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EDITORIAL

Stereotactic navigation for lateral orbital wall decompression

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The orbital surgeon has a *prima facie* obligation to perform the safest and most efficacious orbital decompression possible for a patient with proptosis in thyroid-associated orbitopathy. Orbital decompression has essentially involved the removal of one, two, three, or rarely, four orbital walls. To that has been added a variable degree of fat removal and, in some patients, periorbital onlay implants. A high incidence of postoperative diplopia in patients undergoing inferomedial orbital decompression led to the recognition of the inferomedial orbital strut. Retention of this strut reduced, but did not eliminate the incidence of diplopia. In the 1990s, many surgeons started using balanced orbital decompression with decompression of the medial and lateral orbital walls, with an impressive reduction in new postoperative double vision.

Goldberg *et al*[1] has, more recently, championed the lateral wall decompression as being the ideal decompression in patients with mild-to-moderate proptosis, arguing that the risk of postoperative double vision is minimized. Although his group has shown the anatomy of the lateral orbital wall and the area to be decompressed well, emphasizing the three key areas of decompression, namely, the lacrimal keyhole, the orbital door jamb, and the basin of the inferior orbital fissure, surgeons have approached the lateral wall with trepidation. Observing several established orbital surgeons over the years, I was struck by how gingerly some surgeons approached the lateral orbital wall, whereas others attacked the lateral orbital wall with gusto, but with no clear demonstration of anatomical guidelines. This was by no means universally true, but although their understanding of the anatomy and the degree of decompression required for the medial wall and orbital floor decompression was exemplary, the same could not be said of their understanding of the lateral orbital wall.

The reason for this observation, undoubtedly, is because the limits of decompression of the lateral orbital wall are not well established. The posterior limit of the deep lateral wall decompression is difficult to define intraoperatively. We know that the lateral orbital wall thins out posteriorly, making us cautious when operating in this region. Kakizaki *et al*[2], in a study of Asian cadavers, found that the average distance from the orbital rim to the posterior border of the deep lateral orbital wall was approximately 33 mm (range: 28–38 mm). However, the width of the posterior border of the lateral orbital wall had a wider range (12–24 mm) with an average of 17 mm. Although these measurements may act as a guide during surgery, the wide variation makes it difficult to have definite guidelines. Also, similar measurements in the Caucasian adult skull have not been determined. Preoperative CT assessment of the lateral wall may help to some degree, but the prime fear during a lateral posterior decompression, is the risk of entry into the anterior and middle cranial fossa when one is unsure of the location of the instrument and thickness of the bone.

In another anatomical study of the posterior lateral orbital wall, Beden *et al*[3] recommended that bone removal of the lateral orbital wall should start from the thickest inferior part of the deep lateral orbital wall. However, their study did not establish reliable parameters for lateral orbital wall decompression.

The application of stereotactic navigation is well known to neurosurgeons, orbital surgeons, and to otolaryngologists.[4] An initial report where this technique was used in orbital decompression involved its application in medial wall decompression, a more traditional use of this technique.[5] Whereas stereotactic

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localization is mostly used for localization when performing surgery in sinuses, the study by Millar and Maloof in this issue looks at its use in lateral decompression specifically (they also performed a medial decompression without the use of navigation). The deep lateral orbital wall is the face of the greater wing of the sphenoid posteromedially and the trigone posterolaterally. The lateral wall is thickest inferiorly. The limits of superior decompression vary as the bone thins out in this region. It is here that the surgeons found the navigation to be most useful. They were able to remove all bone that was 1.5 mm or thicker as determined by surgical navigation. Specifically, they used it to determine the safe maximal superior limit of the lateral wall decompression. They further decompressed between the superior and inferior orbital fissures to decompress the lateral wall posteromedially. There is no doubt that knowing where one is allows a more impressive decompression. The authors achieved an average proptosis reduction of 9.36 mm (range: 7–12 mm). None of their seven patients suffered new onset postoperative diplopia. This is an impressive reduction in proptosis as previous balanced medial and lateral wall decompressions have achieved 4.1–5.6 mm reduction in proptosis.

Could it be too much of a good thing? It is clearly important to review patients' premorbidity photographs to ensure that one achieves an adequate decompression. In this study, decompressions as high as 12 mm were achieved. One patient's Hertel measurement was reduced from 21 to 13 mm. The measurement of the opposite eye is not stated. There were others reduced to 14 and 15 mm, and these may be excessive. Furthermore, we cannot effectively predict further orbital changes following such aggressive decompression: will patients become more enophthalmic over time? Their follow-up ranges from 9 months to 3 years. The authors also aimed to 'safely bare the dura of the anterior and middle cranial fossa'. The need for this may be argued. Certainly, most orbital surgeons would err on the side of caution and leave a bony face at these sites.

The introduction of technology requires an analysis of its potential impact using the principles of evidence-based medicine. We must show an improvement in efficacy, and an improvement in complication rates. The only other study using stereotactic navigation for orbital decompression applied it for medial wall decompression; it did not find a statistically significant improvement in outcomes when compared with patients who underwent surgery without image guidance.[5] They did note, however, that there was a subjective improvement in surgeon confidence.

The authors found that the addition of this technology only added 10 min to their operating times. This, of course, will vary, but once established, others have also found that it does not increase surgical time significantly.[6] Another limitation with the current stereotactic technology is that it only enables a surgeon to navigate with images obtained before the surgical intervention. Although soft tissue deformation is limited in lateral orbital wall decompression, the appeal of real-time imaging of the changing intraoperative anatomy during the course of the procedure is clear.

What price technology? Stereotactic guidance technology is expensive with most platform list prices starting at $200 000 or more. Moreover, the technology is upgraded continuously, adding significant costs to maintain the platform hardware and software. Metson *et al*[7] reported that the use of stereotactic guidance technology increased hospital costs by $496 per case in 1998 in the United States. Millar and Maloof noted an increase in their institutional cost of $ 500 in Australia. However, the costs vary widely. In the United States, there is a technical and surgical component to the cost, which currently adds several thousand dollars to the cost of the procedure. From 2009, Medicare no longer pays the operating theatre separately for the technology when used, making it difficult to convince hospitals to invest in the technology.

Finally, the question arises: is it required for every case? The use of this technology is not a substitute for comprehensive surgical training, knowledge of surgical anatomy, and sound intraoperative surgical decision making. A nationwide survery of otolaryngologists in 2006 concluded that the technology was only beneficial in certain situations.[8] I would suggest that the most useful application of this technology may be in making the surgeon familiar with the lateral orbital anatomy. After a certain number of cases, it is probable that the surgeon would no longer need stereotactic navigation. This should not surprise us, as this is not a part of the skull we routinely dissect in anatomy courses, either as medical students or at more advanced dissection courses. Furthermore, the fear of entering the cranial fossa limits the aggression with which a surgeon approaches the lateral orbital wall. In our practice, following cadaver dissections, we have been able to achieve acceptable results with only a lateral posterior wall decompression (without stereotactic guidance) with aggressive orbital fat decompression in most patients excluding patients with enormous extraocular muscles with minimal fat.

These limitations should not be taken as an *ad hominem* indictment of the technique. Stereotactic navigation certainly allows the surgeon to perform an impressive lateral orbital decompression. Although their series is small and does not definitively establish the safety of this technique, the authors are to be commended; their results should stimulate further studies of the lateral orbital wall and eventually establish safe surgical guidelines.

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