Cerebrospinal fluid leaks following spinal or posterior fossa surgery: use of fat grafts for prevention and repair

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Cerebrospinal fluid (CSF) leaks are relatively common following spinal or posterior fossa surgery. A midline dural tear in the spine is readily repaired by direct application of a suture. However, far-lateral or ventral dural tears are problematic. Fat is an ideal sealant because it is impermeable to water. In this paper the author reports his experience with using fat grafts for the prevention or repair of CSF leaks and proposes a technique in which a large sheet of fat, harvested from the patient’s subcutaneous layer, is used to cover not only the dural tear(s) but all of the exposed dura and is tucked into the lateral recess. This procedure prevents CSF from seeping around the fat, which may be tacked to the dura with a few sutures. Fibrin glue is spread on the surface of the fat and is further covered with Surgicel or Gelfoam. For ventral dural tears (associated with procedures in which disc material is excised), fat is packed into the disc space to seal off the ventral dural leak. Leaks in the posterior fossa are managed similarly to those in the spine. Dural suture lines, following suboccipital or spinal intradural exploration, are prophylactically protected from CSF leakage in the same manner. With one exception, 27 dural tears noted during 1650 spinal procedures were successfully repaired using this technique. There was one case of postoperative CSF leakage in 150 cases in which intradural exploration for tumor or other lesions was undertaken. Both postoperative CSF leaks were controlled by applying additional skin sutures. The use of a fat graft is recommended as a rapid, effective means of prevention and repair of CSF leaks following posterior fossa and spinal surgery.

Key Words • cerebrospinal fluid • dura matter • fat graft • fibrin glue • Gelfoam • Surgicel

Cerebrospinal fluid leaks are a relatively common occurrence following spinal or posterior fossa surgery. Leakage may occur at the dural suture line postoperatively or is caused by inadvertent dural tears during extradural spinal approaches for disc surgery or decompresive laminectomy. Postoperative CSF leak after surgery in the cerebellopontine angle has been reported to occur in 17.6% of cases. Cerebrospinal fluid leakage poses a risk of significant morbidity with the potential for meningitis, as well as the late development of pseudomeningocele. Management often consists of insertion of a spinal fluid drain, and administration of prophylactic or therapeutic antibiotics. In cases of persistent CSF leakage, surgical reexploration may become necessary.

In this paper, experience with the use of fat grafts for both the prevention and repair of spinal or suboccipital dural leak is reported. The techniques proposed by the author represent an extension of the observations made by Mayfield, who demonstrated that autologous fat transplants serve as an excellent water sealant, prevent scar formation, and do not adhere to the neural elements; the fat survives for a long time and becomes revascularized. For dural tears in the lumbar region, Mayfield recommended inserting a fat “plug” in each dural defect. This technique involved a separate incision made in the normal dura adjacent to the dural tear to pass a suture attached to the plug of fat, which is then pulled into the dural tear. A few sutures may be placed to secure the fat plug to the surrounding dura. The surgical opening adjacent to the dural tear is then approximated with sutures. Both postoperative CSF leaks were controlled by applying additional skin sutures. The use of a fat graft is recommended as a rapid, effective means of prevention and repair of CSF leaks following posterior fossa and spinal surgery.

Abbreviation used in this paper: CSF = cerebrospinal fluid.
OPERATIVE TECHNIQUES
Development of Technique
In the course of clinical practice, the author has observed, in agreement with Mayfield, that fat can be used effectively in sealing CFS leaks. However, a departure from Mayfield’s insertion of a “fat plug” into the dural defect is the modification proposed here: application of a broad sheet of autologous fat over the dura is simpler, safer, and at least equally effective. Application of a small-sized fat patch overlying the dural defect has generally failed to provide a satisfactory seal. A large-sized sheet of fat is used to cover not only the dural tear(s) but all of the exposed dura. The pad of fat is tucked into the lateral recess, thereby preventing CSF from seeping around the fat, which is applied loosely on the surface of the dura or may be tacked to the dura with a few sutures. Fibrin glue is generally spread on the surface of the fat and this is further covered with Surgicel (Johnson & Johnson Patient Care, New Brunswick, NJ) or Gelfoam.

Following is a description of the fat graft technique as applied to various spinal and suboccipital surgical situations.

Repair of Lateral Spinal Dural Tears
A midline dural tear can be repaired by applying direct sutures because the defect is easily approached (Fig. 1). However, far-lateral tears pose a technically difficult problem for placement of sutures because these sites are inaccessible (Fig 1). In addition, far-lateral tears that are close to a nerve root are potentially dangerous because the suture may impale neural fascicles or cause traction or scarring of the nerve root.

The fat graft, which is made approximately 6 mm thick, is harvested from the patient’s subcutaneous fat layer at the surgical site (Fig. 2). To minimize cosmetic deformity of the skin, the graft is obtained from the deepest portion of the fat layer immediately superficial to the fascia. The graft should be of sufficient size to cover the entire exposed dural surface area. Ideally, the fat pad is prepared in one piece to assure a watertight seal. The surface area of the graft may be enlarged by splitting the harvested fat as an “open book” (Fig. 2). The portion of the graft that is tucked into the lateral recess may need to be thinned to avoid compression of the dural sac or nerve roots.

In an unusually thin patient there may not be adequate subcutaneous fat for harvesting, in which case the fat may be obtained from the lateral thigh. In such patients, if the need for fat is anticipated preoperatively, a fat graft may be harvested from the abdominal wall.

The drawing in Fig. 3 left shows a large fat graft placed over the entire exposed dura, including the dural tear(s). Fibrin glue is spread over the fat, and particular attention is paid to the interface between the fat and the surrounding bone. A sheet of Surgicel or Gelfoam is then applied and, in a manner similar to the fat graft, is tucked beneath the bone margins to help keep the fat from floating off (Fig. 3 right). An additional option, intended to keep the fat pad directly applied to the dural surface, is to suture the undersurface of the fat graft to the outer layer of the dura with several No. 6-0 nonabsorbable sutures.

Repair of Ventral Spinal Dural Tears
For ventral dural tears that occur during disc excision procedures, a large fat graft is packed loosely to fill the disc space (Fig. 4). If sufficient fat is not available to fill the entire disc space, the deep part of the disc space may be packed with Gelfoam to serve as “filler,” and that portion of the space close to the dura is filled with fat to achieve a water-tight seal of the dural leak. A separate sheet of fat is placed over the posterior aspect of the exposed dura (Fig. 5). The posterior fat, combined with the ventral fat graft, creates a circumferential ring of fat surrounding the dural sac to prevent CSF from tracking along unsealed pathways.

Reinforcement of Spinal Dural Suture Lines
Figure 6 left illustrates the dural approximation following an intradural operative procedure. As shown in Figure 6 center, preventive measures are taken to minimize postoperative CSF leakage. As in the case of repairing a leak,
a large fat graft is applied over the entire exposed dura mater. A few No. 6-0 sutures may be used to tack the undersurface of the fat pad to the outer layer of the dura. Fibrin glue is spread over the fat, and a sheet of Surgicel or Gelfoam is then applied and tucked under the bone edges (Fig. 6 right).

**Repair of Suboccipital Dural Leaks**

Figure 7 left shows a dural defect in the suture line following suboccipital surgery. For repair of the leak, a large “pancake” fat graft is applied (Fig. 7 center). The fat is harvested, if possible, from the subcutaneous layer in the upper posterior cervical region or from the lateral thigh or abdominal wall. To secure the fat graft to the dura, four or more No. 6-0 nonabsorbable sutures are placed loosely in the undersurface of the graft and in the outer layer of the dura, after which all sutures are tied (Fig. 7 center). The fat graft, including the interface with the bone edges, is coated with fibrin glue, and the construct is further reinforced with a sheet of Surgicel or Gelfoam (Fig. 7 right).

**Summary of Operative Cases**

In 1650 spinal procedures, 27 dural tears noted intraoperatively were repaired during the procedure by using the fat graft techniques described previously. There was one case of postoperative CSF leak that was readily controlled by placement of additional skin sutures. There were 150 cases of intradural exploration for tumor or other suboccipital or spinal lesions; in these cases the dural suture line was prophylactically reinforced with fat grafts, fibrin glue, and Surgicel or Gelfoam. Postoperative CSF leak occurred in one case following these 150 intradural explorations, and this was successfully managed by placement of additional skin sutures. No spinal drains or postoperative antibiotics were used in any of the patients in this series.

**DISCUSSION**

The development of the techniques proposed here is based on the observations described by Mayfield1 in which he noted that fat is an ideal tissue to seal CSF leaks. There are two advantages to the use of fat grafts: they are impervious to water, and they cause relatively little scarring. The techniques described in this paper are applicable to a variety of operative situations, for both prevention and repair of CSF leaks. The results, thus far, appear promising.

The use of fibrin glue alone may be viewed as being adequate and the use of fat as unnecessary. Experimental evidence obtained in a model of rat CSF rhinorrhea, how-
ever, has shown that a muscle patch combined with fibrin glue provides superior results compared with those found using either material alone in sealing CSF leaks.

The technique of harvesting and applying fat grafts is fairly simple, although it must be performed meticulously to be effective. In terms of avoiding potentially serious procedure-related complications and prolonging hospitalization, cost–benefit considerations favor the added measure of combining fat grafts, fibrin glue, and Surgicel or Gelfoam. Suturing of the fat graft to the dura is an additional option.

On the basis of these findings, the use of autologous fat transplants is recommended as a rapid, effective means for repair of dural tears or defects that are inaccessible or unsuitable for standard suture technique. Furthermore, the techniques presented here are also applicable for reinforcement of suboccipital and spinal dural suture lines.

References


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