fracture) were excluded. Meeting the inclusion criteria were 1289 patients. Of these, 56 (4%) sustained a dural tear repaired using the study technique and met the overall inclusion and exclusion criteria for the study. Each patient's inpatient and outpatient medical records were obtained and carefully reviewed. Patients were excluded if they lacked sufficient follow-up to define the outcome of the dural tear for at least 6 months after surgery. Fifty patients met the inclusion criteria and had sufficient follow-up data to be included in this study. From the medical records, demographic and surgical data were collected, including age, sex, preoperative diagnosis, type of surgery, levels of surgery, length of surgery in minutes, surgical blood loss (mL), and length of hospitalization in days. Each patient's records were also carefully reviewed for any symptoms (headache, photophobia, tinnitus, neck pain, neck stiffness) and any signs of wound fluctuance or wound drainage. We also sought any return to the operating room after the index procedure. This research was conducted by a full-time, independent spine research physician.

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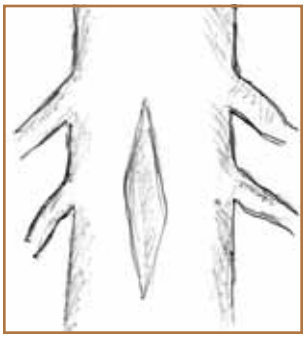

Figure 1. Dural defect is identified.

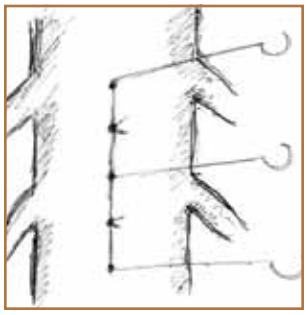

Figure 2. Defect repair leaves uncut stitches at end and in middle of tear.

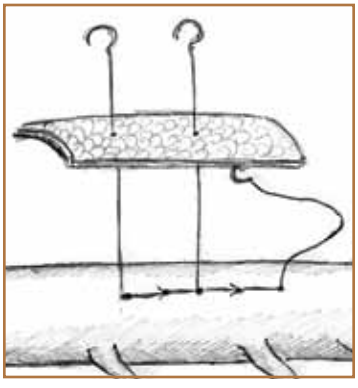

Figure 3. Uncut sutures pass through collagen matrix and fat graft in alignment complementary to position of suture in dural tear.

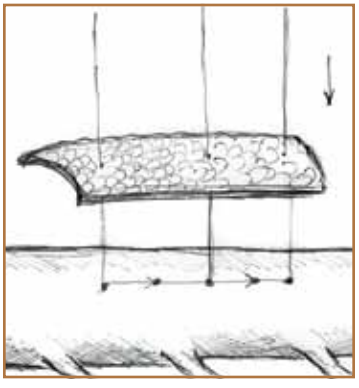

Figure 4. Collagen matrix and fat graft push down along uncut sutures (held upward).

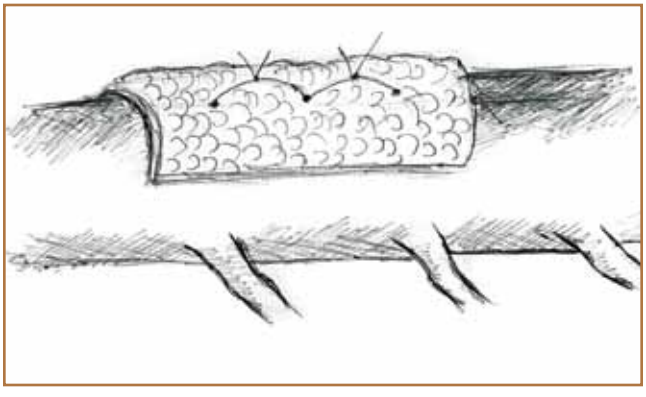

Figure 5. Suture patch secured in place.

Surgical Technique for Dural Repair With a Suture Patch

After recognition of the dural tear, the surgeon plugs the site with a cottonoid patty. Next, double-armed 6-0 GORTEX Suture (WL Gore & Associates Inc, Flagstaff, Arizona) is used to repair the tear using simple interrupted stitches. The stitches are placed 3 to 4 mm apart over the length of the tear. For short tears (<1 cm), the sutures in the middle portion of the tear are cut, leaving them uncut at the end of the tear and with the needles attached. For longer tears, the end sutures are again left uncut, but 1 or more of the middle sutures are also left uncut, such that there is an uncut suture at least every 1 cm along the length of the repair (**Figures 1, 2**). For minimally invasive surgery cases, we use the technique of Chou and colleagues[17] to achieve the same suture strategy as described. Next, collagen matrix (DuraGen Plus; Integra LifeSciences Corp, Plainsboro, New Jersey) is cut longer than the tear by about 1 cm, and wide enough to overlap all portions of the tear by 5 mm. A fat graft is harvested from the subcutaneous fat and cut at a length similar to that of the collagen matrix. The uncut sutures are then passed through the collagen matrix and then through the fat graft in an alignment that complements the position of the suture in the dural repair (**Figure 3**). The sutures are then held gently upward while the collagen matrix and fat graft are pushed down the sutures to rest directly against the dural repair (**Figure 4**). The sutures are then tied over the fat graft and collagen matrix to secure the suture patch in place (**Figure 5**). When the repair is finished, the anesthesiologist provides a sustained Valsalva maneuver of 40 cm of water for 5 to 10 seconds, and the site is examined for any evidence of CSF leakage. After the absence of CSF leakage is confirmed, the wound is closed in routine fashion. A subfascial suction drain is routinely used in patients having lumbar fusion or multilevel laminectomy. No drains are used in patients having microdiscectomy or single-level laminectomy. After surgery, we encourage all patients to walk the day of surgery and prescribe routine postoperative care for the type of surgery performed.

Results

Fifty (28 male, 22 female) patients met the inclusion and exclusion criteria for the study. Mean age was 58.9 years (range, 31-81 years). Preoperative diagnoses (**Table I**) included adjacent segment degeneration (2 cases), degenerative scoliosis (2), degenerative spondylolisthesis (11), degenerative spondylolisthesis with scoliosis (2), herniated nucleus pulposus (14), herniated nucleus pulposus with cauda equina syndrome (1), recurrent disk herniation (9), and lumbar spinal stenosis (9). Known risk factors for a dural tear were present in 19 patients (38%) and included history of prior surgery at the operative levels (17 patients, 34%) and synovial cysts (2 patients, 4%). Overall, 35 patients had surgery using an open, midline approach, and 15 patients had surgery using a minimally invasive approach (paramedian incision with tubular retractor). The operative variables and surgical approaches are listed in **Table II**.

During the follow-up period, no patients complained of headache, photophobia, tinnitus, or neck pain and neck stiffness. No patients had wound fluctuance or drainage at the incisional site. One patient presented with wound redness 7 days after surgery, was diagnosed with a superficial wound

Table I. Patient Sex and Preoperative Diagnoses

	Patients	%
Male	28	56
Female	22	44
Preoperative Diagnosis		
Adjacent segment degeneration	2	4
Degenerative scoliosis	2	4
Degenerative spondylolisthesis	11	22
Degenerative spondylolisthesis with scoliosis	2	4
Herniated nucleus pulpous (HNP)	14	28
HNP with cauda equina syndrome	1	2
Recurrent disk herniation	9	18
Lumbar spinal stenosis	9	18

Table II. Operative Data

Variable	Mean	Range
Blood loss, mL	128	10-700
Operative time, min	106	45-225
Hospital stay, d	1.5	1-7
Approach	**Cases**	**%**
Open	27	54
Minimally invasive	23	46

infection, and was treated with a 10-day course of oral cephalexin, which resolved the wound redness. No patients required a return to the operating room during the follow-up period.

Discussion

Dural tears can be minimized through careful surgical technique but cannot be eliminated when performing spinal surgery. Therefore, surgeons must be capable of managing dural tears and minimizing the risk for postoperative complications. Potential complications from unsuccessfully managed dural tears include headaches, nausea, neck pain, dizziness, diplopia, photophobia, tinnitus, blurred vision, meningitis, subdural hematoma, subcutaneous fluid collections, wound breakdown or drainage, and surgical site infection.[7,9] Fortunately, with successful management, dural tears have no long-term effect on outcome.[1,7,9,14,15]

One difficulty in managing dural tears is their variability. Location, size, tissue quality, presence of adhesions, and repair technique may affect the quality of the repair. Some authors have suggested that the surgeon must analyze these factors on a case-by-case basis to determine length of postoperative bed rest required.[7] A disadvantage of this approach is the subjective nature of these features and the lack of reliability in communicating or teaching this approach to others. Some have suggested that all patients should undergo bed rest after a dural tear, regardless of the nature of the tear or repair.[7,11-13] The length of bed rest used in studies has differed widely, making a standard treatment approach difficult to define. Unfortunately, bed rest has its risks, including thromboembolic disease, pulmonary dysfunction, and loss of psychological well-being. Hodges and colleagues[10] recognized the benefits of early mobilization in their retrospective report of 20 patients treated with direct suture repair and fibrin glue for 1- to 3-mm dural tears. All patients in the series were allowed early mobilization. Although 75% of them did well with this approach, 25% exhibited symptoms of the dural tear after surgery. These symptoms included headaches (2 patients), nausea (2), tinnitus (1), and revision surgery (1).[10]

There is no well-accepted classification scheme for dural tears, which may vary from tiny pinholes to major lacerations with exposure of multiple nerve rootlets.[15,18] Cain and colleagues[19] conducted a study in which adult beagles had a 2-mm defect repaired with suture alone or suture augmented with a fibrin sealant. Simple suture repair was found to leak at pressures close to the physiologic range, whereas fibrin sealant was found to enhance the resistance to CSF leakage. In a follow-up study, Cain and colleagues[16] studied the histomorphologic sequence of dural healing using the same animal model and found that fibroblastic bridging of the defect was not achieved until day 6, and the defect was not ablated until day 10. Together, these studies support the notion that augmentation of simple suture repair is warranted for dural repair when the patient is to undergo early mobilization.

Dural tear treatment recommendations have differed.[7,9,10,15,17,20] Chou and colleagues[17] suggested that primary closure may not be necessary for a small tear during minimally invasive microdiscectomy. By contrast, Eismont and colleagues[9] advocated careful and complete closure of all dural tears by direct suture repair when possible or with fascial grafts or tissue plugs. Khan and colleagues[14] reviewed a large series of degenerative lumbar procedures and found the rate of dural tears to be 7.6% during primary surgery and 15.9% during revision lumbar surgery. Patients were managed with primary suture closure and a short course of bed rest. In 6 (1.8%) of 338 cases, the initial treatment failed, and return to the operating room for additional surgery was required. Nevertheless, others have observed that, even with tight suture closure, the spaces between sutures and even the needle holes may weep CSF, which may account for a 5% to 10% failure rate in multiple studies.[1,10,19-23] Narotam and colleagues[20] studied the DuraGen collagen matrix, which was applied after suture repair of dural defects for various clinical indications. This approach had a failure rate of 4.3% of 69 incidental dural tears.[20] Use of a graft over the site of a dural repair is not new; it was advocated by Mayfield and Kurokawa[24] as early as 1975. They described the technique of obtaining a watertight closure of dura mater, which was then covered with a fat graft to enhance the repair. Others have more recently described a suture patch technique using fat graft to enhance dural repair,[15] similar to ours.

Conclusion

In this article, we have summarized the demographics, surgical variables, and outcomes of repair of dural tears with a suture patch and early postoperative mobilization. This retrospective study showed that our technique was successful in all patients, as there were no complaints of headaches or other signs of CSF leakage, and no patients required return to the operating room for revision of the repair site. This technique may be considered by surgeons seeking a dural repair strategy that allows early and reliable postoperative mobilization of the patient.

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