Orbitozygomatic Approach To Skull Base Lesions

Kafatabanı Lezyonlarına Orbitozigomatik Yaklaşım

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Abstract: Detailed knowledge of the microneuroanatomy of the skull base enables the neurosurgeon to make more aggressive surgical approaches. The most important goal in skull base surgery is minimizing retraction of the brain tissue, since excessive retraction may lead to cerebral contusion, intracerebral hemorrhage, and neuronal damage. The ideal cranial surgery involves no brain retraction, and neurosurgeons have adopted various skull base approaches with this goal in mind. One such method is orbitozygomatic approach. Between 1992 and 1998, 55 patients underwent surgery via a combined frontotemporal-orbitozygomatic approach to address tumors of the sphenoid wing, cavernous sinus, and orbit. Nineteen of the patients had orbital tumors and 36 had other types of skull base tumors. There were no postoperative complications associated with this technique, and there was no mortality. All patients returned to their previous occupations, and are living independently. The main advantages of the orbitozygomatic approach are (1) enhanced orbital, middle, and anterolateral cranial exposure, and (2) reduced need for brain retraction. The only disadvantage of this technique is the operative time required, which is longer than the standard pterional approach. The orbitozygomatic approach is a useful method for managing extensive tumors of the anterolateral skull base.

Key Words: Cavernous sinus, infratemporal fossa, orbitozygomatic approach, orbita, skull base

Özet: Nöroanatominin daha iyi anlaşılması ile birlikte, cerrahlar giderek agresif cerrahi yöntemleri daha sık kullanmaya başlamışlardır. Beynin mümkün olduğunca az retrakte edilmesinin gerekliliği kafa kaidesi cerrahisinin en önemli özelliklerinden biridir. Gereksiz veya uzun üsreli ekartasyonların, kafa kaidesi cerrahisi gibi uzun süreli cerrahi sonrasında önemli hasarlar husule getirebileceği herkesçe bilinmektedir. Bu nedenle seçilecek ve uygulanacak kafa kaidesi yönteminin lezyona ve cerrahi stratejiye uygun olması şarttır. Seçilebilecek yöntemlerden biriside Orbitozigomatik yaklaşımdır. Ankara Üniversitesi Tıp Fakültesi Nöroşirürji Anabilim Dalı'nda yazar tarafından 1992-1998 tarihleri arasında 55 vakada Orbitozigomatik yaklaşım uygulanmıştır. Vakaların 19'u orbita tümörü olup, diğer 36 vaka ise kafa kaidesine anterolateral yerleşmiş değişik tümörlere aittir. Bu yöntem sonrasında hiçbir hastada bu yöntemin uygulanması ile ilgili bir problem husule gelmemiş ve hastaların tümü normal işlerine geri dönmüşlerdir.

Anahtar Kelimeler: İnfratemporal fossa, kafa kaidesi, kavernöz sinüs, orbita, orbitozigomatik yaklaşım

INTRODUCTION

Especially in recent years, advances in microsurgery, neuroradiology, and microneuroanatomy have spawned the development of new surgical approaches. Some of these involve aggressive and radical removal of bony skull structures in order to gain access to deep lesions, while minimizing the need for brain tissue retraction (2,3,5). It is a formidable challenge to gain surgical access to, and radically remove, lesions located in the orbita, or lesions along the anterolateral skull base that may or may not involve the orbita (1). Standard neurosurgical approaches to these areas often provide only limited exposure (13). The orbitozygomatic approach allows adequate surgical exposure and safe radical tumor resection, and yields excellent functional, anatomic, and cosmetic results. This approach enables the surgeon to directly visualize the region from the apex of the orbit to the depth of the infratemporal fossa, which means that a well-controlled surgery can be performed with the superior, posterior, and lateral regions of the orbita all in clear view (4,8,11).

This report describes my experience using a combined frontotemporal-orbitozygomatic approach, with extensive osteoplastic en-bloc resection of the orbital wall and zygoma.

SURGICAL TECHNIQUE

The patient is placed on the operating table in supine position. The shoulder is elevated slightly and the head is rotated approximately 45 degrees to the side opposite the lesion. In order to achieve sufficient exposure of the zygomatic arch and the lateral orbital rim, a bicoronal scalp incision is made, starting just in front of the tragus at the inferior border of the zygomatic arch, and extending upward and forward and then along the hairline to the contralateral side (Figure 1). The skin flap is dissected in the subgaleal plane with the pericranium left attached to the underlying frontal bones. This skin flap is reflected anteriorly to expose both supraorbital rims. The pericranium is then dissected carefully and reflected anteriorly as a separate flap. This pericranial flap can be used to obliterate the frontal sinus, and to cover the floor of the anterior fossa to prevent cerebrospinal fluid leakage. This flap also can be used as replacement tissue for duraplasty.

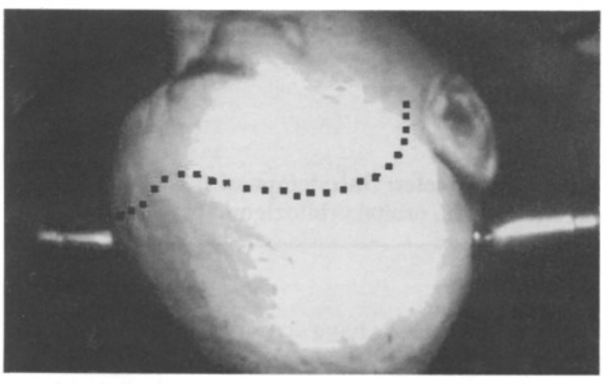

Figure 1: The bicoronal incision extending just the tragus on the involved side.

Once the pericranium is dissected anteriorly, the surgeon locates the supraorbital foramen. The supraorbital nerve and its artery must be preserved by freeing them from the supraorbital canal, which is opened with either an air drill or chisel. While this is being done, a periosteal elevator is used to protect the periorbita. Once free, the nerve and artery can then be reflected anteriorly with the pericranium (Figure 2). The superficial fascia temporalis is incised 3 cm posterior to the lateral orbital. The fascia is then reflected anteriorly to protect the frontal) branch of the facial nerveThe temporal muscle is separated from the bone and is reflected downward toward the zygoma.

Next, a frontotemporal craniotomy is performed. Using a high-speed diamond drill, the surgeon radically removes the lateral part of the sphenoid wing to the level of the lateral margin of the superior orbital fissure. Again using the diamond drill, a small burr hole is made in the posterior section of the roof of the orbita. Then, using a Gigli saw, a cut is made from the burr hole through the superior orbital rim, while protecting the intraorbital contents with a periosteal elevator and cotton pedyUsing the same type of saw, the surgeon then makes a second cut through the infraorbital fissure. Finally, the posterior part of the zygomatic arch is cut using either a Gigli saw or a high-speed drill (Figure 3).

Once these transections are made, the entire lateral orbitozygomatic bone is easily broken free and

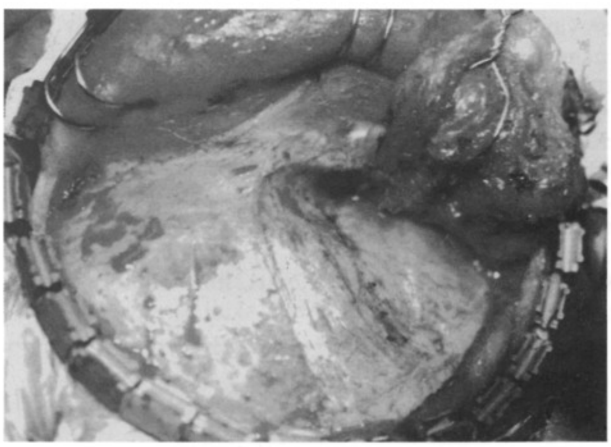

Figure 2: The skin flap has been elevated. The superior and lateral rim of the ipsilateral orbit and the zygomatic arch are exposed.

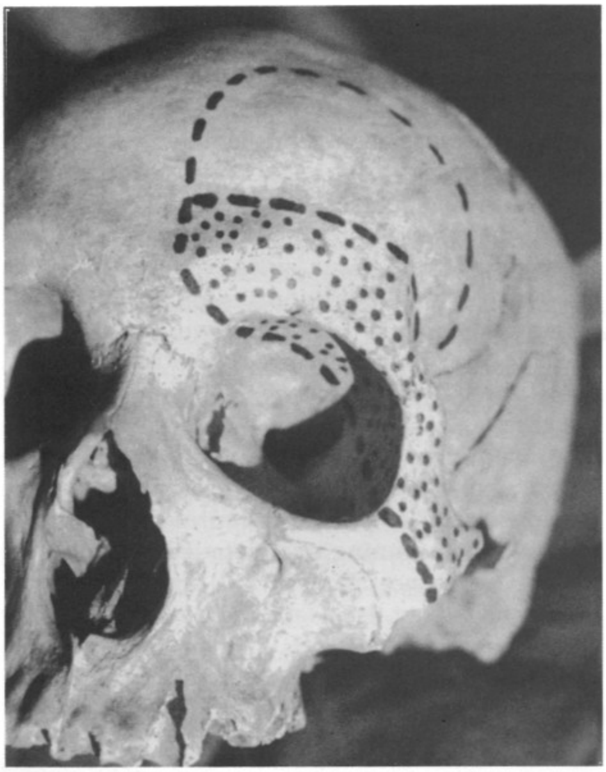

Figure 3: Outline of two bone flaps: The body of the zygoma is cut through its midportion, and directed toward the anterolateral end of the inferior orbital fissure.

removed en bloc. At this point, the temporalis muscle can be retracted further downwards to provide very good exposure of the infratemporal fossa and the inferior orbital wall. This approach also provides access to the lateral, posterior, and superior regions of the orbital cavity. In addition, the pterygoid fossa can be controlled. If the surgeon removes an even larger section of temporal bone, the foramen rotundum, foramen ovale, and foramen spinosum can all be easily visualized. In cases with intradural pathology, the fissure of Sylvius can be opened widely, allowing exposure of any trans-sylvian tumor with minimal retraction of the temporal and frontal lobes. The parasellar region and the interpeduncular fossa are also close at hand, and can be reached with relative ease through the space formed via either approach.

After radical tumor removal, the surgeon closes the dura, returns the removed orbitozygomatic bone and free bone flap to their anatomic positions, and secures them with titanium mini plates (Figure 4). Once the temporal muscle is sutured in place, the pericranial soft tissue and the wound are closed in standard fashion.

Figure 4: End of the operation: The removed orbitozygomatic bone and free bone flap are repositioned and secured with titanium mini plates.

SUMMARY OF CASES

Between 1992 and 1998, 55 patients underwent surgery via a combined frontotemporal-orbitozygomatic approach to address tumors of the sphenoid wing, the cavernous sinus, and the orbit. Each case was assigned to either Group I or Group II, with Group I consisting of orbital tumors and Group II comprised of the masses in other locations. Of the 19 patients in Group I, 12 were women and 7 were men. Their diagnoses included cavernous hemangioma (n=5), lacrimal gland adenoma (n=3), schwannoma (n=3), adenoid cystic carcinoma (n=2), plasmacytoma (n=1), orbital pseudotumor (n=1), hydatid cyst (n=1), PNET (n=1), lymphangioma (n=1), and dermoid tumor (n=1). The patients' clinical issues included ophthalmological symptoms of exophthalmos in 19 cases, occulomotor damage in 4, and decreased visual acuity in 11, and one was totally blind. In this group, total tumor excision was achieved in 16 patients and gross total excision in 3 cases. Follow-up ranged from 9 to 66 months, and, to date, only two patients have shown evidence of recurrence. Four patients underwent radiation therapy. In the early postoperative period, five patients had slight ophthalmoplegia, and two of these individuals fully recovered, with no deficit evident at 3 months postsurgery. Two patients had cranial nerve VI palsy postoperatively and one of these individuals also recovered completely.

The Group II tumors consisted of masses that extended into the cavernous sinus or infratemporal fossa, and meningiomas affecting one-third of the medial part of the sphenoid wing. Of the 36 patients in this group, 17 were women and 19 were men. The diagnoses included pituitary tumor extending into the cavernous sinus (n=9), meningioma of the sphenoid wing (n=5), cavernous hemangioma of the cavernous sinus (n=6), meningioma of the cavernous sinus (n=4) (Figures 5,6), brainstem glial tumor (n=3), epidermoid tumor (n=2), clivus chordoma (n=2), hypothalamic tumor (n=1), and malignant tumor infiltrating the cavernous sinus (n=4). Complete tumor resection was not achieved in 14 of these patients (Figure 7,8).

There was zero mortality, and all patients have returned to their previous occupations and are living independently.

DISCUSSION

Routine application of microsurgical techniques, better understanding of the microneuroanatomy of the skull base and its related neurovascular structures, and the advent of sophisticated neuroradiological methods have paved the way for a more aggressive surgical approach to neoplasms of the skull base, with the goal of radical tumor resection (6,7,12). Lesions involving the anterolateral portion of the middle cranial fossa, as well as the orbit, and those with significant extension into the pterygoid fossa, cannot be approached adequately by either routine neurosurgical or otosurgical approaches (9,10). The most important issue in skull base surgery is minimal retraction of brain tissue, since excessive retraction may lead to cerebral contusion, intracerebral hemorrhage, and neuronal damage. This issue has been the basis for the new approaches that have been developed in recent years. These approaches incorporate certain aspects of standard techniques used in otorhinology or neurosurgery, such as the infratemporal, subtemporal, supraorbital, and the frontotemporal or pterional approach. Computed tomography scanning and detailed preoperative magnetic resonance imaging (MRI) provide important information about the extent and direction of tumor spread, and these methods help surgeons plan the operative strategy and determine the type and extent of craniotomy required.

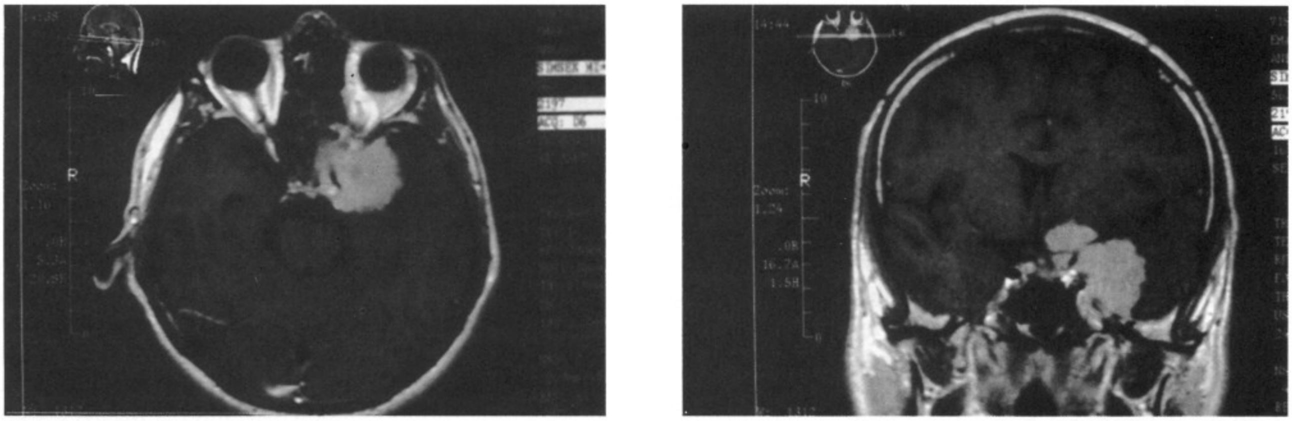

Figure 5,6: Preoperative MRI of a meningioma in the cavernous sinus.

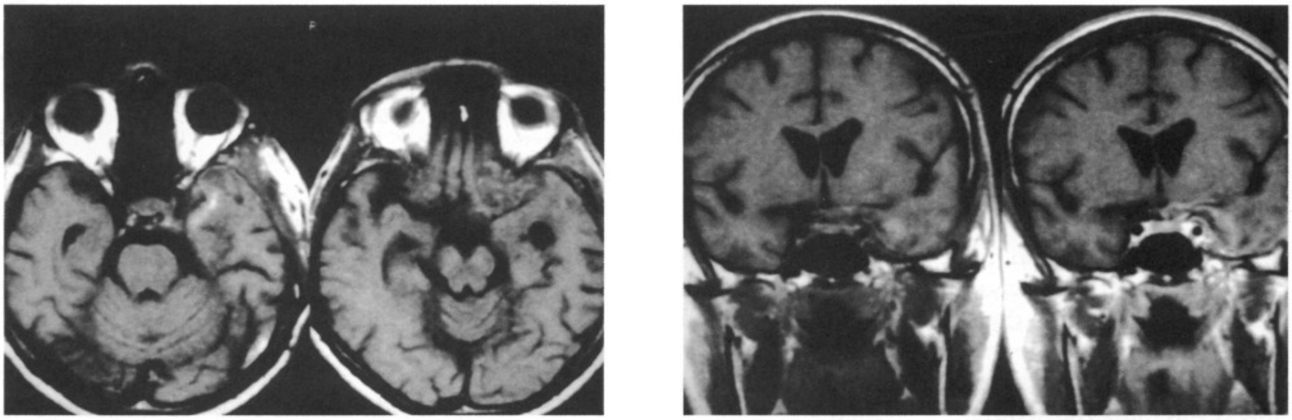

Figure 7,8: MRI findings confirm complete resection of the tumor.

As mentioned, it is a major challenge to gain adequate surgical access and radically remove lesions located along the anterolateral skull base that have orbital involvement, and that may extend into the infratemporal, pterygoid, and/or interpeduncular fossa. The standard neurosurgical or otosurgical approaches to these areas often provide only limited exposure, which means that extensive retraction of the frontal or temporal lobe may be required. Growing interest in skull base surgery, in combination with recent advances in microsurgery, neuroradiology, and microneuroanatomy have fostered the development of combined approaches. Common to these techniques is aggressive and radical removal of bony skull structures, which allows the surgeon to access deep lesions while avoiding the need for extensive brain retraction. The space created by the combination of orbitozygomatic bone removal in association with a frontotemporal craniotomy makes it easier to manage lesions located in the skull base region. This technique improves visualization of the field view angle by 75% in the subfrontal approach, 46% in the pterional approach, and 86% the subtemporal approach (3). As with the monobloc frontoorbital bone flap proposed by Jane and, more recently, by Al-Mefty, the main drawback with this method is the potential for damaging the supraorbital nerve and artery (1,2). This problem can be avoided if detachment of the scalp is done subperiosteally, and if the supraorbital neurovascular bundle is carefully dissected and removed from its bony canal.

The complications encountered with this skull base approach, which can include minor cosmetic defects, temporary denervation of the temporalis muscle, and temporary limited range of motion in the jaw, are negligible considering the intracranial pathology that is treated. In cases where extensive tumor spread incorporates the orbital cavity and/or the pterygoid, infratemporal, and interpeduncular fossa, an extended and combined sub- and infratemporal approach with temporary resection of the fronto-orbitozygomatic rim of the skull should be considered. This is the best way to achieve good surgical exposure and radical tumor resection.

In conclusion, the main advantages of the orbitozygomatic approach are (1) enhanced orbital, middle, and anterolateral cranial exposure, and (2) reduced need for brain retraction. The only disadvantage of this technique is the operative time required. Despite the extensive bone removal required in this approach, meticulous reapproximation and fixation of the fronto-orbitozygomatic bone bloc result in cosmetic defects that are no worse than those encountered with the standard pterional approach. Based on the experience described in this study, the orbitozygomatic approach is clearly a useful method for managing extensive tumors of the anterolateral skull base.

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