Comparison of Different Wound Closure Techniques in Translabyrinthine Acoustic Neuroma Surgery

ABSTRACT—In a series of 277 patients with translabyrinthine acoustic neuroma, three techniques of wound closure were used to prevent cerebrospinal fluid (CSF) leakage. In the first group, we used a piece of fascia to cover the dural defect and then placed several pieces of fat on the fascia. The incidence of CSF leak was 28.2%; 7.7% required reoperation. In the second group, in addition to the fascia-fat complex, we made a large musculoperiosteal flap to compress the fat. The incidence of CSF leak and revision were not reduced, however. In recent cases, we placed several pieces of fat directly into the operative cavity without fascia graft; then it was covered with a musculoperiosteal flap. With this technique, CSF leak was significantly reduced to 7.4%, and reoperation was rare (3.7%). The direct application of fat into the translabyrinthine operation cavity appears to be effective to prevent CSF leaks.

CSF leakage is still one of the most common complications in translabyrinthine acoustic neuroma surgery. It has been reported to occur in 11 to 30% of cases.^{1,2} Postoperative CSF leak usually predisposes to the occurrence of meningitis, which can lead to serious neurological sequelae. Although many factors may play a role in the development of this problem, the technique of wound closure is one of the most important. We report here our attempts to prevent CSF leak through different methods of wound closure.

MATERIALS AND METHODS

This study consisted of 277 patients with acoustic neuroma operated on via the translabyrinthine approach

from 1987 to 1998. All tumors are classified into four stages according to their size. At stage I, the neuroma is confined to the internal auditory meatus; at stage II, it is less than 2 cm in the cerebellopontine angle (CPA); at stage III, it is 2 to 4 cm in the CPA; at stage IV, it is more than 4 cm in the CPA. All of the operations were performed by a single, senior otoneurosurgical team.

The surgical technique for translabyrinthine acoustic tumor removal has been described by Sterkers.³ When the approach is finished, the tympanic cavity is tightly obliterated by several pieces of muscle through the antrum, and the incus is left in situ. Care should be taken not to dislocate the stapes, which can promote the escape of CSF through the oval window.

Three techniques of wound closure have been used to eliminate the CSF leakage.

In the first period of time (1987 to 1989), we used a method of fascia-fat to obliterate the operative cavity. After the removal of tumor, a large piece of fascia lata sampled through a longitudinal incision on the lateral side of the femoral region was first placed on the dural defect. The fascia covered the internal auditory meatus and the opening in the posterior fossa dura. Tissucol® (IMMUNO, Vienna, Austria) was used to glue the fascia to neighbouring structures. Then several pieces of fat were placed on the fascia. The skin was tightly sutured in two layers.

In the second period of time (1990 to 1996), we used a technique of fascia-fat-flap. A large musculoperiosteal flap, pedicled superiorly or anteriorly, was made at the beginning of the operation. At the final wound closure, the fascia was first placed on the dural defect, followed by the application of the fat strips. Then the musculoperiosteal flap was sutured back to cover the fascia-fat complex. Tissucol® was occasionally used. Then the skin was closed in two layers.

From 1997, a simplified technique of fat-flap was developed. After removal of tumor and careful hemostasis of the tumor bed, several strips of abdominal fat were placed directly into the operative cavity without fascia graft. Additional fat was placed lateral to the strips in order to slightly overfill the mastoid up to the level of the cortical bone. To avoid pushing the fat into the CPA, the first piece of fat should be large enough to obliterate the cavity like a "champagne cork," and the musculoperiosteal flap should be sutured back carefully without pressure. No glue was used in any of the cases of this group. Whatever the technique used, continuous lumbar drainage was not routinely performed. It was important to maintain a constant pressure over the wound by a solid elastic bandage. This bandage was kept in place for 4 to 5 days unless it was wet. The sutures were removed on the tenth day after the operation.

CSF leak was diagnosed when clear fluid emanated from the wound (incisional), from the external auditory canal (otorrhea), or from the nose (rhinorrhea). When rhinorrhea was probable, it could be demonstrated by a head-down position of the patient and was then considered positive. A dressing that was wet only on day 1 or 2 but dry by day 4 was not included as a leakage. A mastoid pressure dressing and head elevation were the initial treatments in all cases. CSF leak may cease under medical treatment with acetazolamide (500 mg per day) and lumbar puncture for 2 to 3 days after or even continuous lumbar drainage. If these failed to stop the leak, revision surgery was undertaken that included wound ex-

ploration and reclosure. The usual area of leakage lay along the line of the facial canal, although it could occur by way of the hypotympanic cell chains if the bone was well pneumatized. In some rare cases, the middle ear was obliterated with fat or muscle to the level of the external auditory meatus after the tympanic membrane, malleus, and ear canal skin were removed.

Meningitis was diagnosed clinically when the patient had fever, headache, and meningismus and when CSF examination showed elevated polymorphonuclear leukocyte count, low glucose, and high protein. Positive bacteria gram stain or CSF cultures were not always required to confirm the diagnosis. However, relative changes such as headache or slight fever for 2 or 3 days were put down to chemical changes in the CSF rather than to meningitis.

Statistical analysis (chi square) in relation to incidence of CSF leak and meningitis included different techniques of wound closure and tumor staging.

RESULTS

There were 277 acoustic neuromas removed via the translabyrinthine approach in this series. For obliteration of the operative cavity in wound closure, three techniques were used: the fascia-fat technique for the first 39 patients, the fascia-fat-flap technique for 184 patients, and the fat-flap technique for the last 54 patients (Table 1).

CSF leak occurred in 11 (28.2%) patients in the first group. Of these patients, 3 (7.7%) required reoperation and 1 (2.6%) had meningitis. In the second group of patients, CSF leak occurred in 40 patients (21.7%) and included 21 cases (11.4%) of revision and 1 case (2.2%) of meningitis. There was no significant difference between these two groups in relation to the occurrence of CSF leak, revision, and meningitis. In the last 54 cases, for which the fat-flap technique was used, CSF leak was significantly reduced to 4 (7.4%) patients ($P < 0.05$), and 2 cases (3.7%) required reoperation. Meningitis occurred in 1 patient (1.9%). In 1 asymptomatic patient closed by fat-flap technique after tumor removal, magnetic resonance imaging (MRI) showed that the fat had been prolaping into the CPA with no compression of the brain stem.

The CSF leaks mainly occurred as wound leak and rhinorrhea (Table 2), which did not change with the different techniques of wound closure. There was a tendency of increasing CSF leak with the tumor stage, but

Table 1. Incidence of CSF Leak, Revision, and Meningitis

Wound Closure	No. Patients	No. Leaks	Revision	Meningitis
Fascia-fat	39	11 (28.2%)	3 (7.7%)	1 (2.6%)
Fascia-fat-flap	184	40 (21.7%)	21 (11.4%)	4 (2.2%)
Fat-flap	54	4 (7.4%)	2 (3.7%)	1 (1.9%)

Table 2. Distribution of CSF Leaks

<i>Wound Closure</i>	<i>Total Leaks</i>	<i>Wound</i>	<i>Rhinorrhea</i>	<i>Otorrhea</i>
Fascia-fat	11	5 (45%)	5 (45%)	1 (10%)
Fascia-fat-flap	40	18 (45%)	17 (43%)	5 (13%)
Fat-flap	4	2 (50%)	2 (50%)	0

the difference was not significant (Table 3). There was also no difference in revision incidence in relation to tumor volume.

DISCUSSION

Following a translabyrinthine operation, CSF leak is the reflection of a persisting communication between the subarachnoid space and the temporal bone. CSF leaks can be due to incisions, rhinorrhea, or otorrhea. Incisional leaks result directly from the wound. Rhinorrhea occurs when CSF reaches the eustachian tube to the nasopharynx. Otorrhea occurs when CSF gains access to the external auditory canal through the canal wall or tympanic membrane. Postoperative CSF leaks predispose to the development of meningitis. The site of leakage can act as a portal of entry for bacteria to the subarachnoid space.

The incidence of CSF leakage and meningitis after acoustic tumor surgery has been reported by many authors. In House's series, of 251 consecutive patients with tumors who underwent translabyrinthine surgery, CSF leakage occurred in 20%;⁴ in one third as rhinorrhea and in two thirds as posterior leak. Surgical closure of the fistula was required in 8.5% of the total series. In a later series of operations from 1979 to 1981, House et al⁵ described a technique of wound closure using strips of abdominal fat that is highly effective in reducing the incidence of CSF leakage. Tos and Thomsen⁶ attempted to study the efficacy of specific technical modifications in reducing CSF leak, including obliterating the middle ear cleft with adipose tissue or using tissue seal, large pieces of fat versus strips of fat, sutures to approximate the posterior fossa dura, or one midline incision for dural opening as opposed to a superior and inferior inci-

sion. None of these modifications significantly reduced the incidence of CSF leak. The most important conclusion that the authors⁶ could point out is that the bandages should be kept on for a longer period of time. However, in this series of 200 patients, a piece of fascia was always used to cover the dural defect, and fat tissue was placed up on the fascia. Rodgers and Luxford⁷ reviewed a series of 723 acoustic tumors removed via the translabyrinthine approach at the House Ear Clinic from 1982 to 1988. The incidence of CSF leak and meningitis was 6.8% and 2.9%, respectively. Ten cases (1.4%) needed revision surgery. CSF leak was unrelated to patient age, tumor size, or operative time. The authors concluded that these serious postoperative complications are most likely related to failures of technique or consequences of extensive dissection. Table 4 summarizes recent studies⁸⁻¹³ reporting on CSF leak after translabyrinthine acoustic tumor removal.

In our current series, we have used three methods of wound closure. There was a high incidence of CSF leak when we used a piece of fascia to cover the dural defect. This was not reduced even when we made a large musculoperiosteal flap to tightly press the fascia-fat complex. In the recent cases, we placed several pieces of fat directly into the operative cavity without fascia graft. This significantly reduced the incidence of CSF leak. Reoperation was required in only 2 patients. We believe that the adipose tissue will adhere to the irregular temporal bone cavity more easily than the fascia graft will. A tight press by the musculoperiosteal flap is then necessary to keep the adipose tissue fixed in the cavity. Despite that, a solid compression of the wound by bandage may also be necessary for at least 4 to 5 days. Sometimes it is better to change the bandage after the removal of tracheal intubation because the patient usually has a very elevated CSF pressure while the bandage is loosened. We also found that a musculoperi-

Table 3. Incidence of CSF Leaks by Tumor Stage*

	<i>Fascia-Fat</i>			<i>Fascia-Fat-Flap</i>			<i>Fat-Flap</i>			<i>Total</i>		
	<i>Cases</i>	<i>Leaks</i>	<i>% Leaks</i>	<i>Cases</i>	<i>Leaks</i>	<i>% Leaks</i>	<i>Cases</i>	<i>Leaks</i>	<i>% Leaks</i>	<i>Cases</i>	<i>Leaks</i>	<i>% Leaks</i>
Stage I	0	0	0	2	0	0	0	0	0	2	0	0
Stage II	10	2	20	66	12	18	29	2	6.9	105	16	15
Stage III	20	5	25	97	22	23	22	2	9.1	139	29	21
Stage IV	9	4	44	19	6	31	3	0	0	31	10	32

*stage I: intrameatus tumor; stage II: <2 cm in the CPA; stage III: 2-4 cm in the CPA; stage IV: ≥4 cm in the CPA.

Table 4. Recent Studies Reporting on CSF Leak after Translabyrinthine Acoustic Tumor Removal

<i>Authors</i>	<i>Wound Closure</i>	<i>Year</i>	<i>No. of Cases</i>	<i>Leak (%)</i>	<i>Revision (%)</i>	<i>Meningitis (%)</i>
Glasscock et al ¹	No detail	1986	437	11	8	5 (all approaches)
Mangham ⁸	Fascia-fat, incus removed	1988	103	20	5	5
Hardy et al ⁹	Fat simple, p. tympanotomy	1989	100	13	10	3
Bryce et al ¹⁰	Fascia-fat-flap, incus removed	1990	203	11	5.4	4.4
Tos and Thomsen ¹¹	Fascia-fat-flap, incus removed	1991	504	8.9	4	?
Rodgers and Luxford ⁷	Fat simple	1993	723	6.8	1.4	2.9
Hoffman ¹²	Fascia-fat, incus removed	1994	146	21	4.1	3
Celikkanat et al ¹³	Fat-flap, incus removed	1995	129	6.2	4.7	0

riosteal flap had a cosmetic effect. It avoided the skin retraction caused by the fat atrophy that occurs in later years.

Many factors seems to relate to CSF leakage. However, tumor size, bone pneumatization, and age of the patient had no significant influence on the incidence of CSF leakage.¹¹ Elevated CSF pressure may play an important role in CSF leakage after translabyrinthine surgery. This may be caused not only by mechanical obstruction but also by biochemical changes in CSF because hydrocephalus can be seen even in small acoustic neuroma. Hardy et al¹⁴ indicated that CSF pressure rose consistently on the day following acoustic neuroma surgery and in most cases fell within 4 to 5 days to a value of less than that measured preoperatively. Various techniques of wound closure have been reported to avoid CSF leakage, which has been progressively reduced in the last years. In our experience, fat tissue is better than fascia to close the mastoid cavity tightly. Further investigations should be done to increase the possibility of vascularization for the fat tissue and to decrease the CSF pressure immediately after surgery in a nontraumatic way.

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