Original Article

The efficacy of sleeve technique in primary nasolacrimal duct obstruction with a high lacrimal sac

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Purpose: To evaluate the efficacy of a sleeve technique during endoscopic dacryocystorhinostomy (DCR) in primary nasolacrimal duct obstruction (NLDO) patients with a high lacrimal sac. **Materials and Methods:** The medical records of 45 patients (49 cases) undergoing endoscopic DCR for primary NLDO with a high lacrimal sac were retrospectively reviewed. In 19 patients (21 cases), the thick maxilla covering the common canalicular opening was removed using a drill and a bicanalicular silicone tube was inserted (group 1). In 26 patients (28 cases), instead of removal of the thick maxilla, a sleeve was inserted into the bicanalicular silicone tube (group 2). At 6 months postoperatively, the success rate was evaluated and the size of the intranasal mucosal ostium was measured. **Results:** The success rates in group 1 and 2 was 90.5% and 96.4%, respectively (P = 0.400). The intranasal mucosal ostium in group 1 and 2 measured 1.7 ± 0.7 mm and 3.1 ± 1.0 mm, respectively, and the difference was significant (P = 0.042). **Conclusions:** In primary NLDO patients with a high lacrimal sac, DCR inserting a silicone tube and a sleeve together had a satisfactory success rate without using a drill. In comparison with traditional surgical methods, it helped enlarge the size of the intranasal mucosal ostium.

Key words: Dacryocystorhinostomy, nasolacrimal duct obstruction, silicone tube

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In 1989, McDonogh and Meiring introduced endoscopic dacryocystorhinostomy (DCR).[1] Initially, the procedure was not widely used because it was difficult to examine intranasal anatomical structures and the surgical technique was difficult. Recently, with the development of endoscopic and surgical equipment, the procedure has become widespread.[2] To date, the success rate of endonasal DCR was lower than external surgical methods, although many recent studies have reported success rates of 89-95%.[3-5]

The most common cause of the failure of DCR is obstruction of the common canalicular opening or the intranasal bony ostium.[6] Thus, to improve the success rate of surgery, while creating a sufficiently large bony ostium, the common canalicular opening should be exposed during surgery.[6,7] Nevertheless, in patients with a narrow intranasal cavity or those in whom the thick maxilla of the middle turbinate is in front of the common canalicular opening, the formation of a new intranasal mucosal ostium is difficult, and the success rate of surgery is low.[8]

Olver classified the lacrimal sac according to its location relative to the lateral nasal cavity wall as high, normal, and low, and stated that during DCR, it was important to understand the anatomical location of the lacrimal sac.[9] In our study, cases in which a lacrimal probe's entry into the nasal cavity at the level of medial canthal tendon was impeded by a thick maxillary process were defined as having a 'high lacrimal sac'. In patients with a high lacrimal sac, the common canalicular opening is generally exposed by removing the thick maxilla with a drill or laser.[10-14] This additional manipulation requires expert skill, may cause excess tissue damage because of heat, and requires expensive equipment.[15]

Thus, we proposed that the sleeve technique using a 2.5-mm-diameter polyvinyl chloride cutdown tube would help to maintain the size of the newly formed intranasal mucosal ostium, when applied in primary nasolacrimal duct obstruction patients with a high lacrimal sac.[16] We then examined whether it could replace previous methods that using drills to remove the maxilla to expose the common canalicular opening.

Materials and Methods

Institutional Review Board approval was obtained for this study. The medical records of 162 patients with primary nasolacrimal duct obstruction (185 cases) who underwent endoscopic DCR from November 2005 to July 2008 were reviewed retrospectively. Preoperatively, all patients underwent slit-lamp examination, lacrimal irrigation, the fluorescein dye disappearance test, nasal endoscopy, and dacryocystography. Severe stenosis or obstruction of the canaliculus, nasolacrimal duct obstruction secondary to facial trauma or surgery, failed DCR, and cases followed for less than 6 months postoperatively were excluded. Of the patients with primary nasolacrimal duct obstruction, 45 patients (49 cases) were included as patients with a 'high lacrimal sac'.

All surgeries were performed under general anesthesia by the same surgeon. The nasal mucosa was resected with monopolar cautery and removed with an elevator and ethmoid forceps. The lacrimal bone forming the lacrimal sac fossa and the maxilla were removed with a Smith-Kerrison Rongeur and sphenoid punch. The medial wall of the exposed lacrimal sac was incised with a keratome blade and removed with ethmoid forceps. A lacrimal probe was inserted through the lacrimal canaliculus parallel to the medial canthal tendon; cases in which

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the common canalicular opening was located below the thick maxilla of the middle turbinate so that a probe could be inserted readily were defined as having a 'normal lacrimal sac'. Cases, in which the common canalicular opening was located higher than the remained thick maxilla, blocking entry of the probe into the nasal cavity, were defined as having a 'high lacrimal sac'.

For 19 patients (21 cases; group 1) with a high lacrimal sac, seen from November 2005 to May 2007, the common canalicular opening was exposed by removing the thick maxilla in front of the common canalicular opening using drills, and only a bicanalicular silicone tube was inserted. After June 2007, the thick maxilla was no longer removed and a silicone tube covered with a sleeve made from a cutdown tube were inserted (28 cases; 26 patients; group 2).

As reported previously, the sleeve was prepared from a piece of cutdown tube 2.5 mm in diameter (CoX600, Korea medical supply, Korea), one end of which was penetrated by 4/0 black silk [Fig. 1a].[16] Both ends of the silicone tube were inserted through the lacrimal punctum and passed through the sleeve [Fig. 1b]. The ends of black silk were tied together, and the sleeve was pushed as far as possible within the remaining thick maxilla [Fig. 1c]. The silicone tube exposed under the sleeve was pulled out, tied carefully to induce proper tension, and replaced in the intranasal cavity [Fig. 1d].

For 2 months postoperatively, 0.3% ofloxacin and 0.1% fluorometholone eye drops were applied four times per day, and budesonide nasal spray was applied twice a day. The patient was observed 1 and 2 weeks and 1,2,3,4, and 6 months postoperatively. The presence or absence of epiphora symptom was assessed, and lacrimal irrigation was performed. The silicone tube and sleeve were removed 3 months postoperatively. The new intranasal mucosal ostium was examined endoscopically [Fig. 2], and it was measured using a Schirmer strip.

Success was defined as absent epiphora and a good passage with irrigation. Failure was defined as remaining epiphora or no passage with irrigation. When the patient complained of moist eyes despite absent epiphora with good passage, the fluorescein dye disappearance test was performed. Patients who retained more than +1 after 5 minutes were considered failures. The statistical significance of the success rate of surgery was analyzed using Fisher's exact test, and the size of the intranasal mucosal ostium was analyzed using Mann-Whitney U-test. The significance level for a result was less than 0.05.

Results

The mean age of 19 patients (21 cases) in group 1 and the 26 patients (28 cases) in group 2 was 53.0 ± 12.5 and 51.0 ± 13.0 years (P = 0.802), respectively, and the respective ratios of female patients were 84.2% (16 patients) and 80.8% (21 patients; P = 0.768).

Six months postoperatively, the success rate of the surgery 90.5% in group 1 and 96.4% in group 2 (P = 0.400). The diameter of the intranasal mucosal ostium of the group 1 and 2 were 1.7 ± 0.7 and 3.1 ± 1.0 mm, respectively (P = 0.042) [Table 1].

Postoperative complications include the formation of granulation tissues, punctal slitting, sleeve loosening, and silicone tube prolapse. Two patients in each group developed

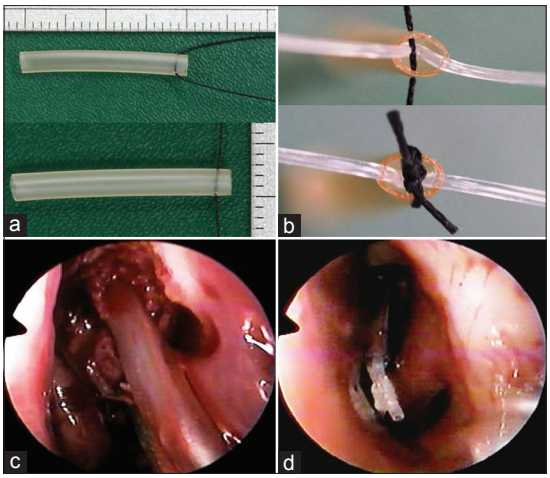

Figure 1: (a) A 2-cm long sleeve was prepared by cutting a polyvinyl chloride cutdown tube (2.5 mm in diameter, CoX600, KMS, Korea), and 4-0 black silk was passed through the distal end of the sleeve. (b) The two strands of the bicanalicular silicone tube were passed through the sleeve on each side of the black silk, and the black silk was tied. (c) The sleeve was pushed into the fundus of the lacrimal sac, surrounded by thick maxillary bone. (d) The two strands of the bicanalicular silicone tube were tied to each other at the distal end of the sleeve

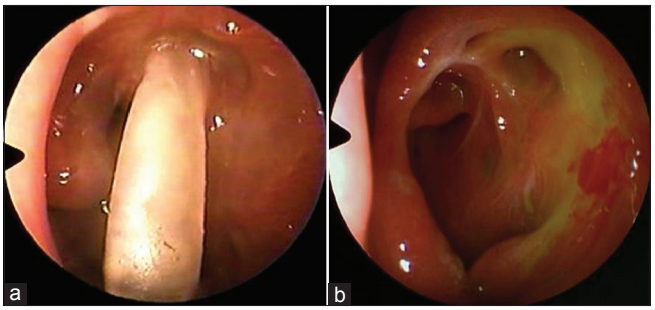

Figure 2: (a) The sleeve with the bicanalicular silicone tube remains in position at 3 months postoperatively. (b) Natural flow of the fluorescein dye through the ostium was noted after instillation in the conjunctival sac after removing the silicone tube and sleeve

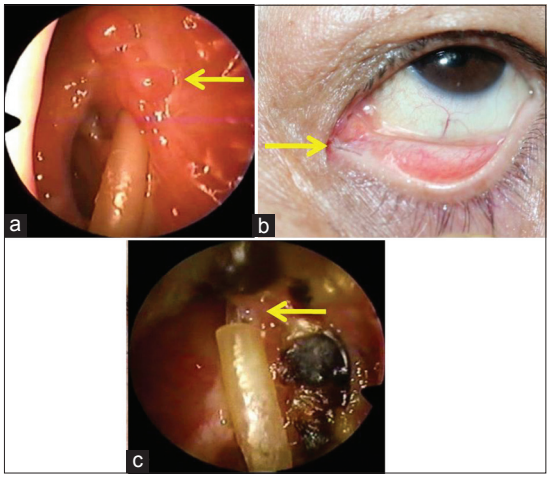

Figure 3: Complications of endoscopic dacryocystorhinostomy using a silicone tube and sleeve: (a) Granulation tissue formation, (b) Punctal slitting, and (c) Sleeve loosening in the nasal cavity

Table 1: Surgical results of endoscopic dacryocystorhinostomy in patients with a high lacrimal sac 6 months postoperatively

	Group 1 (21 eyes)	Group 2 (28 eyes)	*P* value
Success rate	19 (90.5%)	27 (96.4%)	0.400*
Mucosal ostium size (mm)	1.7±0.7	3.1±1.0	0.042†

*Fisher's exact test, †Mann-Whitney U test

granular tissues in the nasal mucosa near the bony ostium (9.5% and 7.1%; Fig. 3a). This was readily removed at follow-up endoscopy. In group 1, the silicone tube was dislocated toward the eye in one case (4.8%), but it was replaced at follow-up as an outpatient. In group 2, punctal slitting was detected in one case (3.6%, Fig. 3b) and the effect of sleeve could not be evaluated in one case, because the sleeve covering the silicone tube was loose (3.6%, Fig. 3c). These complications developed early in our study and appeared to be caused by inappropriate tension during tying the silicone tube and placing it in the nasal cavity. They did not occur once we became familiar with the technique. There was no association between these complications and success of the surgery.

Discussion

It remains controversial whether the size of the intranasal mucosal ostium created by DCR affects the surgery outcome. Nonetheless, many studies have shown that to increase the success rate of surgery, the bony ostium should be as large as possible.[6,17,18] Welham and Wulc reported that the most common reason for failure was inappropriate size or location of the bony ostium.[6] Fayet *et al.*, also reported that the success rate was low when anatomical factors impeded the formation of the intranasal mucosa ostium, such as a narrow intranasal cavity or a thick maxilla located in front of the common canalicular opening.[8]

Classically, the superior border of the lacrimal sac has been described as the thick maxilla above the axilla of the middle turbinate (the anterior point of insertion of the middle turbinate into the lateral nasal wall), and only the upper 0-20% of the lacrimal sac is located higher than the axilla. However, Wormald *et al.*, reported that the upper 8.8 mm of the lacrimal sac was located higher than the maxilla-middle turbinate junction, and the common canaliculus opening was located 5.3 mm below the upper tip of lacrimal sac.[7] Additionally, Jia *et al.*, reported that in 30 eyes of cadavers, 2/3 of the lacrimal sac were located above the maxilla-middle turbinate junction, and 1/3 were located above the common canalicular opening.[19] These results indicate that the lacrimal sac is located higher than traditionally believed and the common canalicular opening is located above the axilla of the middle turbinate.

In our study, 49 of 185 cases (26.5%) had a 'high lacrimal sac'. In patients with a high lacrimal sac, it is difficult to remove the maxilla with rongeurs and punches alone, and drills or lasers are generally needed. Several investigators used drills[10-12] or lasers[13,14] to create a large bony ostium to expose the common canalicular opening, and have reported 75-96% success rate. Nevertheless, surgical procedures using drills or lasers may burn the mucosa, which can impede the surgical recovery, and requires expensive equipment and surgical skill.[15]

In patients whose lacrimal sac was a distance from the intranasal cavity, making it difficult to suture flaps during external DCR, Shin *et al.*, inserted double stents consisting of a silicone tube covered with 3-mm diameter expanded polytetrafluoroethylene (e-PTFE) tube; their success rate was 81.3%, which was higher than the 76.5% for the control group.[20] Additionally, Griffiths obtained large intranasal mucosal ostium using 5-mm diameter Griffiths' collar buttons as stents together with bicanalicular silicone tubes; the stents also serve as a framework, promoting epithelization of the lacrimal mucosal opening.[21] The procedure used to insert the Griffiths' collar button with a collar at both tips into the nasal cavity is similar to our method of inserting silicone tubes and sleeves. Because the flanges of the Griffiths' collar button overlie the newly formed ostium, it may be displaced. In comparison, the sleeve that we used has a very low risk of dislocation because it is tied to the silicone tube. Moreover, sufficient lacrimal sac could be removed because it doesn't require the support of the ostium. Additionally, the Griffiths' collar button is a commercial item, which adds cost, while the sleeve costs very little because it is prepared by cutting inexpensive cutdown tubes.

In our study, when sleeves were used, significantly bigger intranasal mucosal ostiums were generated. The success rate of surgery was slightly higher in cases using the sleeve, although the difference between the two groups was not significant, likely because of the small number of subjects studied. Prospective studies involving more patients are required, as are studies examining the possibility of eliminating the epiphora symptoms effectively with a small intranasal mucosal ostium.

Our study has several limitations. First, it was a retrospective study, and the two procedures could not be performed randomly, but were performed during consecutive periods. However, it does not appear to exert a great effect on the study results because the procedure used to insert the tubes were performed using the same method by a single surgeon and the success rates in both groups were comparable to recent studies reporting high success rates and the success rates are not different significantly.[3-5] Second, the definition of a high lacrimal sac was subjective. In our study, although a single surgeon performed the surgery using identical surgical methods and a standard classification, a more objective classification method is required. Third, the number of subject patients was small. Because we obtained a relatively high success rate in cases when used the sleeve, although the difference was not significant, the size of the control group in which the sleeve was not used could not be increased. Thus, prospective, randomized studies are required.

Conclusions

In primary nasolacrimal duct obstruction patients, in comparison with the surgical procedure that involves removing the thick maxilla using drills, the method using sleeves does not cost more, creates a large intranasal mucosal ostium, and has a comparable success rate. Thus, we believe that our method using a silicone tube and a sleeve in combination can replace the use of drills.

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