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Results of Transmedial-Canthal Ethmoidal Decompression for Severe Dysthyroid Optic Neuropathy

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Purpose: To study the effects of ethmoidal wall (one-wall) decompression using a transmedial-canthal approach (transmedial-canthal ethmoidectomy) for the treatment of dysthyroid optic neuropathy.

Methods: The ethmoidal wall and air cells were completely removed using a transmedial-canthal approach in 6 eyes of 4 patients (mean age = 55 years; age range, 46–69 years) with dysthyroid optic neuropathy. Similar surgery was performed on 2 contralateral eyes in 2 of the patients for cosmetic reasons. The preoperative corrected visual acuity in the 6 eyes ranged from hand motion to 20/100. Centrocecal scotomas were detected using automatic static threshold perimetry in the 6 eyes.

Results: After transmedial-canthal ethmoidectomy, the corrected visual acuity improved to better than 20/20 in the 6 eyes, and the centrocecal scotomas had almost completely resolved. There were no major complications, such as cerebrospinal fluid leakage or diplopia associated with the surgery. There were no relapses during an average follow-up period of 29 months.

Conclusions: These findings suggest that transmedial-canthal ethmoidectomy is an effective and safe therapy for dysthyroid optic neuropathy. **Jpn J Ophthalmol 1999;43:426–432**

Key Words: Dysthyroid optic neuropathy, Graves' disease, orbital decompression.

Introduction

Dysthyroid optic neuropathy is a potentially vision-threatening complication of Graves' ophthalmopathy, although the incidence of optic neuropathy in Graves' disease is relatively low.[1,2] Orbital decompression is indicated for patients with severe dysthyroid optic neuropathy, whereas radiation therapy is not effective for these patients.[3] Many different techniques of orbital decompression, such as lateral or inferomedial orbitotomy, have been described.[4–9] Optic neuropathy does not typically develop in patients with the most severe exophthalmic or congested orbits, but rather in patients with moderate ophthalmopathy.[10,11]

Dysthyroid optic neuropathy is assumed to be a compressive neuropathy caused by enlarged extraocular muscles at the orbital apex.[12] Therefore, orbital decompression at the apex is necessary for the treatment of dysthyroid optic neuropathy. Lateral orbitotomy results in the reduction of exophthalmos, but can lead to secondary strabismus. However, the orbital apex cannot be accessed by lateral orbitotomy, and therefore it is too difficult to relieve compression of the optic nerve by this method.[8,12] Inferomedial orbitotomy, on the other hand, is effective for the decompression of the orbital apex, although the extent of exophthalmos reduction is relatively small. Nevertheless, inferomedial orbitotomy (two-wall decompression) is advisable for patients with severe optic neuropathy.

Recently, two different approaches for inferomedial orbitotomy, transantral and transinferior lid approaches, have been used frequently.[13] The transantral approach is more effective in improving the

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visual acuities of patients than is the transinferior lid approach.[13] However, transantral inferomedial orbitotomy is associated with a relatively high incidence of secondary strabismus after decompression, and when using this approach, there is a possibility of penetrating the dura, resulting in cerebrospinal fluid leakage.[13,14]

To resolve these problems with the two approaches, we have used ethmoidal decompression (one-wall decompression) via a transmedial-canthal approach (transmedial-canthal ethmoidectomy) for the treatment of dysthyroid optic neuropathy. This approach allows us direct entrance into the medial orbital apex without causing damage to the medial periorbita. The anterior ethmoidal artery and the suture between the frontal and ethmoidal bone are good landmarks to indicate the boundary between the ethmoidal sinus and the cranial cavity. With this approach, we are able to remove the ethmoidal wall and air cells completely from the orbital apex without causing damage to the periorbita or the dura. In this study, we performed transmedial-canthal ethmoidectomy for patients with severe dysthyroid optic neuropathy and report the effectiveness and complications of this procedure.

Materials and Methods

Patients

The subjects were four consecutive patients (age range, 46–69 years; mean = 55 years; 4 women) with severe dysthyroid optic neuropathy diagnosed at the Sapporo Medical University Hospital between September 1992 and July 1996. Three of the patients had a 1- to 7-year history of medical treatment for hyperthyroidism. The other patient was diagnosed at our clinic with hyperthyroid Graves' disease, based on the results of blood tests and the typical signs of ocular dysthyroidism. At the onset of visual loss, two of the patients exhibited euthyroidism and two exhibited hyperthyroidism.

All of the patients complained of subacute severe visual loss (visual acuity <20/100) in one or both eyes. Three patients had symptoms of ocular discomfort, proptosis, or conjunctival redness preceding the visual loss. The other patient had visual loss as the initial symptom. The corrected visual acuity ranged from hand motion to 20/100 in the 6 affected eyes. Centrocecal scotomas were detected in 7 eyes using automatic static threshold perimetry of the central 30°. Ophthalmoscopic examinations revealed no abnormalities of the optic disc. The preoperative Hertel exophthalmometer readings ranged from 19 to 27 mm with a mean of 22.4 mm. Computed tomography scans of the orbit revealed enlargement of the extraocular muscles in all of the patients.

Surgical Procedures

Transmedial-canthal ethmoidectomy was performed in the following manner. A skin incision was made medially about 5 mm nasal to the canthus and deepened to the periosteum. The medial canthal ligament was elevated with the periosteum, and the periorbita was then elevated posteriorly to the apex from the medial wall (Figure 1). The anterior ethmoidal artery was exposed and clipped. After exposure of the entire ethmoidal wall, the periorbita was elevated inferiorly. A periosteal elevator was inserted into the ethmoidal sinus just behind the posterior lacrimal crest under the protection of the periorbita using a retractor, and then the ethmoidal wall was elevated. The entire ethmoidal wall and air cells were removed with a pinch forceps below the line of the anterior ethmoidal artery (Figure 1). The periorbita was then incised in an anterior-posterior direction, and orbital fat herniated from the periorbital incision. For all patients, prednisone was administered intravenously (60 mg/day for 3 days) from the day after surgery. Prednisone was also administered orally (20 mg/day for 4 days) to reduce postoperative inflammation of the orbit.

Preoperative and postoperative examinations included visual acuity tests, exophthalmometry, tests of oculomotor range, pupillary reaction tests, and applanation tonometry. Automatic static threshold perimetry of the central 30° was also performed 2 days before and 8 weeks after the surgery. Computed tomography or magnetic resonance imaging scans were performed about 1 week before and 3 months after the surgery for all patients.

Case Reports

Case 1. A 53-year-old woman presented in 1992 with the chief complaint of subacute visual loss in both eyes. Her visual acuity was hand motion in the right eye and 20/300 in the left eye. The lid fissure height was 15 mm in both eyes, and the Hertel exophthalmometer readings were 21 mm for both eyes. The applanation tonometry measurements of intraocular pressure were 24 mm Hg for both eyes. Computed tomography scans of the orbit revealed an enlargement of all rectus muscles in both eyes. Blood tests revealed hyperthyroidism and positivity for the thyroid-stimulating hormone (TSH) receptor antibody. Medical treatment of hyperthyroidism was

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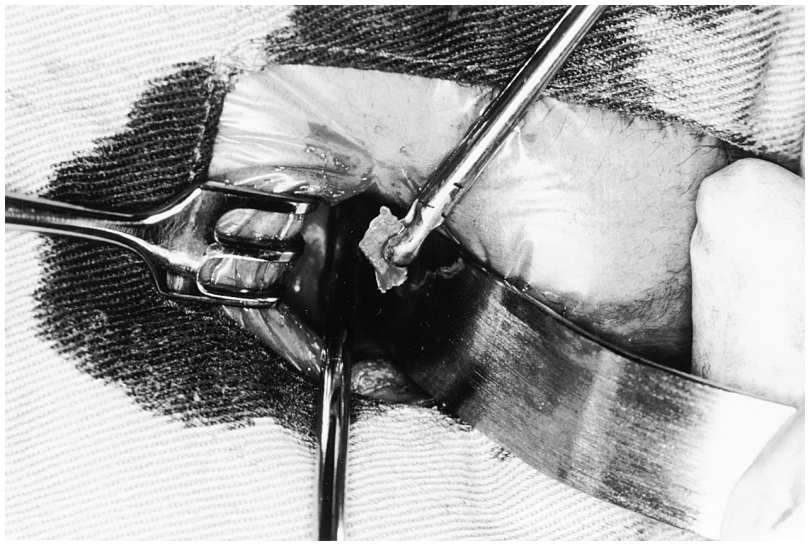

Figure 1. Entire ethmoidal wall and air cells were removed with pinch forceps below line of anterior ethmoidal artery under protection of periorbita by retractor.

started immediately after admission. Automatic static threshold perimetry revealed deep scotomas in both eyes (Figure 2, top left). Prednisone was administered intravenously (1000 mg/day for 3 days) and orally (60 mg/day for 8 weeks). After the prednisone therapy, the patient underwent irradiation to the orbit (24 Gy). However, no improvement of her visual acuities was observed. Bilateral transmedial-canthal ethmoidectomies were then performed 11 and 31 days after the irradiation.

Case 2. A 69-year-old woman presented in 1995 with the chief complaint of subacute visual loss in the left eye. The patient had a 1-year history of medical treatment for hyperthyroidism. Her visual acuity was 20/20 in the right eye and 20/100 in the left eye.

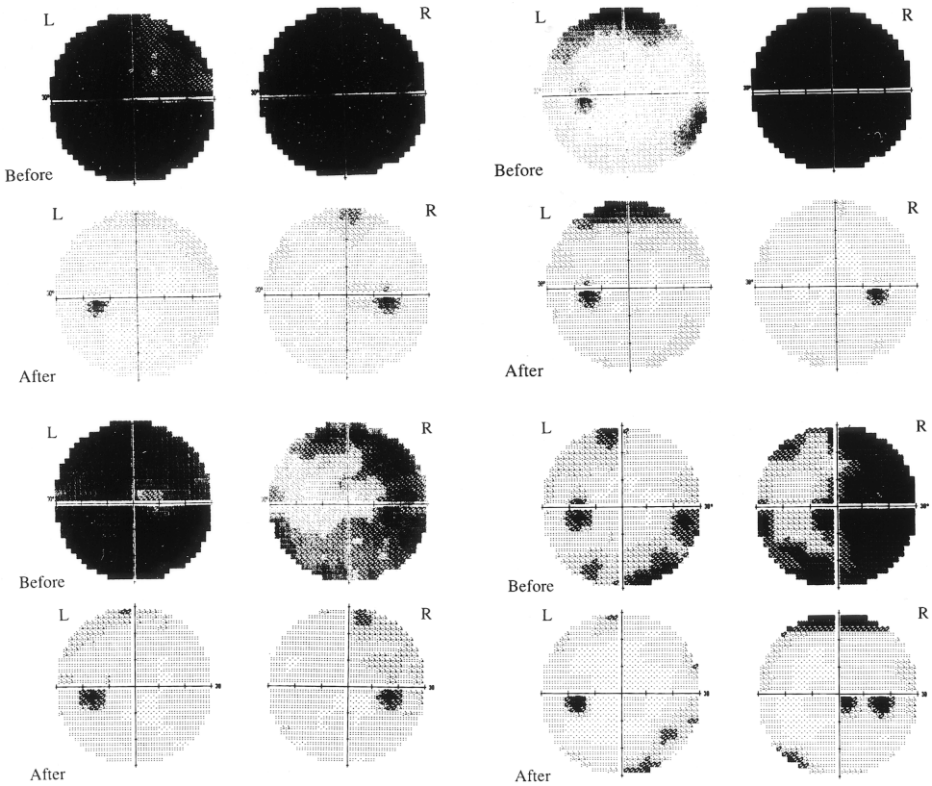

Figure 2. Automatic static threshold perimetry of central 30 degrees before (upper panel) and 2 months after transmedial-canthal ethmoidectomy (lower panel) in Cases 1 (upper left), 2 (lower left), 3 (upper right), and 4 (lower right).

The lid fissure height was 11 mm in both eyes. Hertel exophthalmometer readings were 20 mm for the right eye and 19 mm for the left eye. The applanation tonometry measurements were 18 mm Hg in both eyes. Computed tomography scans of the orbit revealed an enlargement of all rectus muscles in both eyes. Blood tests revealed hyperthyroidism and positivity for the TSH receptor antibody. Automatic static threshold perimetry revealed deep scotomas in the left eye and paracentral scotomas in the right eye (Figure 2, bottom left). Prednisone was administered intravenously (1000 mg/day for 3 days) and orally (80 mg/day for 4 weeks). The patient did not respond to the prednisone therapy, and her right visual acuity decreased to 20/100. Bilateral transmedial-canthal ethmoidectomies were then performed.

Case 3. A 52-year-old woman presented in 1995 with the chief complaint of subacute visual loss in the right eye. The patient had a 1-year history of medical treatment for hyperthyroidism. Her visual acuity was 20/2000 in the right eye and 20/20 in the left eye. The lid fissure height was 10 mm in both eyes. Hertel exophthalmometer readings were 24 mm for the right eye and 22 mm for the left eye. The applanation tonometry measurements were 20 mm Hg for both eyes. Computed tomography scans of the orbit revealed an enlargement of all rectus muscles in both eyes. Blood tests revealed euthyroidism, positivity for the TSH receptor antibody and diabetes mellitus. Automatic static threshold perimetry revealed deep scotomas in the right eye (Figure 2, top right). Prednisone was not administered because the patient had diabetes mellitus. Right transmedial-canthal ethmoidectomy was performed for the optic neuropathy, and left transmedial ethmoidectomy was performed for cosmetic reasons.

Case 4. A 46-year-old woman presented in 1996 with the chief complaint of subacute visual loss in the right eye. The patient had a 7-year history of hyperthyroidism. Her visual acuity was 20/200 in the right and 20/20 in the left. The lid fissure height was 15 mm for both eyes. Hertel exophthalmometer readings were 27 mm for the right eye and 25 mm for the left eye. The applanation tonometry measurements were 25 mm Hg for both eyes. Computed tomography scans of the orbit revealed an enlargement of all rectus muscles in both eyes. Blood tests revealed euthyroidism and positivity for the TSH receptor antibody. Automatic static threshold perimetry revealed deep centrocecal scotomas in the right eye and paracentral scotomas in the left eye (Figure 2, bottom right). Prednisone was administered orally (80 mg/day $\times$ 4 weeks). The patient did not respond to the prednisone therapy. Right transmedial-canthal ethmoidectomy was performed for the optic neuropathy, and left transmedial ethmoidectomy was performed for cosmetic reasons.

A summary of the cases is found in Table 1.

Results

Computed tomography scans of the orbit were taken before and after transmedial-canthal ethmoidectomy in all patients (Figure 3). Before the transmedial-canthal ethmoidectomy, the enlarged medial and lateral rectus muscles were observed to compress the left optic nerve at the orbital apex. During the surgery, the ethmoidal wall and air cells were completely removed, and the medial rectus muscle was shifted toward the midline. The computed tomographic findings after the surgery were similar for all patients.

Changes in the corrected visual acuity were studied before and after the surgery in the 6 eyes of the patients with optic neuropathy (Figure 4). Corrected visual acuity of the 6 eyes ranged from hand motion to 20/100 one day before the surgery. After the

Table 1. Summary of Cases

Case	Age (Years)	Gender	Operation Side	Visual Acuity		Exophthalmometer Reading	
				Preoperation	Postoperation	Preoperation	Postoperation
1	53	Female	Both	HM (R)	20/20 (R)	21 mm (R)	15 mm (R)
				20/300 (L)	20/20 (L)	21 mm (L)	14 mm (L)
2	69	Female	Both	20/100 (R)	20/20 (R)	20 mm (R)	17 mm (R)
				20/100 (L)	20/20 (L)	19 mm (L)	17 mm (L)
3	52	Female	Both	20/1000 (R)	30/20 (R)	24 mm (R)	12 mm (R)
				20/20 (L)	20/20 (L)	22 mm (L)	15 mm (L)
4	46	Female	Both	20/200 (R)	20/20 (R)	27 mm (R)	23 mm (R)
				20/20 (L)	20/20 (L)	25 mm (L)	21 mm (L)

HM: hand movement; R: right; L: left.

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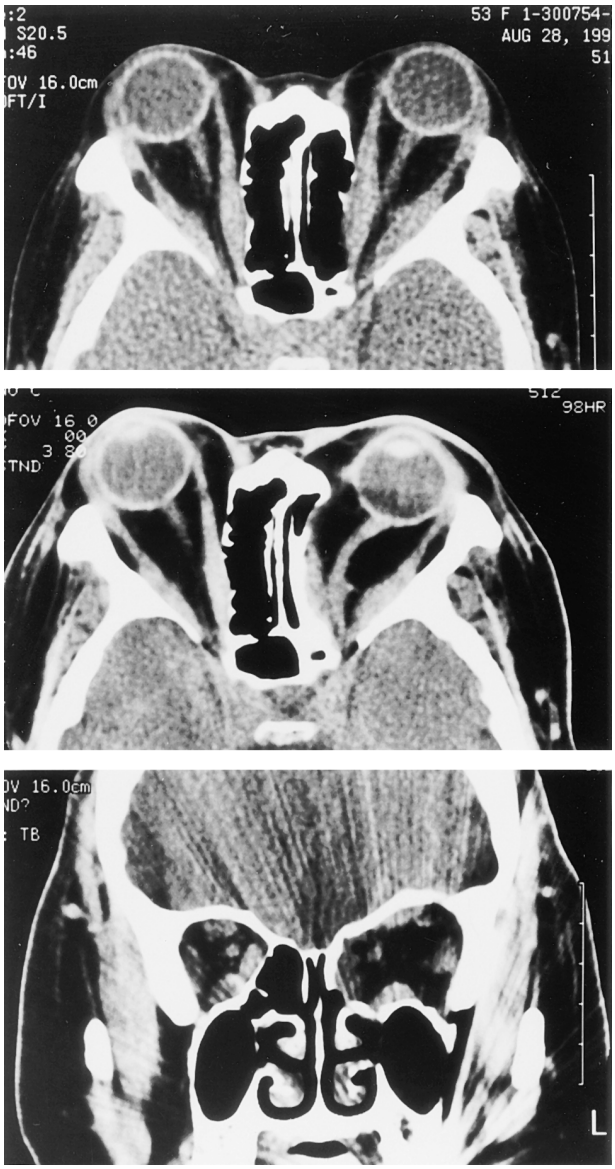

Figure 3. Examples of computed tomography scans of the orbit before (upper panel) and after (middle and lower panels) transmedial ethmoidectomy on left orbit in Case 3. Findings were similar for all cases.

transmedial-canthal ethmoidectomy, corrected visual acuity rapidly improved to at least 20/20 within 10 to 50 days (mean = 29 days). Automatic static threshold perimetry of the central 30° revealed that the centrocecal scotomas were resolved almost completely in all eyes following the surgery (Figure 2). There were no relapses during an average follow-up period of 29 months.

Hertel exophthalmometer readings before the surgery ranged from 19 to 27 mm (mean = 22.4 mm)

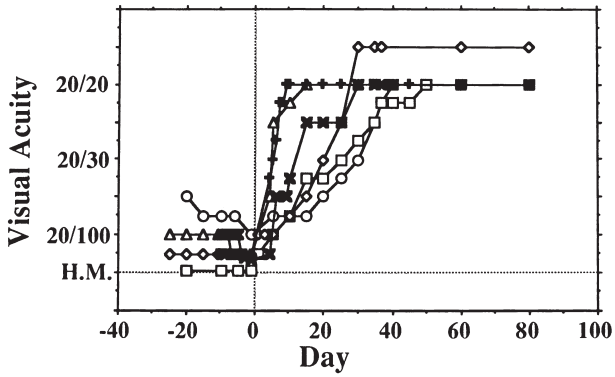

Figure 4. Changes in corrected visual acuity of 6 eyes of patients with dysthyroid optic neuropathy before and after transmedial-canthal ethmoidectomy. Day 0 represents day of surgery.

(Figure 5). Six months after the surgery, the values ranged from 12 to 22 (mean = 16.5 mm). The mean proptosis reduction in Hertel exophthalmometer readings was 5.9 mm (ranging from 2 to 12 mm).

No ocular motility disorder was observed after the surgery in any of the patients (Figure 6). Other complications associated with the surgery, such as entropion or cerebrospinal fluid leakage, were not observed. Scar formation in the medial canthal area was very slight and acceptable at 3 months after the surgery in all patients.

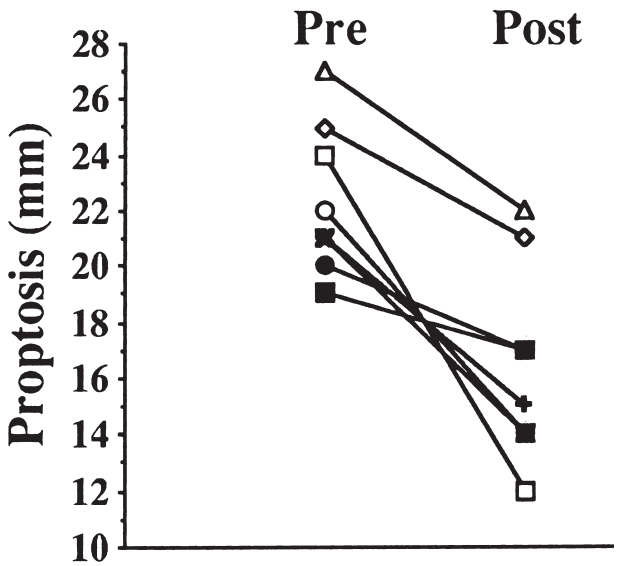

Figure 5. Changes in proptosis in 8 eyes (two patients underwent bilateral surgery.) before and 6 months after transmedial-canthal ethmoidectomy.

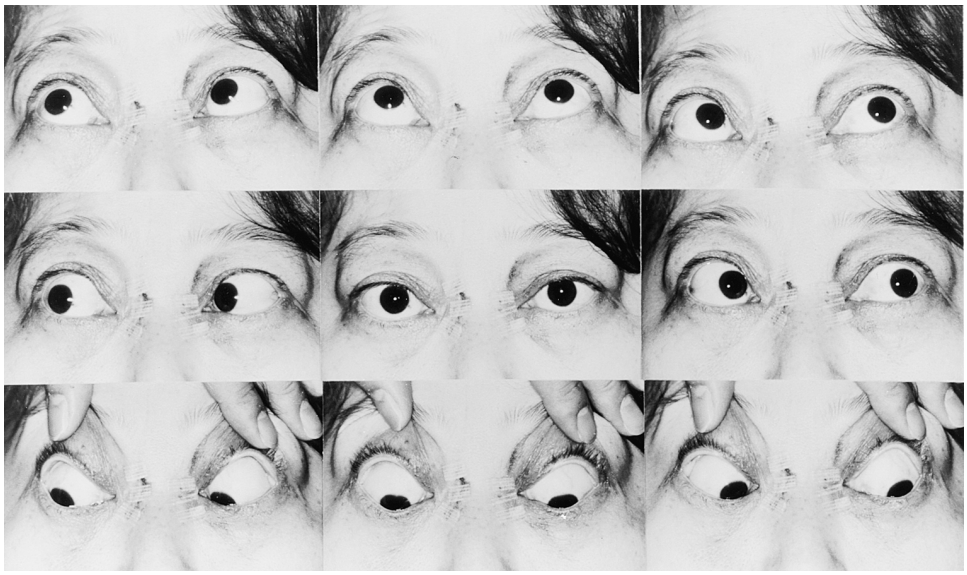

Figure 6. External appearance of eyes looking in primary position and cardinal positions on day 5 after transmedial ethmoidectomy of both orbits (case 4). No limitation of eye movements was noted.

Discussion

The results of the present study indicated that transmedial-canthal ethmoidal decompression (one-wall decompression) is an effective and safe therapy for dysthyroid optic neuropathy. In 6 eyes with dysthyroid optic neuropathy, the corrected visual acuity rapidly improved to at least 20/20, and visual field loss was reversed almost completely following the surgery. The results in this study are much better than the results in other studies using conventional two-wall decompression.[3,13,14]

Two-wall (inferomedial) decompression has been frequently used.[13,14] However, some complications, such as diplopia, entropion, and cerebrospinal fluid leakage, have occurred.[13,14] If the area of orbitotomy can be reduced, the incidence of complications should also be reduced.

Dysthyroid optic neuropathy is assumed to be a compressive neuropathy caused by the enlarged rectus muscles around the orbital apex.[6] To accomplish the decompression of the optic nerve, the posterior end of the ethmoidal wall, which is just anterior to the optic canal, must be removed. The results of the present study demonstrated that one-wall ethmoidal decompression is effective in improving visual acuity. Transmedial-canthal ethmoidectomy may be a suitable procedure for one-wall ethmoidal decompression. This approach enables us to remove the ethmoidal wall and air cells easily at the orbital apex via direct entrance without causing damage to the periorbita and the dura. It is important to avoid damaging the periorbita and the dura during removal of the orbital wall to reduce the incidence of complications. In transmedial-canthal ethmoidectomy, the periorbita is totally elevated from the orbital wall before removal of the orbital wall, and is protected by a retractor during the removal of the orbital wall. In addition, the anterior ethmoidal artery and the suture between the frontal and ethmoidal bone are good landmarks for the boundary between the ethmoidal sinus and the cranial cavity. These landmarks help in reducing damage to the dura during transmedial-canthal ethmoidectomy.

The mean proptosis reduction in Hertel exophthalmometer readings was about 6 mm after transmedial-canthal ethmoidectomy. This value is almost the same as the value obtained after transantral orbital decompression.[4,6,14] In the present study, the 4 patients underwent decompression of only the medial wall. The medial half of the orbital floor can be easily removed using the transmedial-canthal approach. Proptosis reduction of over 6 mm can be achieved using inferomedial orbital decompression. Therefore, inferomedial orbital decompression using the transmedial-canthal approach can be useful for patients exhibiting proptosis.

In summary, transmedial-canthal ethmoidectomy is effective therapy to improve the visual acuities and visual fields of patients with dysthyroid optic neuropathy. This approach enables us to easily remove

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the ethmoidal wall and air cells at the orbital apex via direct entrance, without causing damage to the periorbita and the dura.

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