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Orbital decompression for thyroid eye disease: a comparison of external and endoscopic techniques

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Abstract
The results of orbital decompression for thyroid eye disease are presented in a cohort of 33 patients. It was performed by an external Patterson approach in 21 individuals and in 13 by an endonasal endoscopic approach. The endoscopic approach was entirely comparable in respect of improvement in axial proptosis, giving a mean improvement of 4.4 mm as compared with a mean of 3.8 mm for the external approach, and produced a demonstrable improvement in visual acuity and perception of colour in three individuals, where this was compromised, and was associated with fewer complications.

Key words: Thyroid diseases; Orbit, surgery; Endoscopy

Introduction

There are a number of indications for decompression of the orbital contents but of these, thyroid eye disease is by far the commonest and thus the majority of patients are women. The disease is characterized by significant hypertrophy of the extraocular muscles and fat leading to proptosis and exposure keratopathy, although the exact pathophysiology of the condition is not fully understood (Bahn and Heufelder, 1993). In addition, patients often experience diplopia resulting from asymmetric impairment of the extraocular muscles and compression of the orbital apex which may result in diminished visual acuity, loss of colour vision and defects in the visual field.

Various medical treatments are available, including high-dose corticosteroids, radiotherapy and immunosuppressive agents such as cyclosporin. The steroids are generally required in high doses over long periods which have obvious undesirable side-effects and the radiotherapy, whilst often effective in alleviating optic neuropathy, does not always produce significant resolution of the axial proptosis and thus improvement of cosmetic appearance. For many years the absolute indication for a surgical orbital decompression in thyroid eye disease was failing visual acuity. However, many patients found the cosmetic appearance of proptosis particularly distressing and this has led to a radical reconsideration of our criteria for surgery. The ability to perform this surgery via a transnasal route, under precise endoscopic guidance without an external scar makes it an even more attractive option. This paper compares the results of endoscopic orbital decompression with a conventional external approach in a large sequential series of patients operated on by one surgeon.

Methods and Materials

Patients from the Thyroid Eye Clinic at Moorfields Eye Hospital were referred for orbital decompression between 1989 and 1995. All patients had received specific treatment for their thyroid eye disease, including oral steroids and radiotherapy, in addition to control of the thyroid problem itself. Ideally, surgery was undertaken when the eye disease had been stable for some months but clearly this was not possible in those cases where visual acuity was failing despite medication.

All patients were advised that, potentially, orbital decompression constitutes the first of three corrective procedures, the others being muscle surgery for correction of diplopia and defatting of the eyelids. Muscle surgery was not undertaken until at least three months following the decompression to allow for the effects of the decompression to settle.

Pre-operative assessment

All patients underwent a computed tomography (CT) scan of the orbits and sinuses pre-operatively to assess the anatomy, to demonstrate any covert sinus pathology and confirm the classical features of thyroid eye disease (Figure 1). The axial view shows the massive hypertrophy of the extraocular muscles and orbital fat with concomitant axial proptosis and a degree of autodecompression into

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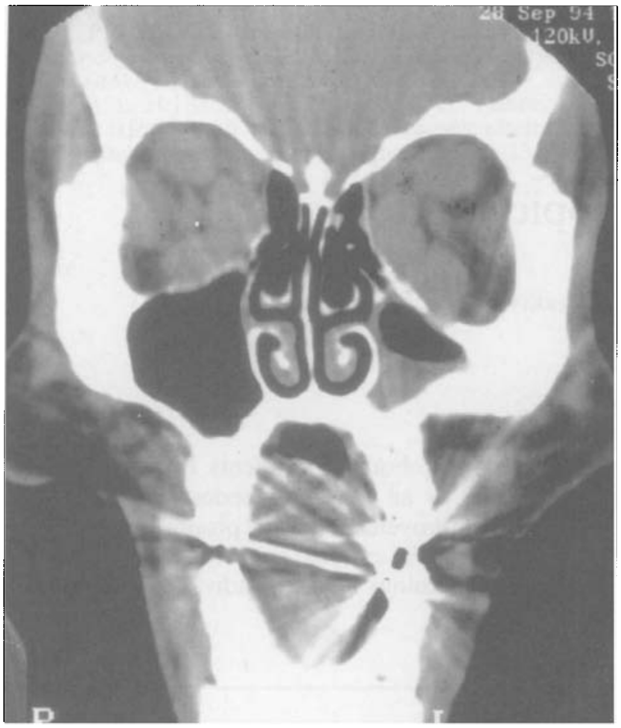

FIG. 1

Coronal CT scan showing muscle hypertrophy, producing an autodecompression into the ethmoids.

the ethmoid labyrinth which produces the classical 'coca-cola bottle' sign (Figure 2).

All patients were under the care of one of two ophthalmic consultants with a special interest in thyroid eye disease and were carefully assessed prior to, and following, surgery.

FIG. 2

Axial CT showing 'coca cola bottle' sign as a result of autodecompression into the ethmoids.

Surgical technique

The procedure is essentially an extension of the standard endoscopic sinus surgery (ESS) (Kennedy, 1985; Stammberger, 1985). It is performed under general anaesthesia with the use of Moffat's solution. The patient lies in a reverse Trendelenberg position and ribbon gauze soaked in 1:1000 adrenaline is packed around the surgical field to achieve additional haemostasis.

As in routine endoscopic sinus surgery the operation commences with an infundibulotomy. This is performed with a sickle knife or preferably Freer's elevator to ensure that the orbit is not penetrated initially. It may be necessary to remove a small anterior wedge of middle turbinate to ensure adequate access to the middle meatus. The bulla is opened and the lamina papyracea defined and skeletonized. In most of the patients one has the advantage of operating within normal sinuses. Any mucosal thickening or previous surgical intervention will be apparent on the pre-operative scan although the presence of chronic sinusitis does not necessarily preclude decompression.

The ethmoids are progressively cleared from front to back, defining the skull base and ethmoidal vessels if present. The sphenoid sinus should be opened either from the posterior ethmoids, by entering it as inferiorly or medially as possible from the last ethmoidal cell, or more safely by direct entry through the natural ostium which can usually be found by direct visualization or blunt probing approximately 1 cm up on the anterior face of the sphenoid, adjacent to the septum in the spheno-ethmoidal recess. In the latter case the bony lamella should be cleared laterally under direct vision to define the ethmo-sphenoidal junction which generally represents the posterior limit of the decompression. In cases where there is severe visual impairment it may be necessary to remove the thick bone of the orbital apex using an endoscopic drill designed for this purpose but in the vast majority of cases, complete removal of the bone anterior to this junction will be sufficient to effect visual improvement. The largest possible middle meatal antrostomy is fashioned to allow adequate access to the orbit.

The bone of the lamina papyracea and medial orbital floor are then removed, either with a small drum elevator or Freer's elevator. The bone at the junction of the lamina with the orbital floor is thick, and strong down-biting forceps are usually required or the bone may be drilled in exceptional cases. Similarly bone should be removed anteriorly with back-biting forceps, 'J' curettes or ball tipped seekers as far as the anterior attachment of the uncinate process with the maxilla. Care should be taken not to damage the nasolacrimal duct which runs anterior to this and it is also advisable to keep the orbital periosteum intact at this stage to prevent prolapse of the fat which will obscure the view of the surgical field.

It is important to go as far posteriorly as the ethmo-sphenoid junction, superiorly to the skull base and laterally as far as possible through the middle

TABLE I
PRE-OPERATIVE ORBITAL STATUS

			Overall (%)	External	Endoscopic
Axial proptosis		n	33 (100)	20	13
	Range	(mm)		19–35	18–31
	Mean	(mm)		27.8	26.1
Diplopia			14 (41)	7	7
Optic nerve compression			3 (9)		3
Reduction in visual acuity					1–6/24 1–6/9 1–6/18
Reduction in colour vision on Ishihara plates					1–1/17 1–11/17 1–16/17

meatal antrostomy, although it is technically often difficult to reach the infraorbital nerve. Bone is removed antero-superiorly in the region of the frontal recess but bone should be retained in the immediate vicinity of the recess to avoid occlusion of the area when orbital fat prolapses into the surgical field.

The actual decompression can only be effected if the orbital periosteum is cut and this is done either with a Beaver knife or disposable myringotomes. Several longitudinal incisions are made starting most posteriorly, and working from inferior to superior. These should be connected by vertical cuts so that the periosteum is completely disrupted. However, great care should be exercised when making the incisions so that only the periosteum is cut. The medial rectus muscle runs in close proximity to the posterior ethmoids and significant bleeding should be avoided. Several blades may be required as the cuts become more difficult as tension on the periosteum slackens and as they quickly blunt.

Very gentle palpation of the globe encourages the fat to prolapse and ideally the orbital contents should fill the majority of the ethmoidal cavity but should not compromise the drainage of the frontal or maxillary sinuses. The decompression at the end of the procedure largely represents the end-result although a small amount of improvement may be anticipated in the first few weeks.

A small Telfar dressing is inserted and removed on the following morning. The patient is instructed not to blow the nose vigorously until after they have been seen in the out-patients' department at two weeks post-operatively. They are usually discharged on the first post-operative day, unless there is significant bleeding or bruising which is rare.

Results

Between 1989 and 1995, 53 patients with thyroid eye disease were referred for orbital decompression. Thirty-three were available for follow up at three-70 months (mean 55.4 months). Only those with full pre- and post-operative assessment were included in the study. There were 20 women and 13 men. Their ages ranged from 20 to 75 years (mean 46.5 years). Twenty-one underwent external decompression via a Patterson's approach through the nasojugal fold (12 men; eight women) predominantly between 1989 and 1993. Thirteen underwent an endoscopic trans-nasal approach, the majority from 1994 onwards (one man; 12 women). Subsequently one patient who had had an external approach had further surgery performed endoscopically and one patient had external revision of an endoscopic decompression on one eye (results not included). Twenty-six patients had bilateral decompressions (15 externally; 11 endoscopically), and seven had a unilateral decompression (five externally; two endoscopically). The indications for surgery were exclusively for thyroid eye disease which had produced significant axial proptosis (Table I). In some the proptosis produced significant chemosis and in four cases it was actually possible for the patient to sublux the globe. Diplopia in the primary position was present pre-operatively in 14 cases (41 per cent). Three patients (nine per cent) had unilateral reduction in visual acuity and reduced colour vision (as assessed by Ishihara colour plates) for which they were taking high dose steroids at the time of surgery. The worst affected patient was amblyopic in the contralateral eye.

In total, 10 patients had received pre-operative oral steroids and eight had undergone radiotherapy. Following decompression oral steroids were not

TABLE II
RESULTS OF ORBITAL DECOMPRESSION

		External	Endoscopic
Reduction in axial proptosis	Range	1–12 mm	1–10 mm
	Mean	3.8 mm	4.4 mm
Change in visual acuity	Pre-operatively		6/24 6/9 6/18
	Post-operatively		6/9 6/5 6/12
Change in colour vision on Ishihara plates	Pre-operatively		1/17 11/17 16/17
	Post-operatively		17/17 15/17 17/17

TABLE III
COMPLICATIONS OF ORBITAL DECOMPRESSION

	External	Endoscopic
Haemorrhage	3	–
Diplopia requiring surgery	4	4
Epiphora	1	1
Paraesthesia of infra-orbital nerve	4	–
Acute bacterial sinusitis	3	–

required (but two patients who had an external decompression received radiotherapy). The results of external and endoscopic decompression are shown in Table II with a mean improvement of 3.8 mm for an external approach and 4.4 mm for an endoscopic approach. In all three cases with unilateral visual impairment, clinical improvement was achieved in visual acuity and colour vision. This was greatest in the patient with amblyopia in the contralateral eye.

Complications (Table III)

The extent of orbital bruising was variable but usually minimal. Three cases of moderate haemorrhage occurred in the external group in the immediate post-operative period which only required the insertion of a vaseline gauze pack overnight in one patient. All patients had been warned that they would experience diplopia or an exacerbation of existing diplopia. This was temporary in four (12 per cent) or permanent in eight cases (24 per cent) (four external cases; four endoscopic cases) and sufficiently severe to require corrective surgery. The patients with temporary diplopia were managed by the use of a prism applied to their spectacles.

Two patients experienced mild epiphora post-operatively (one external; one endoscopic), neither requiring surgery and four external cases had persistent paraesthesia in the distribution of the infra–orbital nerve. This did not occur in any of the endoscopic cases.

No cases of acute bacterial sinusitis occurred in the endoscopic group during the period of follow-up whereas three of the external group had problems; two principally affecting a unilateral maxillary sinus and one the frontal sinus. All were associated with obstruction of the natural ostia and required surgical drainage in two cases (one by an endoscopic middle meatal antrostomy and one by an external Lynch Howarth approach).

Discussion

It has been estimated that between 25 and 50 per cent of patients with hyperthyroidism will develop some form of ocular involvement which will be severe in three to five per cent (Garrity, 1994).

A number of approaches have been used since the turn of this century to effect decompression of the orbit. In 1911, Dollinger described removal of the lateral wall but the amount of decompression by this route was disappointing. Removal of the orbital roof was advocated by Naffziger (1931) although again with limited benefit except that it allowed access to both orbital apices and is still used for some cases where bilateral optic nerve decompression is required. A more satisfactory decompression resulted from removal of the medial and inferior walls, either individually (Sewall, 1936; Hirsch, 1950) or combined (Walsh and Ogura, 1957; Harrison, 1981). Walsh and Ogura employed a transantral approach whereas Harrison modified the Patterson external ethmoidectomy via the nasojugal fold. In either case, the entire medial wall can be removed from the level of the ethmoidal vessels superiorly, as far as the orbital apex posteriorly and across the floor of the orbit to the infra-orbital nerve. It is also possible to remove the orbital floor lateral to the nerve by this route although the extra reduction in axial proptosis derived is only 1–2 mm. In extreme cases removal of three and even all four walls has been described (McCord, 1985).

Using an endoscopic approach it is evident that a similar amount of bone may be removed. Indeed it could be argued that the bone may be removed more accurately and completely using endoscopic visualization. The endoscopic approach obviously avoids an external scar, does not disrupt the attachment of the inferior oblique muscle or medial canthal ligament and avoids damage to the nasolacrimal duct and infra-orbital nerve. However in common with the Patterson's approach, it produces an asymmetric decompression, with retrograde movement of the globe medially and inferiorly. It is, therefore, to be expected that patients experience diplopia in the immediate post-operative period, either *de novo* or as an exacerbation of existing double-vision. This will generally return to pre-operative levels after three to four months and the decision to offer corrective muscle surgery should be delayed until that time. In the interim, patients can be successfully treated with a prism attached to their spectacle lens.

The results by the endoscopic approach are clearly more than comparable to the external Patterson's approach in our own series and compare favourably with the results reported by other approaches. This is of interest given the potential limitation in lateral access for removal of the orbital floor. Kennedy *et al.* (1990) reported an average reduction in axial proptosis of 4.7 mm in three cases who underwent transnasal endoscopic decompression alone. This was improved by a mean of 1 mm when combined with lateral orbitotomy which was performed in a further eight individuals. Metson *et al.* (1994) reported a mean of 3.2 mm in three patients managed endoscopically compared with a mean of 5.6 mm in the eight individuals undergoing additional lateral orbitotomy. Although less encouraging results of 1.5 mm mean reduction were reported immediately following endoscopic surgery by Mann *et al.* (1993), they interestingly found that this increased to 4 mm by six-month follow-up.

Similar results to our own and Kennedy *et al.* (1990) have been reported in large series utilizing a

Walsh-Ogura transantral approach. Warren *et al.* (1989) reviewed 305 patients who achieved a mean recession of 4 mm and De Santo (1980) reported an average improvement of 5.5 mm in 200 patients.

With respect to complications none of our patients undergoing endoscopic decompression experienced problems due to damage of the infra-orbital nerve, and none have had acute episodes of sinusitis which could be considered iatrogenic. This is in contrast to our series of external decompressions in whom four cases have experienced persistent paraesthesia in the distribution of the infra-orbital nerve and three individuals have had acute bacterial maxillary or frontal sinusitis requiring surgical drainage. The incidence of permanent disturbance of the infra-orbital nerve has been reported at four to 55 per cent (De Santo, 1980; Warren *et al.*, 1989) for transantral decompression and in our own patients (four out of 20) is more in keeping with the 23 per cent of patients who complained of pain and/or paraesthesia after Caldwell-Luc for chronic sinusitis (Penttila *et al.*, 1994). De Santo also had an incidence of 3.5 per cent (seven cases) with oroantral fistula requiring closure. Theoretical complications in the long-term might also include the development of a fronto-ethmoidal mucocoele. To date the authors have seen one case following an external decompression via a Lynch Howarth approach performed 15 years earlier.

All routes for decompression are inevitably associated with some degree of diplopia which generally settles to pre-operative levels but for which subsequent muscle surgery may be required. Both this study and Kennedy (1985) *et al.* encountered this with an endoscopic approach, McCord (1985) found it in 40 per cent of transantral decompressions and DeSanto (1980) noted an increase in diplopia from 54 per cent of patients pre-operatively to 79 per cent post-operatively with the same approach. In addition to muscle surgery for correction of diplopia (Kraus and Bullock, 1993), patients should be advised that defatting of the eye lid (Stark and Olivari, 1993; Trokel *et al.*, 1993) and upper lid retraction (Garrity *et al.*, 1993; Liu, 1993) may be addressed at a later date.

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