Surgical Strategy in the Treatment of Globe Protrusion Depending on Its Mechanism (Graves' Disease, Nonsyndromic Exorbitism, or High Myopia)

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Background: Graves' ophthalmopathy affects orbital contents and eyelids. Protrusion of the globe can also be the result of myopia and/or an abnormal orbit shape, which is responsible for nonsyndromic exorbitism. It is necessary to recognize these components of protrusion to treat patients adequately. The authors present a surgical strategy for treatment of the orbit and lids.

Methods: Files of 84 patients treated from 1984 to 2003 were retrospectively reviewed. Sixty-eight patients were operated on for Graves' ophthalmopathy and 16 for nonsyndromic exorbitism with or without myopia. The surgical strategy was adapted to the degree of emergency, the age of the patient, and the shape of the orbit measured using computed tomography. The accepted standard of treatment was a coronal approach with a two-wall expansion, with or without bone grafts, especially in cases of associated nonsyndromic exorbitism, with or without complementary ablation of the external part of the orbital floor. Lid surgery was performed at a second stage.

Results: Nonsyndromic exorbitism patients were successfully treated in one step. No diplopia was present either preoperatively or postoperatively. In contrast, the treatment of the Graves' ophthalmopathy patients justified one to three orbital expansion procedures per patient and/or one to seven procedures for levator palpebrae lengthening or reinsertion. Forty-three percent of preexisting diplopias were improved by the surgery. The overall postoperative incidence of de novo diplopia was 19 percent. In the Graves' ophthalmopathy series, three patients (5 percent) finally underwent strabismus surgery. No major complication occurred.

Conclusions: The treatment of Graves' ophthalmopathy is challenging. A graded approach is justified. Patients have to be informed that several procedures may be necessary and, in cases of nonsyndromic exorbitism or myopia, that facial modifications might occur. (*Plast. Reconstr. Surg.* 117: 553, 2006.)

Protrusion of the ocular globe is the consequence of a dysharmony between the bony orbit and its contents. This imbalance can result from an increase of the orbital contents, that is, exophthalmos. The main etiology for this mechanism is Graves' disease, which involves an increase of volume of the fat and/or oculomotor muscles. The increase in the volume of the ocular globe observed in high myopia can enhance the phenomenon. The other possible mechanism for a globe protrusion is an abnormal orbit shape, which results in nonsyndromic exorbitism.[1] These mechanisms can be associated and have to be taken into account when planning a surgical procedure.

Graves' ophthalmopathy manifests as nonpulsatile exophthalmos secondary to inflammation of the orbital contents, associated with eyelid changes. Upper lid retraction is the most frequent change, but ptosis can also be observed, due to rupture of the tarsal insertion of the levator palpebrae muscle. With prolonged or severe proptosis and lid retraction, keratitis and corneal ulcer may occur.

In the stable phase of the disease, orbital expansion (increasing the volume of the orbit) or

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orbital decompression (decreasing the volume of orbital fat) is indicated for aesthetic and functional purposes (protection of the globe) and to improve quality of life.

To obtain effective and predictable results, it is important to distinguish the anatomical components responsible for the globe protrusion. If Graves' ophthalmopathy appears in a patient with nonsyndromic exorbitism or myopia, the resulting exophthalmos is extremely difficult to treat with the classic procedures.

The aim of this retrospective study was to present a strategy for orbital expansion/decompression and treatment of lid retraction, which has evolved through the observation of the long-term results of a large cohort of patients treated surgically for Graves' ophthalmopathy or nonsyndromic exorbitism.

PATIENTS AND METHODS

Patients

The records of 84 consecutive patients treated for globe protrusion between 1986 and 2003 were retrospectively reviewed. Of these patients, 68 had Graves' ophthalmopathy. Only two patients were treated as an emergency. There were 56 women and 12 men with an average age of 43 years at the time of the first surgical procedure (range, 25 to 67 years). The average time lapse between the onset of Graves' ophthalmopathy and the first surgical orbital procedure was 4 years (range, 1 to 14 years). Treatment of hyperthyroidism had included a total thyroidectomy in 60 percent of the patients. Thirty-seven percent had been treated with carbimazole. Twelve percent of the patients were treated using radioactive iodine. Eleven patients (16 percent) had been treated with external-beam radiotherapy. Forty-three percent had been treated with corticotherapy. Sixty-two percent had diplopia that was either permanent or brought on by fatigue. Forty-four percent had experienced keratitis. Thirty-seven percent of the patients had asymmetrical exophthalmos. Two patients (3 percent) had myopia. The mean ocular tonus was 17 (range, 12 to 34) and the mean visual acuity was 8 (range, 2 to 10).

Sixteen patients (four men and 12 women) were operated on for nonsyndromic exorbitism. Their mean age was 36 years (range, 22 to 55 years). Nine (56 percent) presented with myopia. One patient had an associated ptosis. None of these patients had diplopia. Thirty-one percent of these patients presented with asymmetrical exophthalmos. The mean ocular tonus was 14 (range, 11 to 19) and the mean visual acuity was 7 (range, 1 to 10).

Methods

A multidisciplinary team approach is mandatory for the treatment of this complex pathology. Our team included an endocrinologist, an ophthalmologist, a radiologist, and a craniofacial surgeon.

The preoperative work-up included photodocumentation, with pictures taken before the onset of exophthalmos for evaluation of global premorbid facial morphology and of the ocular region in particular. Preoperative ophthalmological examination evaluated visual acuity, corneal status, and eye muscle motility. Computed tomography was used in all cases to evaluate the degree of exophthalmos, as measured by the ocular distance in front of the bicanthal line.[2] The shape and volume of the orbits and ethmoid sinuses were measured on axial computed tomography slides.[1] The bony facial morphology was subjectively taken into consideration.

The surgical strategy depended primarily on the cause of the globe protrusion. Graves' ophthalmopathy is much more complex to deal with than nonsyndromic exorbitism. Figure 1 summarizes our proposition for a surgical strategy in the management of Graves' ophthalmopathy.

Surgical treatment was divided into two stages: orbital expansion and treatment of lid retraction. Strabismus surgery ultimately followed for three patients but will not be discussed in this study.

Different procedures were used according to the state of the patient's health and the need for emergency surgical treatment. In case of visual loss resistant to intravenous corticotherapy, an emergency orbital decompression is mandatory. Through a subtarsal approach and a subperiosteal dissection of the orbital floor, it is possible to remove the orbital floor, to try to preserve the infraorbital nerve. Infracture of the medial wall provides further expansion.

In the case of severe corneal lesions unresponsive to medical therapy, a levator muscle lengthening was performed at the same operation. We used the technique of graft interposition derived from the procedure initially described in 1981 by Harvey and Anderson.[3] A strip of autologous fasciae latae graft, with a length at least twice that of the degree of lid retraction, is necessary to obtain adequate corneal protection. Müller's muscle is recessed at the same step.

No further surgery was performed until the disease had entered a quiescent phase. After at

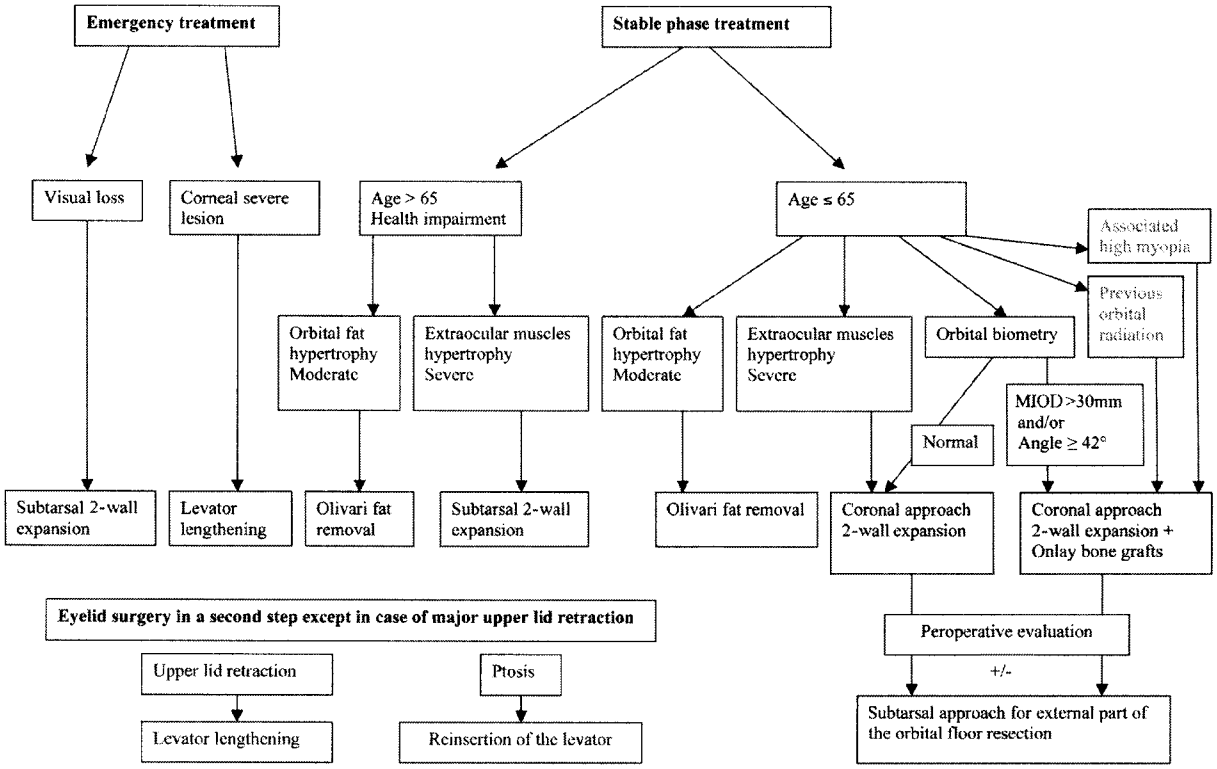


Fig. 1. Algorithm for our surgical strategy in the treatment of Graves' ophthalmopathy, according to the state of the patient's health, the degree of emergency, the orbital morphology, previous history of radiotherapy, and associated high myopia. *MIOD*, midinterorbital distance.

least 1 year of euthyroidism, and with the agreement of the endocrinologist, the surgical strategy was adapted to the age of the patient, the severity of the exophthalmos, and the computed tomography data.

If the patient was older than 65 years and/or suffered from any other pathology contraindicating a lengthy surgery, the surgical procedure was simplified. In moderate exophthalmos caused mainly by orbital fat hypertrophy, we used the translid approach for fat removal, as described by Olivari.[4] In more severe exophthalmos, with extraocular muscle hypertrophy, expansion of the medial orbital wall and part of the orbital floor lateral to the infraorbital nerve was performed using a subtarsal approach. Preservation of the anteromedial portion of the orbital floor is necessary to support the eyeball and to avoid its "falling" into the maxillary sinus. However, in extreme cases, the whole orbital floor may have to be removed.

In patients younger than 65, the Olivari method was used only for moderate exophthalmos caused by orbital fat. The accepted standard for orbital expansion was obtained via the coronal approach. An inferior lid incision was added for resection of the orbital floor. The procedure was planned according to the orbital anatomy. The use of bone grafts was a priori decided in case of associated nonsyndromic exorbitism, which can be stated if the midinterorbital distance is greater than 30 mm and the angle is greater than or equal to 42 degrees.[1] If the nonsyndromic exorbitism was not associated with Graves' ophthalmopathy and required surgical treatment, the procedure described below was performed directly and was sufficient to treat the whole problem in one step in all cases. Aesthetic procedures (two blepharoplasties, three lipofillings, two rhinoplasties, and one genioplasty) were performed separately to enhance the result in six patients.

The first step of the procedure is the same dissection used for a mask lift[5,6]: the complete subperiosteal dissection of the facial skeleton is extended to the superior, medial, and lateral orbital rims and walls and the zygomatic process. The malar process and inferior orbital rim are dissected to the infraorbital nerve foramen. The amount of required expansion is dictated by the degree of exophthalmos and by the degree of

intraorbital fibrosis induced by the disease or by orbital radiotherapy. Fibrous change of the orbital contents in long-standing Graves' ophthalmopathy more often requires removal of a third orbital wall than in more recent, less fibrous Graves' ophthalmopathy. The initial step of burring the superior and lateral orbital rims and walls allows for better visual control and provides the first degree of expansion. The second step in expansion is in-fracture of the medial orbital wall, using a Freer elevator. The fracture is made inferior to the anterior ethmoid artery and posterior to the medial canthus and the lacrimal duct. The second wall for expansion that we routinely consider is the lateral wall. This allows for symmetrical expansion in the axial plane, theoretically decreasing the risk of postoperative diplopia. The anterior one-third of the temporal muscle is raised from the temporal fossa, with care taken to leave 5 to 10 mm of fascia attached to the anterior temporal crest to facilitate repositioning of the muscle after removal of the orbital wall. The lateral orbital wall is removed with saw and rongeur from the orbital roof to the inferior orbital fissure, with care taken to protect the orbital contents. The lateral orbital rim is preserved in all cases. Incisions in the orbital periosteum may be necessary to liberate the orbital contents. A portion of the temporal muscle is excised from its medial side, and the remaining muscle and fascia are sutured back in place.

Reduction of exophthalmos is subjectively evaluated intraoperatively. If a three-wall expansion is required, a subtarsal inferior lid incision is performed as previously described, to resect the part of the orbital floor lateral to the infraorbital nerve. If necessary, some orbital fat may be removed from the anterior portion of the orbital contents superiorly and inferiorly, with care taken not to remove more than 5 cc per eye[4] and not to remove too much posterior orbital fat around the extraocular muscles,[7] because of the risk of producing or aggravating strabismus. Fat removal may be performed through the coronal approach or in a second stage by a translid approach.

At this point, the orbital expansion has been completed. However, whenever the orbital volume is small, the midinterorbital distance is greater than 30 mm, and the angle is greater than or equal to 42 degrees,[1] further orbital enlargement, in a plane axial to the orbit, can be achieved with onlay calvarial bone grafts. A rectangular graft is placed along the lateral orbital rim, and a triangular bone graft is placed obliquely on the anteroexternal side of the malar region to elevate the inferior lid. The grafts are held in place with screws. These bone grafts may also serve to aesthetically enhance the cheek bones. Other possible reasons for using these bone grafts include a past history of radiotherapy—whenever they are irradiated, the orbital contents tend to be fibrous, limiting expansion of the orbital contents into the newly created space—or an associated high myopia.

The lateral canthopexy, performed in all cases, must be pulled tight, to tighten and improve the position of the lax or fibrous lids. It is secured to the temporalis aponeurosis with a nonresorbable stitch. This allows the upper and lower lids to enhance the "strapping in" of the globe and treats the major part of lid retraction. Canthopexy also plays an aesthetic role, lengthening and lifting the palpebral fissure. An onlay bone graft on the nasal bridge increases skin tension in the medial region and may also serve to enhance a small, insignificant, or upturned nose. This is only indicated if the nasal bone grafting induces an aesthetic improvement compatible with the patient's preoperative desire. A graft on the upper orbital rims, as well as a graft on the inferior orbital rim in case of malar hypoplasia, can also be performed.

Other adjunct procedures have to be performed at the time of orbital expansion. Incision of the corrugator muscles is necessary to relax the tension of the glabella, which is maximal in Graves' ophthalmopathy. The shape of the orbital rim may be modified, especially in cases of "cocker spaniel eye," to decrease the lateral ptosis of the orbit. Frontal rounding with burring of frontal bossing gives a more youthful appearance. Partial excision of the frontal muscles reduces frontal rhytides. A mask lift may have to be performed with resection of a 5- to 10-mm band of the scalp, to increase forehead height and give a more youthful appearance.[6] Genioplasty, submental lipoaspiration, lipofilling of the nasolabial folds, and even botulinum toxin injection may supplement the orbital expansion for facial aesthetic modifications.

The scalp is closed over nonsuction drains. A pressure dressing is applied over the entire scalp, upper face, and eyes at the end of the procedure. It should be changed at day 2 and be left in place for 4 days.

Special precautions are indicated to avoid severe chemosis and lid edema in the postoperative period, even in long-standing, stable Graves' ophthalmopathy. Intraoperative and postoperative systemic steroids are prescribed for 48 to 72 hours. At the beginning of the procedure, a subconjunctival steroid injection is performed bilaterally. Ste-

roid-containing eye gel is applied before the pressure dressing, and steroid-containing eye drops are prescribed once the pressure dressing is removed. Blepharorrhaphy protects the cornea under the dressing as well as the edematous conjunctiva in the postoperative period, and is often left in place up to the sixth postoperative day.

The second part of the surgical treatment is the management of the lid deformities. Except in cases of major initial lid retraction, we prefer to perform levator muscle lengthening as a second stage, because of the unpredictable effects of the lateral canthopexy and bone grafts on lid position.

In the case of upper lid ptosis, the approach and dissection are the same as for levator lengthening, but the distal end of the muscle is sutured to the superior border of the tarsus. For refractory lid retraction, sectioning of the muscle, along with Müller's muscle, may be performed; there is a risk of ptosis, but sufficient corneal protection is provided.[8] A permanent tarsorrhaphy may also treat refractory retraction.

RESULTS

Figures 2 and 3 summarize the surgical treatment performed in this study. It should be noted that eight patients initially had fat extraction or lid procedures at other institutions. The mean follow-up for the series was 70 months (range, 3 to 184 months).

The non-Graves patients were far easier to treat, as a fair result was obtained in one procedure in all cases, except for the ptosis, which required two additional procedures. The postoperative ocular tone was unchanged (mean, 14; range, 11 to 17). The visual acuities were slightly improved (mean, 7.5; range, 1 to 10). No diplopia was noted. Complications were one case of dysesthesia of V2, one case of postoperative blindness followed by total recovery, one case of keratitis, and one case of corneal ulceration.

Treatment of the Graves' ophthalmopathy was far more complex, as summarized in the algorithm. Among the 63 patients treated with orbital expansion/decompression, 32 (51 percent) were operated on at least twice (maximum, three procedures). The postoperative ocular tone was unmodified (mean, 17; range, 12 to 22), as was the visual acuity (mean, 8; range, 2 to 10). The result of the orbital surgery on diplopia was positive. Among the 62 percent who presented a preoperative diplopia, 43 percent were improved by the surgery. The diplopia persisted in the remaining 57 percent. The overall postoperative incidence of de novo diplopia was 19 percent. All cases but one resolved spontaneously or after reeducation. The patient who developed a persistent diplopia was successfully treated with strabismus surgery. In the whole series, three patients (5 patients) finally had to undergo strabismus surgery. One of them subsequently developed lower lid retraction that was successfully treated with a palate mucosa graft. The other complications were keratitis (n = 16, with one case of corneal ulceration), hypoesthesias of the V2 nerve (n = 3), ptosis (n = 1), reactivation of the Graves' ophthalmopathy (n = 1), postoperative sepsis requiring drainage of the maxillary sinus (n = 1), and bone graft rejection (n = 1).

Among the 41 patients treated with lid surgery, 19 were operated on at least twice (maximum, seven procedures). The main complication was overcorrection/hypocorrection, which required reoperation. Leg muscle hernia after repeated harvest of fasciae latae occurred in one case and was effectively treated with a nonresorbable surgical patch. An upper lid conjunctival hernia occurred in one patient who underwent lid length-

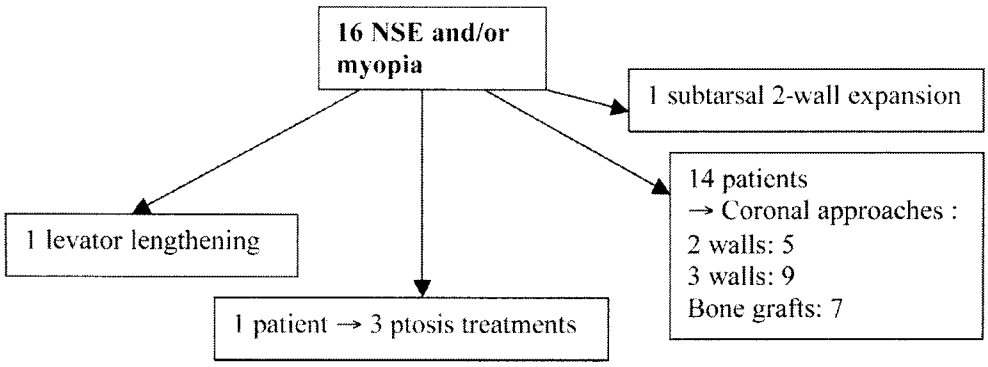
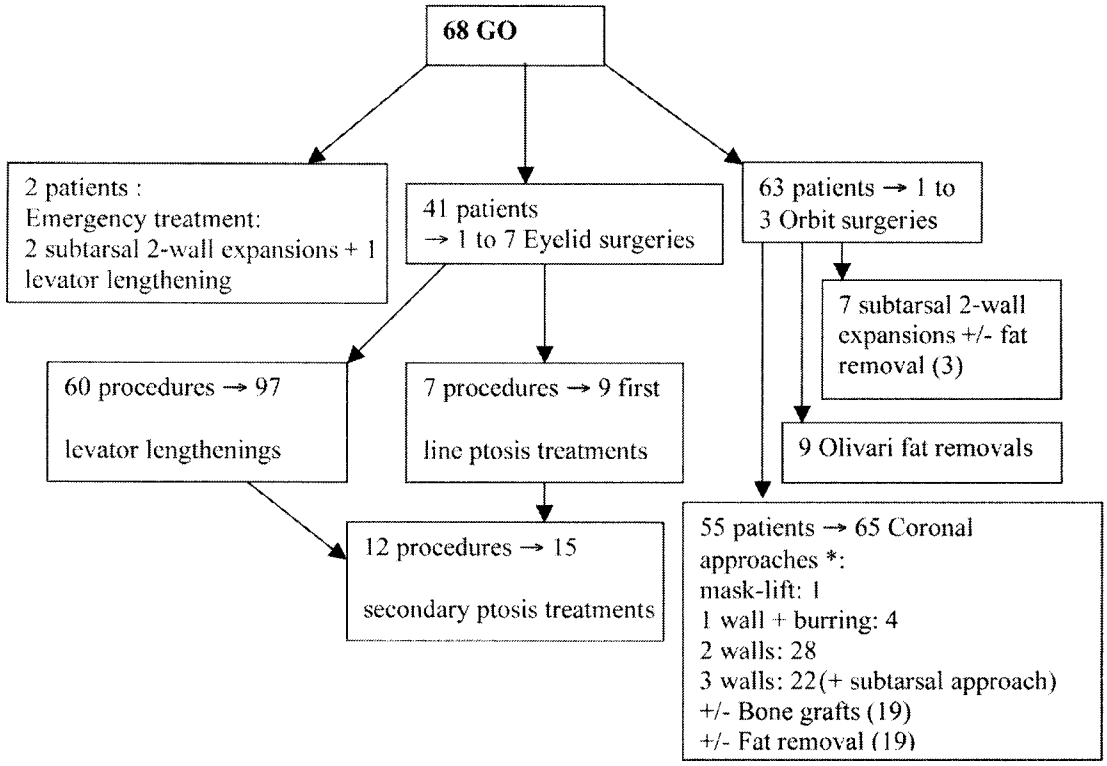


Fig. 2. Algorithm for the treatment of the 16 patients without Graves' ophthalmopathy. *NSE*, nonsyndromic exorbitism.



* 55 patients underwent at least 1 coronal approach. What was on the whole performed through these approaches (sometimes in more than one step) is detailed below.

Fig. 3. Algorithm for the treatment of the 68 patients with Graves' ophthalmopathy (*GO*). Many patients had multiple procedures.

ening three times. The excess conjunctiva was successfully resected.

Preoperative and postoperative computed tomography scans were available for only 34 patients. They were performed over a time period ranging from 2 months to 12 years postoperatively. The results may be biased, especially if the scan was ordered because a recurrence of the exophthalmos was reported. The mean reduction of exophthalmos between preoperative and postoperative scans was 4.5 mm (range, 0 to 8.5 mm) for the coronal approach and three-wall expansion, 2 mm (range, 0 to 5 mm) for the coronal approach and two-wall expansion, and 2 mm (range, 0 to 3 mm) for the Olivari lipectomy. An aesthetic improvement was always obtained, as can be seen in Figures 4 through 8).

DISCUSSION

Surgical orbital expansion for Graves' ophthalmopathy was first described by Dollinger in 1911. Since then, a large number of approaches for increasing the volume of the orbital "container" or decreasing the volume of the orbital contents have been described. Among these procedures, we do not recommend the neurosurgical approach,[9,10] the transantral approach,[11,12] or malar valgisation.[7] Neurosurgical approaches provide a maximum of orbital expansion and may be necessary in extremely severe proptosis with optic nerve compromise. However, the inherent risk of a life-threatening complication (such as meningitis, intracranial hemorrhage, and cerebrospinal fluid leak) makes this approach unsuitable for what is frequently an aesthetic problem. In the transantral approach, there is more chance of infection than with the subtarsal approach. However, this approach can be justified when there is a need for a decompression of the optic nerve. Out-fracture of the malar and lateral orbital rim is a beautiful technique, first described by Dr. Paul Tessier and developed by Dr. S. A. Wolfe, which

Fig. 4. Case 1. (*Above, left*) Preoperative view of a 38-year-old woman with nonsyndromic exorbitism and high myopia of the right eye. (*Above, right*) Postoperative view 1 year after two-wall expansion of the right orbit, burring of the orbital rim, and medial wall expansion of the left orbit. No bone graft was required for this mild unilateral proptosis, but bone grafting would have been necessary in a case of associated Graves' ophthalmopathy. (*Below, left*) Preoperative computed tomography scan. (*Below, right*) Postoperative scan.

can be an alternative to the use of bone grafts. However, it seems to us that taking into account the psychism of the Graves patients leads to choosing first a technique that will minimize the risk of facial change and offer the shortest postoperative recovery time. It should be held in reserve for certain long and flat faces, or for full-moon faces with thick and heavy skin.

Our therapeutic strategy for Graves' ophthalmopathy is summarized in Figure 1. It is based on the degree of emergency, as well as the state of the patient's health, the results of the orbital biometry, and the patient's desires.

In emergency cases, the expansion must be minimally invasive to save vision without risking an overcorrection of the proptosis in case of a secondary regression of the ophthalmopathy. In cases of extraocular muscle hypertrophy, fat extraction will not be sufficient to relieve the intraorbital pressure. The subtarsal approach for two- wall expansion is then preferred to the coronal approach. The less the inflammatory orbital tissues are dissected, the better. We do not use transcanthal approaches to avoid scarring the lid margin. In this context, protection of the cornea often requires a lengthening of the levator palpebrae, as a single tarsorrhaphy will not be possible without an excess of tension.

At the stable phase, each approach has to be considered according to the patient's health, his or her expectations, and the degree of the exophthalmos. Lipectomy is fast and relatively easy to perform. Used alone, however, proptosis reduction is often insufficient, because of a predomi-

Fig. 5. Case 2. (*Above, left*) Premorbid appearance of a 44-year-old woman with Graves' ophthalmopathy. (*Above, center*) Preoperative view. (*Above, right*) Postoperative view 3 years after three-wall expansion and bone grafts on the orbital rims and the nasal bone. Five procedures were necessary to correct the upper lid retraction. (*Below, left*) Preoperative computed tomography scan. (*Below, right*) Postoperative three-dimensional scan.

nance of extraocular muscle hypertrophy as compared with excess fat.

One-, two-, and three-wall expansion, excluding the orbital roof, allows one to tailor the degree of orbital enlargement to the degree of exophthalmos. One-wall expansion, however, be it the medial wall (for which expansion can be performed by the endoscopic sinus surgery approach[13,14]) or the orbital floor, has the disadvantage of inducing a medial or inferior "deaxing" of the eyeball, with the risk of inducing diplopia. It is moreover not sufficient to provide a significant reduction of proptosis. We no longer use this technique. Translid, canthal, and transconjunctival incisions traumatize the already pathological lid structures and may leave visible scars.

Our preference for the coronal approach, whenever the patient's health is compatible with this procedure, stems from its many advantages. The scalp incision carries no aesthetic sequelae. Bilateral expansion is performed simultaneously, and the wide exposure facilitates the comparison of the orbits to assure symmetry. Medial and lateral walls are treated in all cases to obtain a symmetrical expansion in the coronal plane. The lateral wall has to be totally removed, and the edges of the resection have to be smoothed to avoid entrapment of the rectus lateralis muscle. If a three-wall expansion is required, we remove only the lateral part of the orbital floor by a translid approach, preserving the medial support of the eyeball to minimize postoperative dysmotility.

Fig. 6. Case 3. (*Left*) Preoperative view of a 43-year-old woman with Graves' ophthalmopathy. (*Right*) Postoperative view 3 years after three-wall expansion and a nasal bone graft, followed 1 year later by a ptosis correction and Olivari's fat extraction.

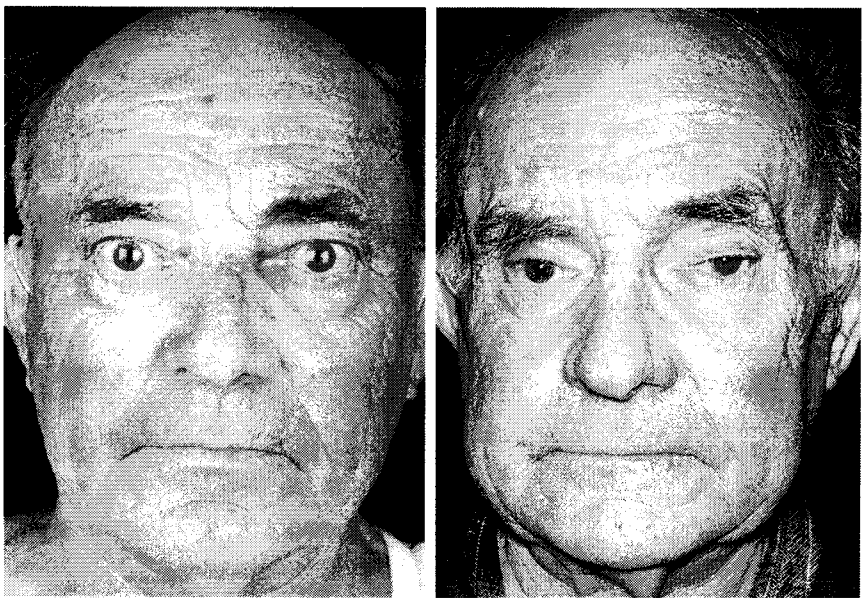


Fig. 7. Case 4. (*Left*) Preoperative view of a 67-year-old man with Graves' ophthalmopathy. He had diplopia and visual loss. (*Right*) Postoperative view 10 years after an emergency two-wall expansion followed 1 year later by a levator palpebrae lengthening. Although the initial result was good, aging of the orbit and the absence of recurrence of the Graves' disease led to a left enophthalmos.

This supplementary incision is necessary to prevent an infraorbitary nerve injury during resection of the orbital floor. Further orbital enlargement can be obtained using calvarial bone grafts, harvested through the same coronal incision. The need for bone grafts in surgical treatment of Graves' ophthalmopathy can be predicted based on the orbital shape and size[1] in patients previ-

Fig. 8. Case 5. (*Above, left*) Preoperative view of a 65-year-old woman with malignant Graves' ophthalmopathy justifying an emergency procedure. (*Above, right*) Postoperative view 6 years after emergency expansion, a secondary coronal approach for three-wall expansion, and three procedures for upper lid lengthening. Strabismus surgery was performed by another team was followed by a lower lid retraction, treated with chondromucosal graft. (*Below, left and right*) Preoperative and postoperative lateral views.

ously treated with radiotherapy or in cases of associated high myopia. Other techniques do not provide for this further enlargement. If performed by an experienced team of maxillofacial and ophthalmologic surgeons, these procedures are well tolerated and have an acceptable rate of complications. Nineteen percent of our patients developed diplopia after surgery, similar to the 19 percent rate reported by Paridaens et al.[15] for the coronal/translid approach or the 18 percent re-

ported by Lyons and Rootman[16] for a translid approach. It is of note that in our non-Graves patients, no diplopia existed before surgery and no diplopia occurred de novo, thus suggesting that diplopia is more attributable to the Graves' ophthalmopathy than to the surgical techniques alone. The difference in outcome between our Graves patients and our nonsyndromic exorbitism/myopic patients corroborates this fact, as does the stability of the surgical results in this population after no more than one orbital expansion and/or one palpebral procedure per patient.

Lateral canthopexy is performed in all cases, as the first step in repositioning and tightening of the stretched, lax lower lids. This is generally sufficient to correct the lower lid retraction. No exogenous material should be used for this purpose. A palate mucosa graft was required only once in this series. Modification of the orbital contour by burring can also be performed, according to preexisting orbital morphology. Correction of the lateral slant of the orbit in "cocker spaniel" eyes, or enlargement in initially small eyes, can provide aesthetic improvements as compared with the premorbid orbitofacial morphology. The rate of postoperative keratitis was greatly diminished by the systematic use of steroid subconjunctival and systemic injections, steroid eyes drops, and blepharorrhaphy.

Treatment of upper lid retraction is difficult and discouraging, a fact reflected in the many different approaches described, such as Müller's muscle excision, levator stripping, levator marginal myotomy,[8,17] and levator elongation by placement of a spacer. We prefer this latter technique, and in the past have used preserved sclera and, now, autologous fasciae latae.[3] The consistency of the latter is better than that of fascia temporalis. This technique allows for preservation of levator muscle continuity and lid function. Levator myotomy alone can lead to ptosis and upper lid immobility. We have found our technique to be reliable and sufficient when combined with the lateral canthopexy performed during coronal orbital expansion. We recommend overcorrection with a graft twice the length that is needed. Even with overcorrection, treatment of eyelid retraction may require several procedures to obtain adequate corneal protection. Because eyelid modification after orbital expansion is unpredictable, we recommend not performing any upper lid procedure at the same time as the orbital expansion, except in cases of a major preexisting upper lid retraction. After expansion, this retraction is generally increased. Particularly in these cases, the patient must be informed preoperatively that a second procedure may be necessary after 1 week to correct an excess or a lack of overcorrection. If this second procedure is not performed after the first week, one has to wait for at least 1 year before doing it. Meanwhile, the dissection can be very difficult.

Use of botulinum toxin to treat upper lid retraction in previously unoperated eyes has been reported.[18] In our experience, this technique has not been effective, at least as a second-step procedure. It seems that the muscle location after lid-lengthening surgery may vary, rendering percutaneous injection of botulinum toxin unreliable unless an electromyographic guidance is used.

In our experience, ptosis was caused by rupture of the levator muscle's tarsal insertions. Repair consisted of simple translid suture of the muscle to the tarsus.

Although a real quality-of-life study would be justified, the general feeling of the patients is in favor of a significant benefit in terms of quality of life after the proptosis surgery. The cosmetic procedures that we frequently include in our surgical management are undoubtedly part of this benefit.

CONCLUSIONS

The treatment of the exophthalmos in Graves' ophthalmopathy has to be associated with the treatment of the lid pathology. Surgical two- or three-wall expansion of the orbit by a coronal approach is the accepted standard that we usually recommend as a first step, except in older patients. Bone grafts, mask lift, frontal remodelling are adjunctive procedures made possible by the coronal approach and are not possible with other orbital expansion techniques. The treatment of a nonsyndromic exorbitism has to be adapted to the orbital biometry, using bone grafts. The results of the surgery are usually satisfying and stable. In contrast, treatment of Graves' ophthalmopathy is a challenging task. It must be adapted to each case, with the knowledge that further evolution of the disease can lead to recurrence of the exophthalmos, the lid retraction, and the diplopia. The difficulty in managing this disease and the psychological characteristics of patients with Graves' disease lead us to recommend a global approach using a multidisciplinary team. Graves' ophthalmopathy appearing with nonsyndromic exorbitism or a preexisting myopia constitutes the most complex type of case. In these cases, the results of standard surgery are not good. It is necessary,

therefore, to recognize them and treat them adequately to optimize postoperative results.

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