Prevention of Postexenteration Complications by Obliteration of the Orbital Cavity

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ABSTRACT

Objective: In patients for whom aggressive disease processes have necessitated the surgical removal of the orbital contents, many reconstructive options are available to address the exenteration cavity. While cavity lining, such as with a skin graft, has been commonly employed, areas of bone injury or loss may still provide a pathway for bacteria to access the cranial vault. We suggest that complete obliteration of the cavity provides a protective barrier, which minimizes this risk. **Design:** A retrospective review of four patients with significant intracranial infectious complications following orbital exenteration. All patients were managed at a tertiary care academic medical center. **Results:** Three of the four patients developed large brain abscesses, and one was symptomatic with computed tomography (CT) evidence of epidural enhancement in areas of bony dehiscence in the orbital cavity. Overall, three of the patients had free-tissue transfer to obliterate the orbit, and two of these had no further infectious problems. In one patient, the flap pulled away from the superior orbit leading to infectious complications, which were successfully managed by obliterating the remaining area of the orbit with a temporoparietal fascia flap. **Conclusions:** In light of the overall prognosis of patients requiring orbital exenteration, we believe that tissue obliteration of the cavity as an initial management strategy provides advantages that outweigh the increased surgical time and loss of socket visualization.

KEYWORDS: Orbit exenteration, brain abscess, reconstruction

In the surgical treatment of aggressive tumors or fungal infections of the globe, maxilla,

periorbital skin and adnexa, lacrimal system, cranial vault, and nasal cavity, it is occasionally necessary to

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Received: August 30, 2005. Accepted after revision: March 28, 2006. Published online: May 11, 2007.

DOI 10.1055/s-2007-977468. ISSN 1531-5010.

perform an orbital exenteration and completely remove the orbital contents. At times the excision is extended to include any of the bony margins of the orbit or skull base to ensure resection margins that are free of residual disease.

Following exenteration, the patient is left with a significant functional defect and esthetic deformity. Many reconstructive options are available to address the exenteration cavity.¹⁻⁴ These include obliteration via vascularized free tissue transfer or pedicled myocutaneous flap, lining the cavity with skin grafts or fascia/galea flaps, and allowing the cavity to heal via granulation tissue formation.

We believe that some sequelae associated with an orbital exenteration cavity can be greatly reduced via obliteration of the cavity. Specifically, an open or incompletely obliterated orbit has reduced protection of the anterior cranial fossa. Foramina through the bone and areas of bone injury (e.g., osteoradionecrosis) or loss provide a pathway for bacteria to access the cranial vault. We report on four patients with significant intracranial infections and the role of cavity obliteration in the treatment and prevention of these sequelae.

PATIENT 1

This 36-year-old male was referred for a recurrent adenoid cystic carcinoma of the right ethmoid and frontal sinuses with extension into the right orbit. Previously he had received intranasal ethmoidectomy and Caldwell-Luc with postoperative radiation therapy to a total dose of 60.75 Gy. At this time he underwent partial maxillectomy and extended orbital exenteration including the inferior aspect of the frontal sinus. Anterior cranial fossa dura was noted to be intact and free of tumor. Reconstruction consisted of a split thickness skin graft. Postoperative radiation was done with an intraorbital cone to 40 Gy. Three years later he had two small intranasal recurrences which were locally resected with an additional

course of radiation therapy to 44 Gy. A year after this, a 2- × 3-cm recurrence developed in the superolateral aspect of the orbital cavity. This tumor was fulgurated with laser followed by an additional 45 Gy of radiation.

Five months later the patient developed progressive confusion and lethargy with headache. Magnetic resonance imaging (MRI) revealed an enhancing frontal lobe mass consistent with a brain abscess. Inferior frontal lobectomy via bifrontal craniotomy was performed along with orbital cavity obliteration with a free rectus abdominus muscle. Approximately 19 months later, the patient presented with headaches, a dorsal nasal cutaneous lesion, and loose maxillary teeth. Evaluation at this time revealed large-scale recurrence including the nose, maxillary sinus, skull base, brain, and cavernous sinus. He was not thought eligible for proton or neutron therapy and was started on chemotherapy but succumbed to his tumor over the next 6 months.

PATIENT 2

This 33-year-old male developed swelling of his right medial canthus which did not respond to medical therapy. Lateral rhinotomy was done and the right lacrimal sac was removed and diagnosed as containing a transitional cell papilloma. The lesion recurred 20 months later and a second excision via lateral rhinotomy was performed. Pathology at this time was read as inverted papilloma with moderate degree of cellular atypia. A third recurrence and resection occurred 8 months later, now with significant atypia approaching in situ carcinoma. As the patient was thought to be at significant risk for development of invasive squamous cell carcinoma, 55 Gy of radiation was administered postoperatively. Additional recurrences developed and were locally excised, eventually requiring reconstruction of his midface with calvarial bone graft and free rectus flap. However, his orbit remained free of disease.

Four years after initial presentation, the patient was noted to have a mass in the right maxillary sinus consistent with nonkeratinizing squamous cell carcinoma. The mass was noted on MRI to extend into the sphenoethmoid region and into the orbit inferiorly, as well as toward the middle cranial fossa where the dura was noted to be superiorly displaced. A facial translocation approach was used to excise the tumor and perform orbital exenteration. The neurosurgical service performed a craniectomy where the bone of the middle fossa floor was involved. Reconstruction of the orbit was done with a temporoparietal fascia flap to cover the exposed middle fossa dura and a skin graft to line the orbit. He was then treated with concomitant radiation and chemotherapy. Several months after surgery he was admitted to the hospital for intravenous (IV) antibiotic treatment of *Streptococcus* sepsis. Moderate crusting of the orbital cavity was present and cleaned. On subsequent follow-up visits he had thick cavity crusting with an underlying layer of pus. This was cleaned at each visit and no tissue defect was noted. The cavity subsequently became clean and free of pus. Osseointegrated implants were placed and generation of an orbital prosthesis was begun.

An MRI done 2 months later showed edema of the right temporal lobe along with a lesion of the right cranial base. The patient was noted to have a recurrence in the anterior cavernous sinus and was treated with a single fraction of high-dose proton beam therapy. The patient began experiencing right headache and shooting pain 12 months after his last radiotherapy treatment. An emergent head CT showed a massive temporal lobe abscess (Figs. 1 and 2). Urgent craniotomy was performed but he lost all neurologic function and on postoperative day 1 all support was removed.

PATIENT 3

This 40-year-old female presented with adenoid cystic carcinoma of the left lateral nasal wall, maxilla, ethmoid, and orbit with enhancement of the

Figure 1 Patient 2. Axial computed tomography scan following orbital exenteration. Note area of bony dehiscence (arrow) allowing access to middle cranial fossa.

left cavernous sinus. She underwent wide excision with orbital exenteration and a skin graft to the orbital cavity. Osseointegrated implants were placed at the time of initial surgery. Proton beam therapy was started postoperatively and administered to a total of 76 Gy administered twice a day.

Approximately 1 month after completion of this radiation therapy, the patient began having yellow nasal pus and orbital crusting. This was cleaned daily and treated with several courses of antibiotics. Over the next 4 months the pus and headaches returned each time antibiotics finished. However, there was no evidence for a recurrence either clinically or on MRI. Eventually, a persistently exposed area of orbital roof bone presented. Thus, the cavity was filled with a free latissimus dorsi flap, but the flap did not adhere to the orbital roof.

In the superior orbit, persistent crusting was noted. The patient then began to develop headaches. An enhanced CT scan showed epidural enhancement consistent with epidural inflammation (Fig. 3). This woman underwent temporoparietal fascial

Figure 2 Patient 2. Axial computed tomography scan. A large right-sided lucency consistent with a frontal lobe abscess is readily identified.

flap obliteration of the superior aspect of the exenteration cavity and was treated with oral antibiotics. A subsequent CT showed resolution of the epidural process.

Figure 3 Patient 3. Coronal computed tomography scan. Epidural enhancement overlies an area of bony dehiscence in the superior aspect of the left orbit. Soft tissue within the orbit represents a free latissimus dorsi flap which has pulled away from the orbital roof.

PATIENT 4

This 69-year-old male had resection including orbital exenteration and radiation therapy (XRT) of a large BCC (basal cell carcinoma) of the orbit. A split-thickness skin graft was used to line the orbital cavity. He subsequently developed orbital crusting, exposed bone, and osteoradionecrosis of the orbital rim (Figs. 4 and 5). Headaches followed and he was diagnosed with a frontal lobe abscess requiring neurosurgical drainage, 8 years after his initial treatment. Following this, the cavity was debrided and obliterated with a free rectus flap (Fig. 6). The patient has had no further orbital problems.

DISCUSSION

When removal of the orbital contents is necessitated by extended disease, the surgeon is left with a variety of reconstructive options. Fundamentally, these are divided into whether to obliterate the orbit or to provide a thin lining to the cavity walls. Obliteration options include local and distant flaps, but free microvascular tissue transfer provides the best potential to ensure that an adequate supply of nonirradiated tissue is available to fill the cavity. Lining options include skin grafts directly onto the bone or

Figure 4 Patient 4. Orbital exenteration cavity with persistent crusting in areas of exposed bone.

Figure 5 Patient 4. Missing bone along the superior aspect of the orbit (arrow), likely a result of osteoradionecrosis.

periosteum, or onto a thin local lining flap such as a temporoparietal fascia flap, and healing by secondary intention. The orbital socket has been managed with many such options including cheek flaps, forehead flaps, latissimus flap, pectoralis flap, eyelid skin graft, periosteal flap, and dermal-fat grafts.^{5,6}

Figure 6 Patient 4. Orbital exenteration cavity obliterated with a free rectus flap.

Proponents of cavity lining can provide several reasons why this is their preferred orbital cavity reconstruction. There is no argument that lining the cavity is easier and faster. An open cavity provides an improved future opportunity for placement of a prosthesis. Most significantly, many believe that lining the cavity is important for tumor surveillance. That is, obliteration of the cavity interferes with the ability to monitor for areas of recurrence.

It is our assertion that obliteration of the orbital cavity has many distinct advantages over lining. First, the obliterated orbit is frequently easier for both the patient and physician to care for postoperatively. The persistent crusting and frequent cleanings of a lined cavity are eliminated. This in itself may reduce the risk of serious intracranial infection, as the most likely source is not infected. Second, the obliterated cavity has some cosmetic advantages. While it may be more challenging to fashion a prosthetic to an obliterated orbit, it can be done, either with or without osseointegrated implants. Additionally, if not using a prosthesis, an obliterated cavity is more presentable. Patients with lined cavities usually select to use an eye-patch to be more presentable when venturing outside of their homes or the medical center. Those with obliterated cavities may still choose to wear a patch, but are frequently far less concerned that the patch may become displaced than those with a lined socket.¹ An additional cosmetic concern develops when a skin graft lining contracts, as this may draw neighboring periorbital structures toward the socket, leading, for example, to a depressed eyebrow position.¹

Most significantly, lining the cavity may prevent serious sequelae of orbital exenteration with postoperative XRT. Specifically, intracranial infections may be prevented. Among the four patients discussed herein, all had intracranial infectious complications following XRT and chronic crusting of the exenteration cavity. Three of the patients had free-tissue transfer to obliterate the orbit, and two of those then had no further infectious problems. The one who did have further problems had an area where the flap pulled away

from the orbit and was therefore not providing coverage as intended. Her problems were remedied by filling in the gap by packing a temporoparietal fascia flap into the defect.

This complete filling of the orbital cavity has a secondary advantage if done prior to radiation therapy. When presented with a lined cavity, radiotherapists will frequently fill the orbit with moist gauze or foam. This is done to allow for more uniform and predictable administration of radiation to the orbital margins. Many radiation oncologists prefer tissue within the orbit as it provides a more consistent and predictable density to use for dosage calculations (personal communication, J. MacIntyre, 2000).

Finally, with contemporary radiological imaging techniques such as MRI, the need to monitor a lined cavity visually for recurrence is obviated. In addition, resection including orbital exenteration with postoperative XRT is usually the last available treatment prior to attempts at palliative chemotherapy or hospice care. Thus, the utility of identifying a recurrence early is questionable, as there may likely be no available therapeutic options. In a discussion of a 20-year experience with orbital exenteration at the Mayo Clinic, Bartley and colleagues⁵ describe the procedure as "often the final surgical event after a chronic and futile attempt to control progressive neoplasia." Given that scenario, the ability to monitor with frequent MRI scans, the elimination of crusting, prevention of intracranial abscesses, enhanced administration of XRT, and cosmetic advantages of an obliterated cavity strongly support the routine obliteration of the exenteration cavity.

CONCLUSION

We have presented four patients, all of whom developed intracranial infectious complications following orbital exenteration. In three of the patients, further problems were eliminated by obliterating the cavity in its entirety with soft-tissue free-flaps. We

believe that orbital obliteration provides a safer, more therapeutic management of the orbital socket which provides for easier postoperative management and improved cosmesis. Obliteration of the cavity provides a protective barrier that protects the cranial vault from infection. In light of the overall prognosis of exenteration patients, we believe that tissue obliteration of the cavity as an initial management strategy provides advantages which outweigh the increased surgical time and loss of socket visualization.

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Commentary

This article by Spiegel and Varvares reiterates a long-standing philosophy of surgeons who perform free-tissue transfers. There has been an historical precedent set for local regional flaps for orbital exenterations. As treatment has become more aggressive over the past couple of decades, so have the post-treatment complications. Tumors that have

undergone exenteration of the orbit have been treated in the past with skin grafts or even temporo-parietal fascia flaps. If this is followed with radiation, there is a predilection to osteoradionecrosis, which can lead to locoregional infections and exposure of the intracranial content. This article brings forward, once again, the problems with these types of flaps. The patients that have been presented show good examples of the complications that may occur with radiation treatment to the orbit without adequate soft-tissue compromise. There must be due consideration for postoperative treatment and adjuvant treatment rather than trying to make the orbit functional. In Patient 3, a skin graft is performed along with an osseointegrated implant followed by radiation. This particular patient outlines the difficulties in postoperative care for these types of patients. This may be "putting the cart before the horse." Because of the concern with placement of the prosthesis, the complication rate may have been increased. It has been our general consensus to be quite aggressive with free-tissue transfers in this particular area; thus to be quite aggressive is actually

the more conservative route with regard to free-tissue transfers. With the advent of free-tissue transfer, wide local resections do not have as great an impact on reconstruction as local flaps did. The resection site would have possibly needed to be limited in order to provide a safe closure. Free-tissue transfers have become routine at major medical centers and therefore the extirpative surgery can be more *aggressive* with the resection, which is more *conservative* from an oncologic perspective. These flaps can later be modified to accommodate a prosthesis in the future. However, the primary concerns in these patients are to eradicate the disease and also to provide an adequate bed for adjuvant radiation, if not therapeutic radiation.

I would like to commend the authors for presenting these complications and bringing to light, once again, the complications that can occur. The goal of reconstruction should be more aggressive with a flap of some type, rather than concentrating on a post-exenteration prosthesis.

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Published online: May 11, 2007.

DOI 10.1055/s-2007-977469. ISSN 1531-5010.