

External Dacryocystorhinostomy Combined with Mucosal Grafting and Magnetic Resonance Imaging

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Purpose: To facilitate understanding of the use of magnetic resonance imaging (MRI) in nasolacrimal obstructive diseases and to determine the indication for external dacryocystorhinostomy (DCR) combined with mucosal grafting.

Methods: We retrospectively studied the correlation between MRI images and surgical findings in 13 consecutive patients with swollen lacrimal sacs because of obstruction of the nasolacrimal duct or lacrimal sac. They were treated at the Kagoshima University Hospital between June 1999 and May 2001.

Results: A simple procedure of external DCR was performed in 9 cases, and a procedure combined with mucosal grafting was performed in 4 cases (age range, 51–88 years). Surgical findings in the fibrous region of the lacrimal sac corresponded to the hyperintense signal on MRI T₁-weighted (T1W) images, more remarkably after enhancement. Surgical findings in the granulomatous sac and proteinaceous contents corresponded to the isointense areas on T2W images. Cases with thin sac were treated by standard DCR, whereas cases with thick, fibrous and granulomatous sac were treated by external DCR combined with mucosal grafting.

Conclusions: The MRI images provide a useful preoperative determination for indications of external DCR combined with mucosal grafting. **Jpn J Ophthalmol 2002;46:183–188** © 2002 Japanese Ophthalmological Society

Key Words: External dacryocystorhinostomy, intralacrimal sac obstruction, magnetic resonance imaging, mucosal grafting.

Introduction

External dacryocystorhinostomy (DCR) and endonasal DCR are standard methods of treatment for nasolacrimal obstruction.^{1–5} In these procedures, a larger bony resection is recommended for successful fistulization.^{1,3} However, a previous report showed that patients with small healed ostia obtained the same clinical relief as those with large ostia.⁵ These findings suggest that inhibition of the postoperative growth of fibrous tissue into the fistula is more important for successful DCR rather than the ostium size. To achieve such inhibition, the nasal and lacrimal sac flaps should be joined adequately. In the

case of intralacrimal sac obstruction, a larger bony resection is still required to obtain a large nasal flap to compensate for the absence of lacrimal sac flap. However, we have once injured the nasal-septum mucosa, resulting in severe nasal hemorrhage during wide bony resection. To avoid this problem, we have employed a buccal mucosal graft to inhibit postoperative fibrous tissue growth into the fistula without large bony resection.

Magnetic resonance imaging (MRI) provides not only morphological but also qualitative information about the eye and the orbit.^{6–8} In mid-1999, we treated a difficult case with swollen lacrimal sac. This patient was histopathologically diagnosed as having mucoepidermoid carcinoma in the lacrimal sac of the right orbit, which required further radical surgery by an otorhinolaryngologist. This experience led us to routinely use MRI with enhancement in patients with swollen lacrimal sacs, after obtaining informed

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consent, for the differential diagnosis of tumors. When abnormal findings were detected in the lacrimal sac by MRI, we explained to the patients the possibility of either dacryocystectomy⁹ or DCR using mucosal grafting. Then, we treated chronic dacryocystitis by external DCR and lacrimal sac tumor by dacryocystectomy⁹ on the basis of intraoperative findings including pathological examination. In this study, we retrospectively examined MR images and correlated these with surgical findings in order to explore to what extent MRI provides an aid in determining the indication for the DCR combined with mucosal grafting in the surgical management of swollen lacrimal sac. This finding will help us to explain preoperatively in more detail about which surgical procedure will be selected for future patients.

Materials and Methods

Thirteen patients with lacrimal sac swelling due to nasolacrimal duct obstruction or intralacrimal sac obstruction underwent external DCR with or without mucosal grafting between June 1999 and May 2001 at the Kagoshima University Hospital. They were 2 men and 11 women with a mean age of 70 years (range, 51–88 years). Nine cases received a standard external DCR,² and 4 cases external DCR combined with mucosal grafting (Table 1).

We briefly describe the surgical procedure of DCR combined with mucosal grafting by showing

the intraoperative findings in case 13 (Table 1 with swollen lacrimal sac of the left orbit (Figure 1A). With the patient under general endotracheal anesthesia, the procedure was the same as the standard external DCR until exposure of the lacrimal sac.² The middle portion of the lacrimal sac was granulomatous (Figure 1B), whereas the inferior part, on opening its interior, was fibrously obstructed (Figure 1C). Because we considered that we could not use this lacrimal sac to connect to the nasal mucosal flap, we prepared a mucosal graft (approximately 10 × 20 mm) by excising a graft from the lower lip. After removing the inferior part of the lacrimal sac and performing osteotomy using a chisel (10 × 10 mm), nasal mucosa was excised in a U-shape to form a posterior flap through the fistula. Then, two nunchaku-style silicone tubes (N-S tubes)¹⁰ were intubated from the superior and inferior lacrimal puncta and pulled out through the superior, residual lacrimal sac (Figure 1D). Subsequently, the tubes were intubated through the fistula to the nasal cavity (Figure 1E). Using the prepared buccal mucosal graft, we formed an anterior flap and united it with the remaining anterior nasal mucosa and the superior part of the lacrimal sac (Figure 1F). The separated orbicularis oculi muscle and the skin incision were then closed.

In the MRI examination, coronal sections were considered to effectively display the diseased features of the lacrimal sac and to indicate the relation-

Table 1. Clinical and Magnetic Resonance Imaging (MRI) Findings of Patients with Obstruction of Lacrimal System

Case No.	Age	Sex	MRI Finding of Lacrimal Sac				Intraoperative Finding of Lacrimal Sac	Selected Surgery*	Postoperative Prognosis	
			T1W		T2W				Lack of Tearing	Irrigation Passage
			Content	Sac	Content	Sac				
1	60	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
2	65	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
3	82	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
4	78	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
5	85	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
6	76	Female	Mix [†]	Mix [†]	Hyper	Hyper	Thin	DCR	+	+
7	88	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
8	75	Female	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
9	71	Male	Hypo	Iso	Hyper	Hyper	Thin	DCR	+	+
10	67	Male	Mix [‡]		Mix [§]		Thick	DCR+MG	+	+
11	58	Female	Mix [‡]		Mix [§]		Thick	DCR+MG	+	+
12	51	Female	Mix [‡]		Mix [§]		Thick	DCR+MG	-	+ [¶]
13	53	Female	Mix [‡]		Mix [§]		Thick	DCR+MG	+	+

*Dacryocystorhinostomy (DCR) + mucosal grafting (MG).

[†]Hyperintense and hypointense signals were mixed.

[‡]Hypointense and slightly hyperintense signals in the superior and inferior parts, respectively.

[§]Hyperintense and isointense signals in the superior and inferior parts, respectively.

[¶]Irrigation passage was present after nunchaku-style silicone tube intubation.

ship between the lacrimal sac and the nasal cavity. The MRI images differed in cases undergoing a combined procedure from those undergoing a simple external DCR. Surgical findings of the lacrimal sac were compared with T₁-weighted (T1W) and T₂-weighted (T2W) MR images retrospectively.

Results

Surgical success was evaluated by the objective demonstration of a patent lacrimal system through irrigation and a subjective lack of postoperative tearing. Both successful irrigation and lack of tearing were achieved in 100% of the patients after standard DCR. This good result may have been attained because the difficult cases with abnormal lacrimal sacs were not treated with standard DCR. On the other hand, with respect to the 4 cases with abnormal lacrimal sacs after DCR combined with mucosal grafting, both successful irrigation and lack of tearing were

achieved in 3 cases (75%), whereas in 1 case (25%) there was postoperative canalicular blockage, which was treated by intubation with N-S tubes.¹⁰

The 9 cases undergoing a standard external DCR showed the following preoperative MR images. On T1W images, 8 cases showed hypointense signals in the intralacrimal sac content and isointense signals in the lacrimal sacs (Figure 2A: case 8), whereas one exceptional case showed a mixture of hyperintense and hypointense signals in the lacrimal sac and interior (Figure 3A: case 6). In the exceptional case, enhancement with intravenous gadolinium-diethylenetriamine pentaacetic acid (Gd-DTPA) increased the contrast between the interior and the sac (Figure 3B). Other usual cases with simple hypointense signals in the sac content also showed a distinct image of the sac wall by enhancement (Figure 4A: case 3). On T2W images, all cases disclosed hyperintense signals in the sac as well as in interior content (Figures 2B, 3C, 4B). At the time of surgery, the sacs were

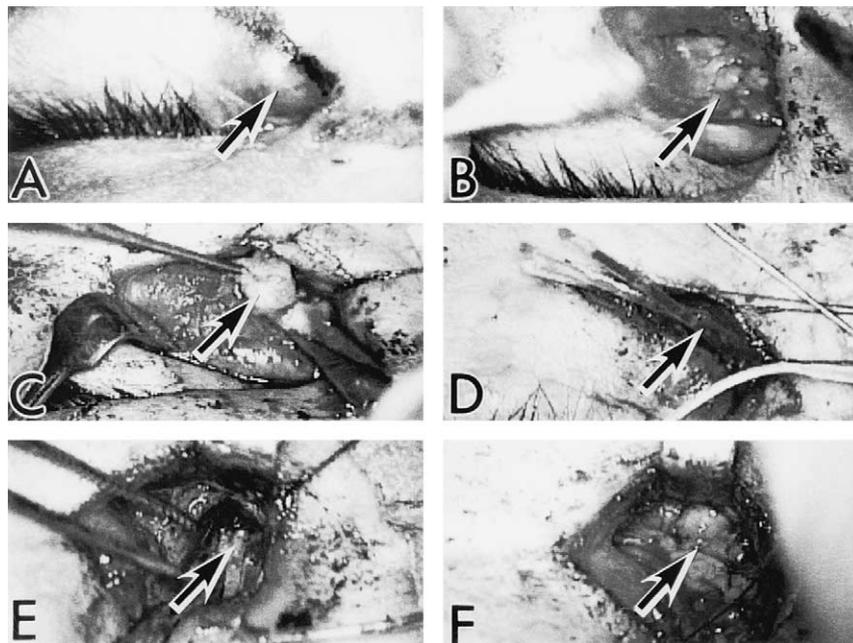


Figure 1. External dacryocystorhinostomy combined with mucosal grafting. Intraoperative findings in case 13 showing swollen lacrimal sac of left orbit. (A) A marking for skin-incision was drawn across a swelling of the nasal portion of the lower eyelid (arrow) due to chronic lacrimal sac inflammation along the side of the nose. (B) After the orbicularis oculi muscle was separated, the anterior wall of the lacrimal sac was observed to be replaced by granulomatous tissues (arrow). (C) After the periosteum and the lacrimal sac wall were incised, a thick fibrous tissue was seen to occupy almost two-thirds of the inferior part of the lacrimal sac (arrow). (D) After removal of the inferior part of the lacrimal sac and osteotomy, two nunchaku-style silicone tubes, which had been intubated from the superior and inferior lacrimal puncta, were observed through the superior part of the residual lacrimal sac (arrow). (E) After the posterior portion of the fistula was covered with the nasal flap, the silicone tubes were inserted into the nasal cavity through the fistula (arrow). (F) Using the prepared buccal mucosal graft, an anterior portion of the artificial lacrimal sac was formed to connect with the residual anterior nasal mucosa and the superior part of the lacrimal sac (arrow).

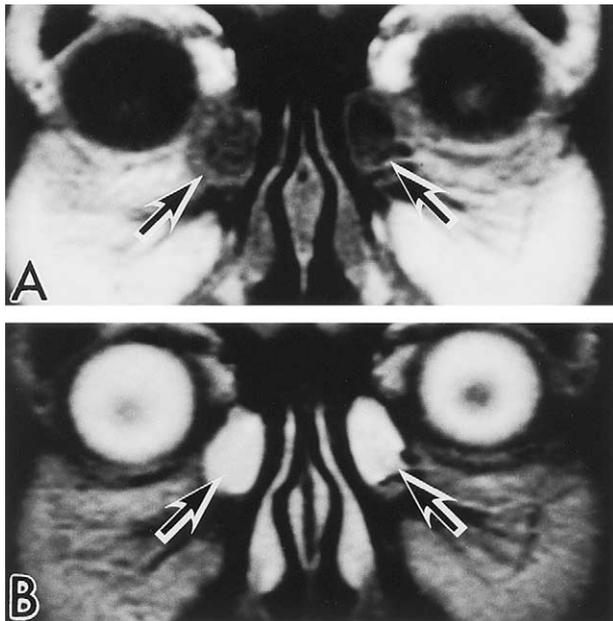


Figure 2. Magnetic resonance imaging coronal sections of a patient (case 8) treated by standard external dacryocystorhinostomy (A) T₁-weighted image shows both intralacrimal sac spaces to be homogeneously hypointense with respect to the lacrimal sac walls (arrows). (B) T₂-weighted image shows the lacrimal sac interiors to be homogeneously hyperintense (arrows).

found to have thin walls that were large enough to be joined with nasal mucosal flaps by standard external DCR in these 9 cases.

The 4 cases receiving external DCR combined with mucosal grafting showed the following preoperative MR images. T₁W images disclosed hypointense signals in the superior part of the sac, and slightly hyperintense signals in its inferior part (Figures 5A: case 13, Fig. 6A: case 12). Enhancement showed that the inferior part of the sac had a thick wall with increased contrast between the interior and the sac (Figure 5B). T₂W images demonstrated hyperintense signals in the superior part of the sac and isointense signals in the inferior part (Figures 5C, 6B). The T₁W-imaged hypointense areas and T₂W-imaged hyperintense areas of the superior part of the sac were not necessarily in agreement (Figures 5A,C, 6A,B). The anatomical configuration of the fibrous region of the sac at the time of surgery conformed to the slightly hyperintense areas on T₁W images, which was more marked on enhanced T₁W images. The T₂W-defined isointense areas of the middle and inferior parts of the sac appeared to have granulomatous sac regions and dense proteinaceous con-

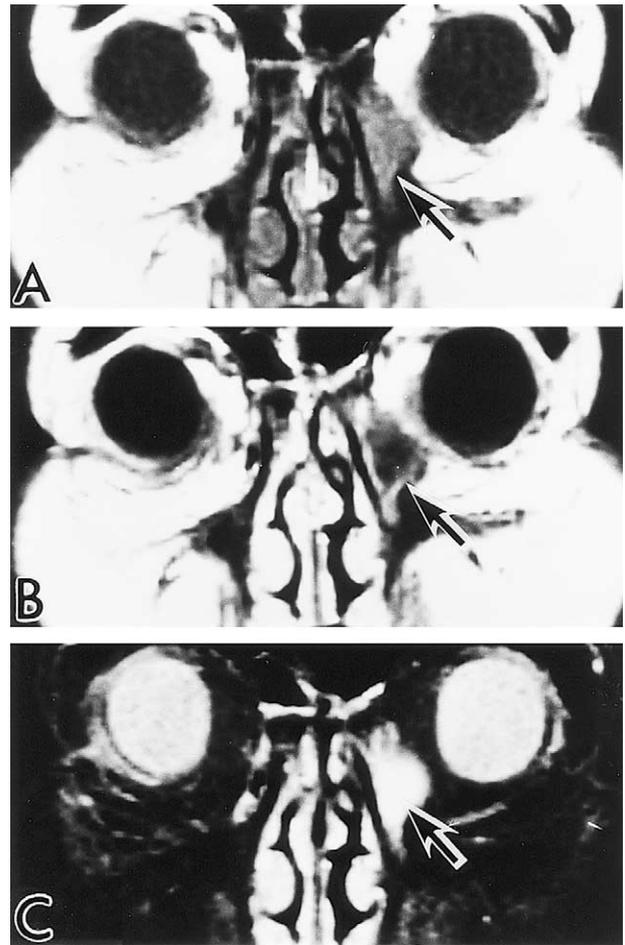


Figure 3. Magnetic resonance imaging coronal sections of a patient (case 6) treated by standard external dacryocystorhinostomy. (A) T₁-weighted (TW₁) image shows left intralacrimal sac space to be heterogeneous with slightly hyperintense and hypointense signals (arrow). (B) T₁W image after administration of gadolinium-diethylenetriamine pentaacetic acid exhibits the left lacrimal sac wall with increased contrast between the interior and the wall (arrow). (C) T₂-weighted image shows the lacrimal sac interior to be homogeneously hyperintense (arrow).

tents. Rapid histopathological examination during the surgery revealed that these lacrimal sac lesions were not malignant tumors. These 4 patients required mucosal grafting to connect the superior portion of the sac with the nasal flap.

Discussion

External DCR combined with mucosal grafting is advantageous in the unification of a thickened lacrimal sac with a nasal mucous membrane through the naso-lacrimal fistula. By external DCR combined

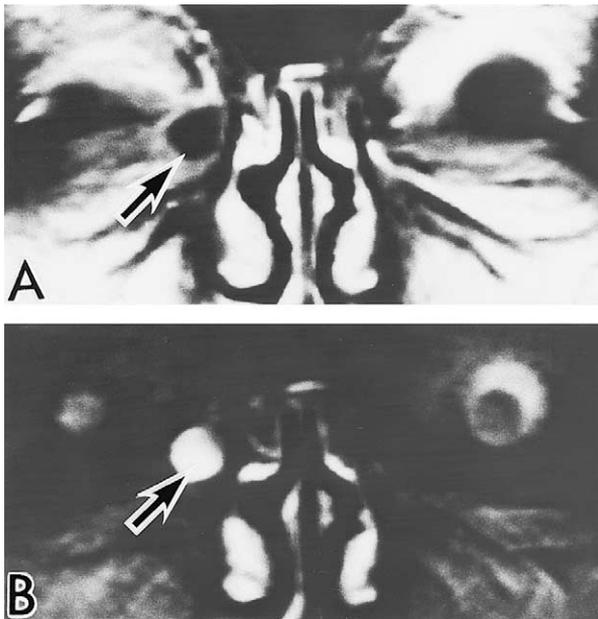


Figure 4. Magnetic resonance imaging coronal sections of a patient (case 3) treated by standard external dacryocystorhinostomy (A) T₁-weighted image after enhancement with gadolinium-diethylenetriamine pentaacetic acid shows the right lacrimal sac wall to be slightly hyperintense with increased contrast between the interior and the wall (arrow). (B) T₂-weighted image shows the lacrimal sac interior to be homogeneously hyperintense (arrow).

with buccal mucosal graft, we obtained a satisfactory success without a large bony resection except for 1 case who was required intubation with N-S tubes¹⁰ to treat postoperative canalicular blockage (case 12, Table 1). Even in this case, smooth and slippery probing was feasible through the mucosal graft-surfaced fistula after opening the canalicular blockage, suggesting that the graft had sufficiently inhibited postoperative fibrous-tissue growth into the fistula. Therefore, in the maintenance of the naso-lacrimal fistula, the postoperative success rate is considered to be 100% in the patients after DCR combined with mucosal grafting, although endoscopic observation of the rhinostomy will be required to confirm the existence of the mucosal graft in the future. If the patient (case 12, Table 1) suffers canalicular blockage again after removing the N-S tubes, we should try to do conjunctivo-dacryocystostomy, probably by match-style silicone tubing¹¹ combined with mucosal grafting.

This study demonstrates that MRI is a useful aid in determining the indication for external DCR combined with mucosal grafting. In a combined assessment of preoperative MRI with intraoperative find-

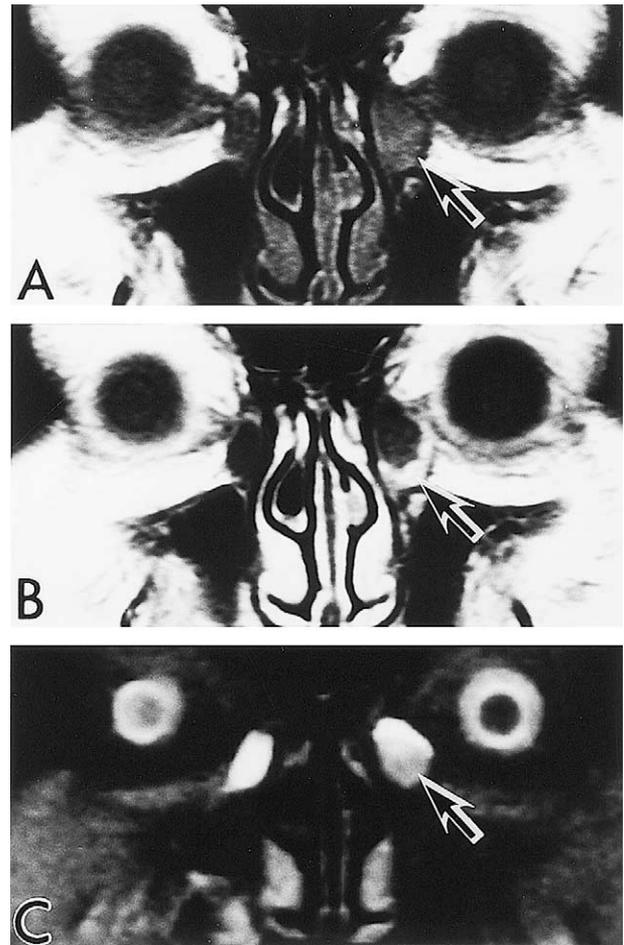


Figure 5. Magnetic resonance imaging coronal sections of a patient (case 13) treated by external dacryocystorhinostomy combined with mucosal grafting. (A) T₁-weighted (TW1) image shows the superior and inferior halves of the left lacrimal sac to be hypointense and slightly hyperintense, respectively (arrow). (B) T1W image after the enhancement with gadolinium-diethylenetriamine pentaacetic acid clearly shows the thick inferior wall of the left lacrimal sac to be hyperintense (arrow). (C) T₂-weighted image shows the superior and inferior halves of the left lacrimal sac to be hyperintense and isointense, respectively (arrow).

ings, T1W images give a clear distinction between the sac (including fibrous region) and the content, presenting an isointense signal in the sac, featuring its anatomic configuration, and a hypointense signal in the content. Only one case undergoing standard DCR showed a mixture of hyperintense and hypointense signals in the interior (Figure 3A). Rubin et al⁷ reported that a homogeneous mass of lacrimal sac mucocele showed hyperintense signals that were attributed to the mucus in both T1W and T2W im-

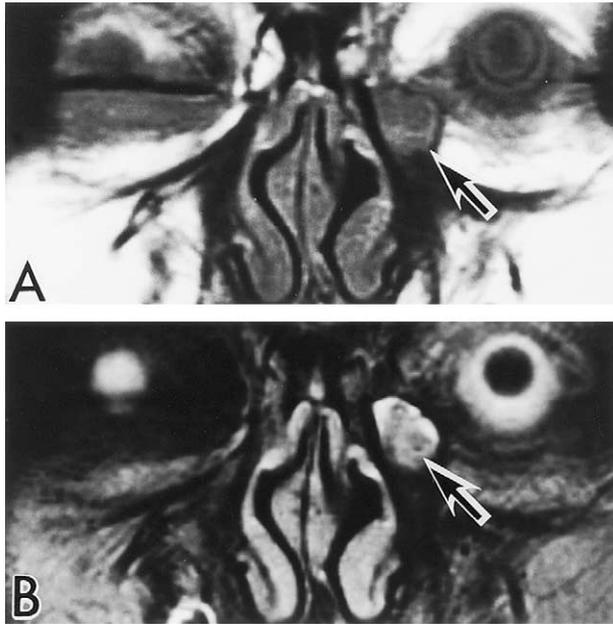


Figure 6. Magnetic resonance imaging coronal sections of a patient (case 12) treated by external dacryocystorhinostomy combined with mucosal grafting. **(A)** T₁-weighted image shows the superior two-thirds and inferior one-third of the left lacrimal sac to be hypointense and slightly hyperintense, respectively (arrow). **(B)** T₂-weighted image shows the left lacrimal sac to be heterogeneously mixed with hyperintense and isointense signals (arrow).

ages. Likewise, the slightly hyperintense signals in the lacrimal sac content of our exceptional case may be explained by mucus content. In contrast to the results with T1W images, T2W images did not show the exact anatomical configuration of the lacrimal sac, which is probably due to the protein in the content and the granulomatous tissue of the sac. The possibly increased proteinaceous secretions and granulomatous tissue in chronic nasolacrimal obstruction are likely to modify T2W images to produce isointense signals and hence to cause poor distinction from the inherently isointense sac. Thus, for determining the indication for external DCR combined with mucosal grafting, not only T1W images delineating thickened, fibrous sac, but also T2W images showing possible granulomatous change in the lacrimal sac are important because both fibrous and granulomatous changes make it difficult to use it as a mucosal flap. On the other hand, it was evident in cases undergoing a standard external DCR that diffuse hypointense signals were detected on T1W image in the lacrimal sac

as in the interior content with or without enhancement. Even an unusual case showing a mixture of hyperintense and hypointense signals in the interior content exhibited a thin lacrimal sac wall image on enhancement with Gd-DTPA. Hoffman et al¹² have reported that MRI with conjunctival contrast enhancement is useful to detect the location of stenosis or obstruction in the lacrimal system. Although we did not perform conjunctival enhancement,¹² MRI with the standard intravenous enhancement was enough to provide useful information on the lacrimal system. This examination is especially advantageous for a patient with obstruction of lacrimal canaliculi because dacryocystography is not indicated in such a case.

In conclusion, through such surgical efforts as described in this paper, the success rate of DCR will ultimately approach 100%. For this purpose, MRI images of the lacrimal sac are useful since the preoperative determination of the surgical procedure and obtaining informed consent from patients are important.

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