

# Microscopical surgical management of cerebrospinal fluid rhinorrhoea with free grafts\*

Joo-Heon Yoon<sup>1</sup>, Jeung-Gweon Lee<sup>1</sup>, Sun Ho Kim<sup>2</sup>, In Yong Park<sup>1</sup>

<sup>1</sup> Department of Otorhinolaryngology, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea

<sup>2</sup> Department of Neurosurgery, Yonsei University College of Medicine, Seoul, Korea

## SUMMARY

*Iatrogenic cerebrospinal fluid (CSF) rhinorrhoea can occur after intranasal ethmoidectomy or removal of pituitary tumours using a transsphenoidal approach, and is categorized as intra-operative or post-operative according to the time of onset. From 1989 to 1992 at Severance Hospital, Seoul, Korea, we successfully repaired nine cases of CSF rhinorrhoea using fibrin-glue-coated fascia or inferior turbinate mucosa under a surgical microscope. Neither recurrent leaks nor post-operative complications were associated with the free graft. Our results indicate that repair of CSF rhinorrhoea using free grafts under a surgical microscope is as successful as using a local flap, and it is a simple and very effective method in managing CSF rhinorrhoea. The surgical technique is discussed in detail.*

*Key words: cerebrospinal fluid rhinorrhoea, surgical repair, operating microscope*

## INTRODUCTION

Most cases of cerebrospinal fluid (CSF) rhinorrhoea occur as result of traumatic or iatrogenic causes, and it can lead to serious complications such as meningitis and brain abscess. Intranasal ethmoidectomy and removal of pituitary tumours using the transsphenoidal approach are two of the most common causes of iatrogenic CSF rhinorrhoea. Once the site of the fistula is identified, which is the most important procedure in the process of surgical management, it can be managed by using a local flap (Hirsch, 1952; Montgomery, 1973; McCabe, 1976; Calcaterra, 1985; Yessenow et al., 1989) or graft (Wigand, 1981; Papay et al., 1989a, b; Levine, 1991; Stankiewicz, 1991a, b; Yoon et al., 1991). The purpose of this article is to introduce our repair method and to report on our results in nine cases of CSF rhinorrhoea repair using a free graft under a surgical microscope from 1989 to 1992.

## PATIENTS

This is a review of nine patients undergoing intranasal microscopical repair of CSF rhinorrhoea in the fovea ethmoidalis, cribriform plate and sella floor with a free graft from March 1989 to February 1992. Six cases were caused by intranasal ethmoidectomy and the other three were caused by removal of pituitary tumours using the transsphenoidal approach. The patients ranged in age from 22 to 64 years, and the male-to-female ratio

was 2:1. The onset of CSF rhinorrhoea was noted during surgery itself in four cases (Table 1), and in five cases during the post-operative period (Table 2).

## SURGICAL TECHNIQUE

### *Intra-operative CSF fistula*

A CSF fistula identified during intranasal ethmoidectomy can be surgically managed without additional laboratory study to verify CSF. It is important not to panic and to completely finish the ethmoidectomy in order to obtain a good surgical view of the fistula site. This will help to achieve full exposure of the bony and dural defect. Using local anaesthesia in a sitting position will not allow the surgeon to prepare the patient properly for harvesting the fascia. However, the operator can easily obtain mucosa from the same side of the inferior turbinate with conchotomy scissors, and divide it into mucosa and submucosa to be used as the graft material. Since there is not enough time for lumbar draining to reduce CSF pulsation, the fistula should be sealed off with submucosal tissue of the proper size and bleeding should be controlled using bipolar electrocautery to dry the fistula site. Then, the fibrin-glue-coated mucosa should be applied over the fistula site and additional fibrin glue added. Intranasal packing with Gelfoam and Merocel is necessary to avoid detachment of the inferior turbinate mucosa from the dural defect. A post-operative lumbar drain is not necessary in

Table 1. Intra-operative CSF rhinorrhoea.

case no.	age/sex	type of surgery	site	approach	graft material	result	follow-up
1	34/M	ethmoidectomy	FE, CP	intranasal	turbinate mucosa	success	2 years
2	36/M	ethmoidectomy	FE, CP	intranasal	turbinate mucosa	success	3 years
3	45/M	ethmoidectomy	FE	intranasal	turbinate mucosa	success	1 year
4	51/M	ethmoidectomy	FE	intranasal	turbinate mucosa	success	1 year

FE: fovea ethmoidalis; CP: cribriform plate

Table 2. Post-operative cerebrospinal fluid rhinorrhoea.

case no.	age/sex	type of surgery	glucose level (mg/ml)	site	approach	graft material	result	follow-up
5	22/M	ethmoidectomy	62	FE, CP	intracranial	temporalis fascia	success	3 years
6	48/M	ethmoidectomy	78	FE	intranasal	temporalis fascia	success	3 years
7	64/F	TSA	76	SF	intranasal	fascia lata	success*	1 year
8	38/F	TSA	85	SF	intranasal	fascia lata	success	1 year
9	52/F	TSA	98	SF	intranasal	temporalis fascia	success	1 year

TSA: transsphenoidal approach; FE: fovea ethmoidalis; CP: cribriform plate; SF: sellar floor; (\*): underwent two operations for cerebrospinal fluid rhinorrhoea

any of our cases because their fistulae were small. The patients have been conservatively treated for seven days post-operatively.

#### Post-operative or delayed CSF fistula

In the case of delayed CSF rhinorrhoea, it is essential to determine whether the watery rhinorrhoea is true CSF by measuring the levels of glucose, protein and specific gravity in the collected fluid. After CSF is confirmed by chemical analyses, localization of the fistula site is the next most important step. In most cases, a pre-operative CT scan after an intrathecal injection of Isovue (Iopamidol) is a sophisticated method of determining the site of the leakage and the size of the bony defect. After localizing the site of the fistula, the operation is performed under general anaesthesia. Just before the operation, a lumbar drain is inserted. It is also important to harvest graft materials (such as temporalis fascia, fascia lata and muscle) in advance of the actual repair procedures. The side of the nasal cavity through which the repair is to be performed is determined by the site of the fistula. In the case of a fistula located in the fovea ethmoidalis or cribriform plate, the site of the leak is obviously used. On the other hand, if the fistula is near the sella floor, the wider of the two nasal cavities is chosen. Using a self-retaining retractor under a surgical microscope, we were able to identify the site of leakage by looking for pulsating CSF after careful removal and trimming of the mucosa and fibrous tissue, surrounding it. Once full exposure of the bony and dural defect is accomplished, adequate haemostasis near the fistula is achieved with bipolar electrocauteries and muscle packing through the fistula to dry the surgical field. About 30 ml of CSF should be drained through the lumbar catheter to avoid detachment of the grafted fascia by pulsating CSF. Then, the fibrin-glue-coated fascia is applied over the muscle and packed with additional fibrin glue (Figure 1). Reinforcing with Gelfoam and Merocel packing is necessary when the site of the fistula is located on the fovea ethmoidalis or cribriform plate. When the fistula is located near the

sella floor, only Gelfoam packing is needed inside of the sphenoidal sinus and the Merocel packing in the nasal cavity to prevent the Gelfoam from falling out of the sinus. In our cases, approximately 150–200 ml of CSF was removed daily to reduce the pressure on the repair site and to allow the arachnoid granulations to recover their function of CSF resorption through the lumbar catheter for seven days post-operatively. Then, the catheter was removed. Patients were treated conservatively for 10 days post-operatively.

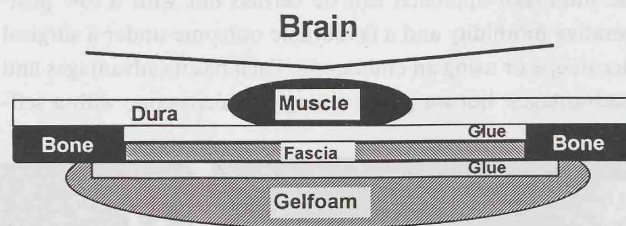


Figure 1. Schematic drawing of surgical repair in the management of CSF rhinorrhoea. After sealing off the dural defect with muscle, fibrin-glue-coated fascia is laid over the exposed dura and raw bone. Then, the fascia is reinforced with fibrin glue and Gelfoam.

#### RESULTS

All four cases of intra-operative CSF rhinorrhoea occurred following an intranasal ethmoidectomy for treatment of chronic sinusitis with polyposis. The resulting fistulas were identified as bony defects on the fovea ethmoidalis. Among them, relatively large-sized dural defects were observed in two cases with a cribriform plate and fovea ethmoidalis defect. In cases of intra-operative CSF rhinorrhoea, the glucose level could not be measured due to difficulties in collecting it. A free graft of inferior turbinate mucosa with fibrin glue was used in all four cases of intra-operative CSF rhinorrhoea, and no complications of meningitis or recurrent leaks were noted during the follow-up period of 1–3 years.

Among the five cases of post-operative CSF rhinorrhoea, two cases occurred after intranasal ethmoidectomy and the other three cases after removal of pituitary tumours by the transsphenoidal approach. The glucose level was more than 60 mg/ml in every case. Fibrin-glue-coated fascia lata or temporalis fascia was used as the graft material depending on the circumstances, and no recurrent leaks were identified during 1-3 years of follow-up. Unfortunately, three cases of post-operative CSF rhinorrhoea showed signs of meningitis even before the repair of CSF rhinorrhoea; they received antibiotic therapy pre-operatively.

#### DISCUSSION

Iatrogenic CSF rhinorrhoea can be categorized as intra-operative and post-operative (or: delayed), according to the time of onset. The truly delayed type is assumed to be very rare.

The diagnosis of CSF rhinorrhoea can be a difficult clinical problem. While the analysis of nasal secretion for i.a. glucose and protein is a very useful way of confirming the existence of CSF, it is not infallible. Recently,  $\beta$ -2 transferrin analysis has been proposed as an important diagnostic method of CSF leak (Oberascher, 1988; Skedros et al., 1993).

In the process of planning for the surgical management of delayed CSF rhinorrhoea, exact localization of the fistula site is of utmost importance, and the type of previous surgery can help the surgeon to predict the site of the leaks. Although the use of various dye markers (such as fluorescein, metrizamide, nitrosamide, Isovue and Omnipaque) has been employed to localize the site of the CSF leak without significant side effects, we prefer to use CT scanning with Isovue or Omnipaque, rather than using metrizamide which is reported to cause headaches, nausea and vomiting in 30-50% of the cases (Levine, 1991).

The intranasal approach can be carried out with a low post-operative morbidity and a favourable outcome under a surgical microscope or using an endoscope. Each has its advantages and disadvantages, but we prefer a surgical microscope with a self-

retaining retractor for the following reasons. Firstly, both hands are available to manipulate the fascia or control bleeding. Secondly, a severe septal deviation is not a hindrance in this approach. Thirdly, stereoscopic vision provides the surgeon with a more appropriate view of the surgical field.

The most important factor in our surgical procedure is to make sure that the surgical field around the fistula site is well dried, so as to keep the fascia from detaching from the bone or dura. In order to achieve this, meticulous control of bleeding by means of bipolar electrocautery and cessation of CSF pulsations are required. There are two ways to control CSF pulsation. One of which is to seal off the fistula site using muscle packing for a temporary effect, and the other is to drain about 30 ml of CSF through a lumbar catheter just before attaching the fascia. We only used the former method to repair intra-operative cases of CSF rhinorrhoea; however, both methods were utilized in repairing cases of post-operative CSF rhinorrhoea. As long as the dry, fibrin-glue-coated fascia is well attached to the fistula site, we believe that reinforcement with Gelfoam and merocel is sufficient to prevent the fascia from detaching; the use of muscle or osteomucoperiosteal flaps along with gauze impregnated with antibiotics for reinforcement is not necessary. No matter what kind of method is used (flap or graft), the key to a successful repair is good apposition between the fascia and the dura, which is apparently in accordance with Mattox's opinion. We prefer the free graft to the flap, which may not seal tightly due to displacement and tenting, although flap surgery also has an acceptable success rate.

CSF rhinorrhoea, in case 7, was identified three weeks after removal of a pituitary tumour using the transsphenoidal approach. The intranasal approach to the sphenoid sinus revealed a dural defect with a white semi-translucent arachnoid membrane, and it was repaired with fibrin-coated fascia lata with a lumbar drain. However, the patient again complained of similar postnasal drip seven days after the operation, and a second

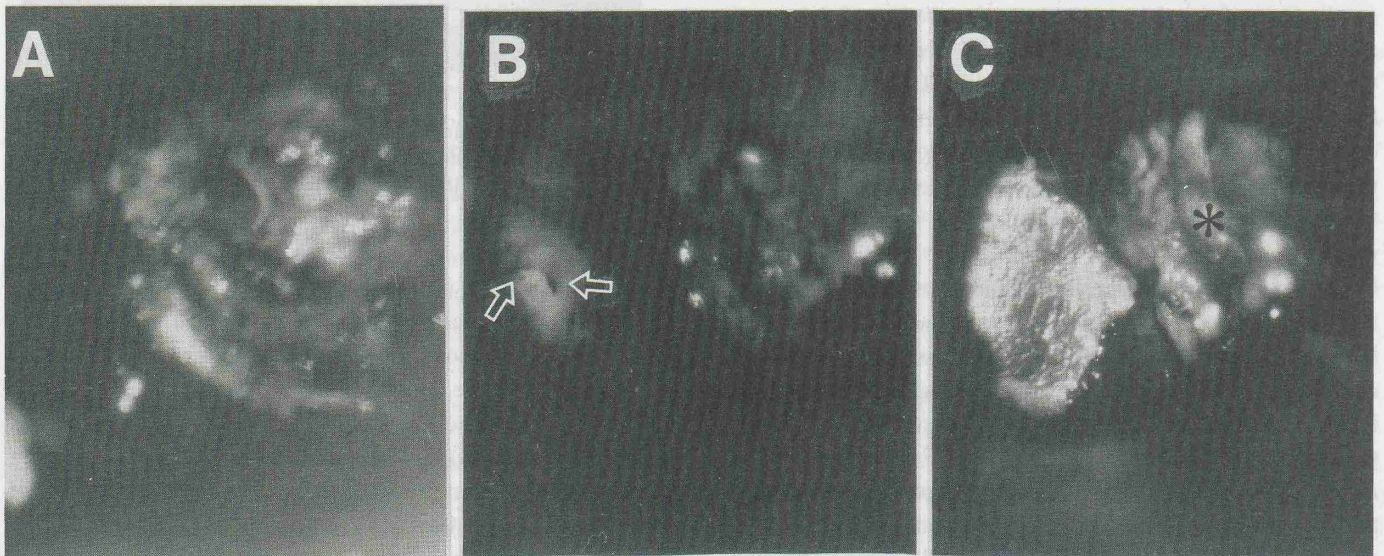


Figure 2. Operative findings in Case 7. A dural defect and a whitish arachnoid membrane were noted during the first surgery (A). A small amount of CSF rhinorrhoea recurred seven days after removal of the lumbar drain post-operatively. So, a second surgery was necessary. At the time of the second surgery, two additional pinpoint-sized dural defects (B; arrows) near the previously repaired dural defect were observed. The previously attached fascia remained well approximated (C; asterisk) and repair of the two pinpoint-sized dural defects was successfully performed using the same method.

operation using the same method was required to seal two additional small defects noted laterally to the well-attached fascia from the previous repair (Figure 2). One of the significant limitations of the intranasal approach when using fibrin-coated fascia is the size of the dural defect. Case 6 had a bony defect with the largest diameter (8×15 mm) identified on our PNS-CT scan; the rest of our cases had small dural and bony defect of less than 10 mm. When the size of the defect is more than 10 mm and CSF rhinorrhoea is detected more than two months post-operatively, methods using a flap can be preferred to the intranasal patch method using fascia.

The timing of fistula repair usually depends upon the size of the dural defect. Conservative management with observation is an acceptable measure, if simple tearing without dural loss is the cause of intra-operative CSF rhinorrhoea. However, immediate surgical repair is recommended if any dural loss has occurred. In the delayed type of CSF rhinorrhoea, surgical management is also preferred to conservative management, because there is always the risk of such complications as meningitis or brain abscess. The current emphasis on the use of the endoscope seems to have overshadowed the advantages of using the surgical microscope in the repair of CSF rhinorrhoea. Therefore, it is essential to understand the merits and disadvantages of each, in order to promote a successful rate of surgical management. Also, a free facial patch with fibrin glue applied using a surgical microscope in CSF rhinorrhoea repair is simpler than a flap and is more effective.

#### REFERENCES

1. Calcaterra TC (1985) Diagnosis and management of ethmoid cerebrospinal rhinorrhea. *Otolaryngol Clin North Am* 18: 99-105.
2. Hirsch O (1952) Successful closure of cerebrospinal fluid rhinorrhea by endonasal surgery. *Arch Otolaryngol* 56: 1-13.
3. Levine HL (1991) Endoscopic diagnosis and management of cerebrospinal fluid rhinorrhea. *Oper Techn Otolaryngol Head Neck Surg* 2: 282-284.
4. Mattox DE, Kennedy DW (1990) Endoscopic management of cerebrospinal fluid leaks and cephaloceles. *Laryngoscope* 100: 857-862.
5. McCabe BF (1976) The osteo-mucoperiosteal flap in repair of cerebrospinal fluid rhinorrhea. *Laryngoscope* 86: 537-539.
6. Montgomery WW (1973) Cerebrospinal fluid rhinorrhea. *Otolaryngol Clin North Am* 6: 757-771.
7. Oberascher G, Arrer E (1986) Erste klinische erfahrungen mit beta-2 Transferrin bei Oto- und Rhinoliquorrhoe. *HNO* 34: 151-155.
8. Papay FA, Maggiano H, Dominquez S (1989a) Rigid endoscopic repair of paranasal sinus cerebrospinal fluid fistulas. *Laryngoscope* 99: 1195-1201.
9. Papay FA, Benninger MS, Levine HL (1989b) Transnasal transseptal endoscopic repair of sphenoidal cerebral spinal fluid fistula. *Otolaryngol Head Neck Surg* 101: 595-597.
10. Skedros DG, Cass SP, Hirsch BE (1993) Beta-2 transferrin assay in clinical management of cerebral spinal fluid and perilymphatic fluid leak. *J Otolaryngol* 22: 341-344.
11. Stankiewicz JA (1991a) Cerebrospinal fluid fistula and endoscopic sinus surgery. *Laryngoscope* 101: 250-256.
12. Stankiewicz JA (1991b) Endoscopic intranasal closure of cerebrospinal fluid fistulas. *Oper Techn Otolaryngol Head and Neck Surgery* 2: 206-208.
13. Wigand ME (1981) Transnasal ethmoidectomy under endoscopic control. *Rhinology* 19: 7-15.
14. Yessenow RS, McCabe F (1989) The osteo-mucoperiosteal flap in repair of cerebrospinal fluid rhinorrhea: A 20-year experience. *Otolaryngol Head Neck Surg* 101: 555-558.
15. Yoon JH, Lee JG, Park IY (1991) Surgical management of iatrogenic cerebrospinal fluid rhinorrhea. *Kor J Otolaryngol* 34: 352-358.

Joo-Heon Yoon, MD

Department of Otorhinolaryngology

Severance Hospital

Yonsei University College of Medicine

CPO Box 8044

Seoul

Korea