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Review Article

Orbital Floor Reconstruction Options in Head and Neck Oncology- A Review

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ABSTRACT

Orbital fracture is common in road side accidents. The present article covers the recent modality of management of orbital floor reconstruction options in head and neck oncology.

Key words: Head, Neck oncology, Orbital.

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INTRODUCTION

The field of head and neck reconstructive surgery is a dynamic one. Advances made in the last decade are mostly secondary to expanded use of microvascular free flaps. Several flaps, including the anterolateral thigh, fibula osteocutaneous and suprafascial radial forearm fasciocutaneous free flaps have emerged as workhorse flaps for reconstructing a wide variety of defects. As the anatomy of these flaps has become more familiar, their reliability and versatility have increased. Reliable wound closure without exposure of vital structures is no longer the only priority. Preserving function, including speech and swallowing, and restoring appearance are the goals in every reconstruction. Free flap success rates now routinely exceed 95 percent or better at most centers.[1]

Maxillary defect must be assessed in horizontal and vertical dimensions. Reconstructive options available are from prosthesis to free tissue transfer. Isolated palatal defect are managed with obturator, local flap or free tissue flap-like FRAF depending on the size of the defect. In infrastructure maxillectomy with a horizontal extent less than half of the alveolar arch, prosthesis with SSG will be adequate. For larger defects reconstruction with vascularised bone flap-like free fibula osteocutaneous flap (FFOCF) is better than prosthesis (type 2).[2]

Maxillary defect involving the orbital floor but sparing the eye is the most challenging defect to reconstruct (type 3). It needs bony support for orbital floor, cheek skin and dental rehabilitation. Amongst various bone flaps, available FFOCF is most used flap. Prefabricated maxilla using titanium mesh prepared on three-dimensional (3D) skeletal model covered with ALT has been reported. Large volume maxillectomy defect with orbital exenteration is easy to reconstruct as there is no eye to worry about. It needs a bulky flap to fill up dead space (type 4). ALT or rectus abdominis myocutaneous flap could be the answer in such situation. To prevent contour deformity due to sagging of heavy flap, anchoring flap to zygoma is recommended.[3]

In the palate preserving supra structure maxillectomy with orbital exenteration, defect needs a bulky flap as filler to seal off skull base like ALT or rectus abdominis myocutaneous flap. Defects that include palate, cheek, orbit and external nose are difficult to reconstruct with single flap. A combination of free flap and magnet retained facial prosthesis may be better for good functional and aesthetic outcome. The ideal management of orbital floor fractures has been highly controversial. Some fractures require only observation, while others require surgical reduction. The goal of surgery is 2-fold: to reposition the herniated orbital fat and tissue back into the orbit and to reconstruct the traumatic defect.

Many implants, both autogenous and alloplastic, have been used to span the defect. Autogenous grafts include bone, cartilage, and fascia. Alloplastic implants can be divided into non-absorbable types, such as those made of silicone, polytef, hydroxyapatite, tantalum mesh, or titanium, and absorbable types, including those made of polyglactin 910 or gel film. Whether an autogenous or an alloplastic implant is used, the ideal implant should be nonreactive, provide good structural support, be easily positioned, and be readily available.[4]

Most alloplastic implants in use to- day possess these qualities; however, reported incidences of early and delayed complications vary between 0.4% and 7%. Cordeiro et al[5] reported a similar find- ing in a patient treated with a silicone graft 13 years earlier. Alloplastic complications, which are infrequent and are usu- ally reported as isolated cases, include orbital infection, implant migration, dacryocystitis, hyperophthalmia, fistula formation, visual loss, and proptosis secondary to hemorrhage into the fibrous capsule. However, alloplastic implants are relatively inert and develop a fibrous capsule early (weeks to months), giving the surgeon a false sense of security.

Traditionally, autogenous bone has been the implant material of choice for the past 30 to 40 years for the reconstruction of orbital blowout fractures. Some investigators have advocated the use of iliac crest bone grafts, rib grafts, and tibial grafts.

RECENT ADVANCES

Navigational systems

Like global positioning system, navigation provides 3D road map. Advantages are accuracy, least trauma, shorter duration of surgery, reduced complications, fewer chances of recurrence and excellent success rate. Used mainly by neurosurgeons for removal of brain tumours that are seen on computed tomography or magnetic resonance imaging but are clinically difficult to distinguish from normal brain tissue. Its use in soft tissue resections of head and neck is yet to be established. It has been used for lymphatico venous anastomosis. At present, it is being used for reduction of fractures of orbital floor and zygoma. Software based digital mirror image of the normal side or matching image from database is used for exact reduction. Size and volume are restored accurately.[6]

Yu H et al[7] evaluated the effectiveness of image-guided navigation on open reduction and orbital floor reconstruction as treatment for zygomatic-orbital-maxillary complex fractures in six patients. An accurate match between the intraoperative anatomy and the computed tomography images was achieved through registration, with a systematic error of 1-mm difference. With guidance of the navigation system, open reduction of zygomatic-orbital-maxillary complex fractures and orbital floor reconstruction were performed in all cases. The reduction was checked by postoperative computed tomography scans, with a good match with preoperative planning noted. The maximal deviation between the reduction and preoperative planning was less than 2 mm. The symptoms associated with the orbital floor defects were eliminated, and the postoperative facial appearance of the patients was clearly improved. Navigation-guided open reduction of zygomatic-orbital-maxillary complex fractures with orbital floor reconstruction can be regarded as a valuable treatment option for this potentially complicated procedure.

Stereolithograpy

Stereolithograpy is a technique whereby an accurate hardened three-dimensional acrylic model is created from CT data. Stereolithographic models (SLM) portray accurate anatomy and pathology, and provide a hands-on replica. The use of SLM is well-established in craniofacial surgery. Applications have been described in orbital reconstruction, orbital brachytherapy and planning of stereotactic biopsy of intracranial tumors.

Beigi et al[8] reported four cases of Retrospective case series report. In case 1, SLM facilitated a successful orbital biopsy of a deep orbital mass by allowing several practice trucut biopsies. In case 2, complex orbital fracture-repair was facilitated by using a SLM to

demonstrate post-trauma and previous post-surgical-intervention bony anatomy. In case 3, replication of accurate orbital anatomy in a case of severe socket contracture facilitated the selection of Branemark-implant placement sites to prevent inadvertent entry into the cranial cavity. In case 4, SLM prevented unnecessary surgical intervention.

Robotic surgery

Vinci robotic arm positioned near patient reach inaccessible region easily. Performing surgeon has comfortable sitting position at console. With 3D, endoscopic, microscopic image and sensitive controls desired procedure can be done even from a remote place. Currently, robotic surgery is being used for resections and reconstruction of tumours at base of tongue and larynx, avoiding mandibulotomy for access which has its own morbidity. With trans-axillary approach, thyroid, para thyroid adenoma and neck lymph node can be operated without giving scar on the neck. The incision, approach, and operation view in robotic surgery differ from existing surgical methods. Due to the implement of connection between robotic system and the endoscopic, the intraoperative imaging of the patient's anatomy and the location coordinate of the robot can be fed back to the surgeons in real-time. It seems that any challenging and high-risk surgical procedures are possible by using surgical robots and telemanipulators. Robotic surgery has already been established successfully in various surgical specialties such as cardiac surgery, urology, neurosurgery and gynaecology.[9]

Telepresence surgery refers to the remote operation of a robot to perform a surgical procedure by the control of the surgeons. The idea of “telepresence” surgery was proposed by the National Aeronautics and Space Administration (NASA) in 1972 to provide remote surgical care to orbiting astronauts. At that time, the limitations of robotic and computer systems made the development of such a system hard. Furthermore, time delay is a significantly technical problem. Subsequently, the remarkable progress in computing power and component miniaturization, coupled with the emergence of minimally invasive surgical techniques demanding complex operative procedures, the telepresence surgery has been developed quickly.[10]

Autologous bone grafts

Bone grafts for the orbital floor have long been considered the standard treatment for orbital fracture repair. The principle of this approach requires an appropriate amount of autologous bone harvested from a donor site, which is shaped and inset to provide a rigid structural support in reconstructing the defect. Bone grafts have regained the favour of many craniofacial surgeons due, in part, to their biocompatibility. Donor sites include the split calvarial bone graft, rib, maxillary wall, mandibular symphysis, iliac crest, antral bone and coronoid process. The grafts can be placed as onlay grafts, fixated with a plate and screw, fixated with a lag screw or fixated in conjunction with an alloplastic material, such as titanium mesh or porous polyethylene sheets.[11]

Cartilage tissue engineering

Reconstruction of cartilage defects are challenging due lack of suitable donor sites and prosthetic materials used have their own associated problems. Tissue engineering cartilage is relatively simple because it consists of only one cell type, the chondrocyte. It does not need neovascularization. It survives on the diffusion fluid for nutrition and excretion of waste products. Different shaped cartilage like ear or temporomandibular joint have been produced.[12]

Conclusion

Most of the materials used in reconstructing the orbit have proven useful and reliable in experienced hands. The ideal material for orbital floor fracture repair is one that is resorbable, osteoconductive, resistant to infection, minimally reactive, does not induce capsule formation, has a half-life which would allow for significant bony ingrowth to occur, and is cheap and readily available.

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