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Correction of residual deformity in maxillofacial region: A review

[1]Aditya Ashok Mahendraker, Resident, Division of Oral and Maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India

[2]Vishal Gupta, Senior Specialist, Oral and Maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India

[3]Gopalakrishnan V, Classified Specialist, Oral and Maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India

[4]Rangarajan H, Classified Specialist, Oral and maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India

[5]Gaurav Dua, Classified Specialist, Oral and maxillofacial surgery, Army Dental Centre (R & R), New Delhi -110010, India

[6]Vishal Kulkarni, Classified Specialist, Oral and maxillofacial Surgery, Army Dental Centre (R & R), x

[7]Hitendra Nath Deva, Resident, Division of Oral and Maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India

Corresponding Author: Aditya Ashok Mahendraker, Resident, Division of Oral and Maxillofacial Surgery, Army Dental Centre (R & R), New Delhi -110010, India.

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Abstract

Deformities of maxillofacial regions are a result of developmental anomalies, trauma, or ablative cancer surgeries. Compared to mandibular reconstruction, maxillary reconstruction is still a developing art. In addition to impairing speech, swallowing, and mastication, maxilla abnormalities can result in aesthetic deformity. Patients with maxillary deformities can either undergo surgical restoration or use an obturator prosthesis to restore their shape and function. There is no shortage of literature offering a wide range of reconstructive techniques. There is no single categorization scheme that is widely accepted, and there are several different ones. There is an ongoing dispute over the oncologic safety of these operations, and definitive proof has not yet surfaced in this area. Additionally, orbit management has not yet been adequately addressed. Although tissue engineering has

received a lot of attention as a potential answer to this challenging reconstructive challenge, it has not yet produced consistent and repeatable outcomes. This review article evaluates categorization schemes, presents several reconstructive techniques, and addresses related issues.

Keywords: Impairing Speech, Psychological, Aesthetic Factors

Introduction

It is believed that a person's face reflects their existence and personality. Any change to a person's symmetry or facial structures affects their appearance. Because of the changes in shape, function, and aesthetics, maxillofacial deformities resulting from trauma, developmental abnormalities, or ablative cancer procedures present a challenge to the patient and the maxillofacial surgeon[1]. Maxillofacial abnormalities provide a variety of difficulties, and handling them has shown to be a management conundrum. This is also because management needs to take psychological and aesthetic factors into account to achieve flawless performance and long-term stability of related structures. The intricacy of the anatomy is another element that increases these difficulties[2]. Problems get much more difficult when the flaw affects a bigger surface area or is close to intricately important structures. Still, a multitude of tools and resources exist at one's disposal that may be employed or leveraged to restore normalcy.

Autogenous grafts continue to be a standard management choice[3] despite the numerous research that are accessible in the literature. Nevertheless, they are frequently linked to erratic resorption and donor site morbidity[4], necessitating the need for numerous surgical teams. In addition to bringing about the benefit of custom-made prostheses without requiring donor site morbidity, alloplastic materials are connected with undesirable outcomes such as infection, displacement, and the presence of foreign bodies, which would otherwise make them an unpopular choice.

There hasn't been any discussion of soft-tissue compatibility about this kind of therapy. To give the graft stability and inertness, the flaws must lie beneath the strong soft tissue layer. The typical therapy for these problems involves repairing missing teeth, bone, and soft tissue in an all-encompassing manner. The use of custom computer-designed patient-specific implants (PSIs) in reconstructive surgery has been made possible by advancements in reconstructive techniques, particularly osseointegration and microvascular-free tissue transfer. These advancements, along with recent technological advancements, have produced excellent functional and aesthetic outcomes[5].

The operator is given a variety of indications and contraindications for these restorative treatments by the varied techniques and materials. Still, it's unclear if this is the greatest option available. The literature search gives the researchers a tonne of information on their quest. On the other hand, the articles on inspection provide very few details. The little information is dispersed over a larger region in fragments. With a focus on the maxilla, this article aims to briefly highlight and evaluate a variety of materials for the rehabilitation of complicated craniofacial abnormalities.

Various Classifications For Maxillofacial Defects

The classification of maxillofacial defects has proven challenging which is evident in the literature. There are several variations of these categories due to the intricacy of the system, but none can offer a comprehensive and whole set.

The authors believe that the universal classification system be universal in application and be easy to record and communicate. Hence Aramany et al.[6] and Spiro et al[7] be applied and understood. These classification systems have been appended to this article with figures (table1,2) (Figures 1-4).

Reconstructive Options

The following reconstructive options are described for anomalies resulting from maxillectomy: free flaps with soft tissue alone or in conjunction with bone, regional soft tissue and bone flaps, and combinations of soft tissue flaps and alloplastic implants. Since they are most effective in treating mild to moderate lateral abnormalities, regional soft tissue flaps, including reverse submental flaps, a buccal pad of fat flaps, facial artery myomucosal flaps (FAMM), and temporalis myofascial flaps, are used to repair such maxilla defects[8]. Following the application of FAMM and buccal pad of flaps, there has been a notable success rate.

The temporalis flap, which is still often employed today, was considered the workhorse of maxillary restoration in the early literature on reconstruction. However, there are several drawbacks to this flap, including the possibility of early or late trismus and early dehiscence in larger defects larger than 4 cm. Wang et al.[9] stated that the reverse submental artery flap, which was based on the distal facial artery, had been successful in cases[13]. The flaps were de-epithelialized, utilised to cover inferior maxillary abnormalities, and allowed to epithelize similarly to the temporalis myofascial flaps. These flaps go through an inflammatory phase, which is followed by epithelization and granulation tissue regrowth[10]. However, because all of these flaps that allow for epithelization can result in difficulty with dental rehabilitation due tomuscular contraction.

The literature provides information on free soft tissue flaps, such as radial forearm flaps, rectus abdominis flaps, and deep inferior epigastric perforator flaps (DIEP)[11]. Flaps have become more and more common for closing palatal deformities. It has been used to treat problems after maxillectomy, particularly in cases when the orbital floor remains unbroken. One advantage of these flaps is their long pedicle, which helps with vascular anastomosis in the neck[12]. The drawbacks of these flaps include their incapacity to prevent cheek hollowing, their incapacity to meet the requirement for orbital support, and their unsuitability for dental implant insertion. Under these circumstances, dental rehabilitation becomes difficult because of the insufficiency of the gingiva-buccal sulcus.

The disadvantages of utilising soft tissue flaps alone, such as the lack of skeletal support for the face and the orbit, have been demonstrated in several cases to be addressed by the use of implants or bone grafts in addition to them. Bianchi et al.[14] reported the effective utilisation of a combination of iliac crest bone grafts, Anterolateral thigh flap (ALT)[13], and vertical rectus abdominis flaps. They said that in certain circumstances, bone grafts may withstand post-operative radiation, even though there were few examples reported. The Hashikawa et al.[15] team employed titanium mesh, a free flap from the radial forearm, a cheek flap lining, and an obturator prosthesis only to reconstruct the orbital floor.

Sun et al.[16] reported that radial forearm free flap and titanium mesh were used to treat maxillary deformities. Nakayama et al.[17] discussed the use of several soft tissue flaps, including the rectus abdominis muscle and the ALT, in combination with titanium mesh for the repair of deformities resulting from maxillectomy. Emil Dediolet al.[18] rebuilt the orbital floor, infraorbital rim, zygomatic prominence, anterior wall of the maxilla, and alveolus using a prefabricated titanium mesh..

Many different types of bone flaps have been used in maxillary reconstructions. They provide orbital content support, alveolar repair, and cheek prominence. While free bone flaps have been employed in most publications, very few regional bone-containing flaps have been used for this purpose. The use of the coronoid process of the jaw, which is reliant on the temporalis muscle, for orbital support was observed by Curioni[19] and Pryor et al.[20]. In the instances that Pryor et al. documented, the maxillary cavity was obturated. Using its outer table, Bilen[21] and others described calvarial bone flaps based on veins and the superficial temporal artery (STA). Two of the five instances had significant skin abnormalities that were also covered by lateral frontal skin that was provided by the STA. To restore the upper alveolar defect, Yang et al.[22] used the reverse submental de-epithelialized flap to carry the mandibular lower boundary. In certain circumstances, rapid dental implants were even effectively employed. There are limitations to these pedicled flaps, including limited soft tissue cover and difficulty in moving[23].

The literature has extensive documentation on the application of free bone flaps in maxillary repair. The rise in the number of maxillary reconstructions was largely due to the use of different free bone flaps. Among the flaps that have been used are the medial femoral condyle flap, scapula, iliac crest, radial forearm, Tensor facial lata, rectus abdominis with ribs, and iliac crest with internal oblique[24]. Andredes et al.[25] used them as zygomatic maxillary buttresses, covering the intraoral and exterior skin deficiencies with the skin paddle. The orbits were supported by a mesh. Chepeha et al.[24] used the obturator bone to fix the palatal defect and the radial bone to reinforce the orbital floor.

One advantage of the fibular flap is that it has adequate bone length to sustain several osteotomies if needed. This becomes important when separate bone pieces are needed to support the alveolus and the orbital floor. The separating bone fragment may be removed to achieve this goal. The fibula's biggest advantage, however, is its long pedicle length for tension-free neck anastomosis. The skin paddle can be used for palatal obturation as well as skin cover if needed[25]. The disadvantages of fibula include the difficulty of moulding the fibula to the specifications of orbital floor support and the lack of soft tissue to fill the maxillary cavity, particularly if a mesh is utilised for orbital floor reconstruction.

The deep circumflex iliac artery-based iliac crest flap was suggested by Brown et al. as a better option[26]. In class 2 faults, the iliac crest was positioned horizontally, while in class 3 and 4 flaws, vertically. The usefulness of the iliac crest when positioned vertically for larger defects in the rebuilding of the orbital rim[25], support for the nose and upper lip, and restoration of the facial bone buttress was highlighted by Bianchi.

The use of scapular and parascapular flaps in maxillary reconstruction has grown recently[27]. The benefits of scapular and parascapular flaps include the ability to vascularize the bone through the use of two pedicle systems: the angular artery from the thoracodorsal system and the subscapular vessels; additionally, the availability of a sizable volume of soft tissues with minimal donor site morbidity. One of the disadvantages of this flap is that it can be challenging to harvest it simultaneously. However, Clark et al.[28] address this problem by positioning a beanbag under the patient's ipsilateral side and a protected axilla on the contralateral side. This allows the flap to be harvested without requiring the patient to move, which cuts down on the amount of time needed for the harvest. In research comparing the thickness of four vascularized bone flaps, Frodel JL et al.[29] discovered that the thinness of the bone renders it unsuitable for implant implantation.

Based on the descending genicular arteries, Kadameni et al. suggested that the medial femoral condyle may be useful in the event of mild anterior or anterolateral alveolar abnormalities[30]. The periosteum supplied the soft tissue surface that was mucosalized. Seikidoet al.[31] used a DIEP flap in a separate single case report to vascularize the 9th and 10th ribs by harvesting blood vessels through the rectus abdominis and the cranial part of the rectus muscle. In cases of maxillary restoration, the iliac crest-tensor facia lata muscle, either with or without the surrounding skin, is useful for globe support. Successful cases where the TFL muscle's link nourished the bone have been reported[32]. The authors noted additional benefits to this method when orbital exenteration was used in conjunction with the internal oblique muscle for the orbital lining[32].

Morbidity in Surgery and Related Complications

The literature recommends a careful approach in the therapy of maxillary abnormalities since the morbidities associated with such defects may provide complications for the operator. The majority of operators have expressed concern about the length of the pedicle when selecting a flap, and specialists have often limited their flap selection to soft tissue flaps with lengthy pedicles. Using a donor from the superficial temporal vessels was the alternative[33]. The length of the facial artery that is available in the neck can be increased by cutting the artery into the cheek, creating a vertical incision on the face, employing vein grafts, and utilizing composite ALT arteriovenous grafts[25]. This has significantly decreased the flap's morbidity.

New tissue engineering methods and developments for maxillary reconstruction

Bone abnormalities have been treated via distraction osteogenesis. Xue-Gang Niuet al.[34] used this method in a maxillectomy-treated instance of maxillary ameloblastoma. During the initial operation, an internal curvilinear distraction device was placed in the remaining zygoma. A new distractor was used to create a straight distraction of the palate and curvilinear distraction osteogenesis of the maxillary anterior alveolar process, and the incision was reopened after about a month. After many months, these distractions were removed, and a bone transplant was used to fill in a small area of the shortfall.

Tissue engineering has been proposed as a replacement for sophisticated reconstructive techniques. However, it has been hindered by the manufactured constructions' inadequate vascularization and the lack of therapeutically useful engineering techniques. It has been reported[43] that segmental mandibular and maxillary abnormalities can be successfully repaired using good manufacturing practices in cell culture and seeding. Since the autologous cells are handled and produced in clean rooms that adhere to good manufacturing practices (GMP), they can be regarded as safe for use in clinical cell therapy applications. For the first time, Mesimaki et al.[35] developed a unique tissue engineering technique for maxillary restoration.In the case of maxillectomy for a keratocyst, they collected stem cells from adipose and abdominal tissue. These cells were then separated and multiplied in clean GMP facilities. After 17 days, a titanium cage was put into the rectus abdominis flap area and filled with a mixture of autologous ASCs, betatricalcium phosphate, and bone morphogenetic protein. The flap grew a mature bone structure and vascularity after 8 months of follow-up. The defect was then implanted with this. Dental implants were successfully inserted into the reconstruction after the flap had time to settle. This strategy utilized both tissue engineering techniques and a microsurgical carrier to revascularize the construct. The Helsinki group has used this technique in 10 cases of maxillary reconstructions so far, with 3 failures (personal communication)[36]. The tray is prefabricated using a computer-aided design,however, it is currently made of biodegradable materials. The primary carrier for the construct right now is the vastus lateralis and anterolateral thigh flap.

Use of implants and PSI

Khorasani et al.[37] in their study of 30 cases of high-density porous polyethene implants suggested a better outcome in form and aesthetics following maxillary reconstruction. The study mentioned two implants with issues such as graft infection, managed by antibiotics.

Retrospective research on the utilisation of Medpor implants for midfacial contouring in cleft patients was carried out by Schwaiger M[38] in 2019. A set of characteristics was used to examine 51 orofacial cleft patients. There were many Medpor implants utilised, including Nasal Dorsum, Malar, and Paranasal. Compared to bilateral cleft lip and palate (BCLP), unilateral cleft lip and palate (UCLP) received treatment. The patients had bilateral implant insertions. Implant insertion was often performed in conjunction with other cleft-related surgical operations. In the trial, the complication rate was 6.9% (6 out of 122 implants). Results show that Medpor implants are a solid nasal dorsum material with little issues in cleft individuals, and they are dependable and long-term stable materials to successfully augment paranasal, subnasal, and malar regions.

Conclusion

While maxillary reconstruction is still in its infancy, a great deal of information has been obtained on its numerous constituent parts. Although the overall trend seems to be more in favour of admitting reconstruction's superiority, especially in bigger defects, the degree of evidence that can be utilized to compare the function of obturation against reconstruction is not very high. Reports touting the benefits of one flap over another will persist for some time, as there is once more no agreement on the reconstruction method. It will be difficult to carry out strictly similar research. As a result, certain surgeons' or organization's procedures could nevertheless be accepted as standard for them. Tissue engineering methods and PSI may become more frequently used and inspire new methods in the near future.

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Legend Tables and Figures

Table 1

Aramany's Classification for Maxillectomy Defects(6)-	
Class 1	Resection is performed in the anterior midline of the maxilla, with abutment teeth present on one side of the arch.
Class 2	The defect is unilateral, retaining the teeth on the contra lateral side.
Class 3	Defect occurs in the central portion of the hard palate and may involve part of the soft palate.
Class 4	Defect crosses the midline and involves both sides of the maxilla, with abutment teeth present on one side
Class 5	Defect is bilateral and lies posterior to abutment teeth.
Class6	Anterior maxillary defect with abutment teeth present posterior to the defect on either sides of the remaining maxilla.

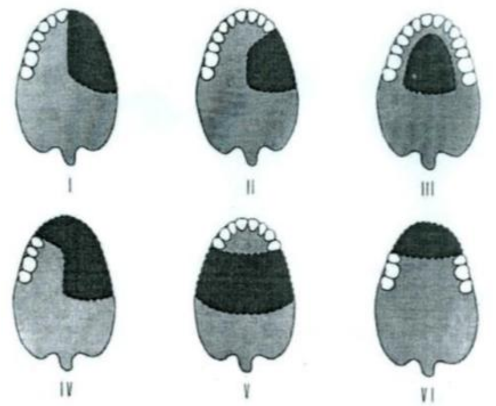

Figure 1

Table 2

Spiro's Classification of Maxillary Defects(7):-	
Type 1	Limited Maxillectomy- Any maxillectomy in which one wall of the maxillary antrum is removed.
Type 2	Subtotal Maxillectomy- Maxillectomy in which atleast two walls of the antrum are removed including the palatal wall.
Type 3	Total Maxillectomy- Complete resection of the maxilla.

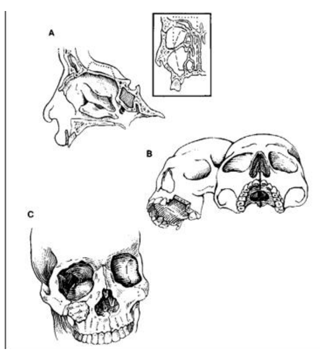

Fig.2: Limited Maxillectomy

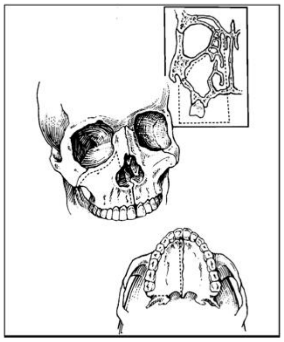

Fig. 3: Subtotal maxillectomy

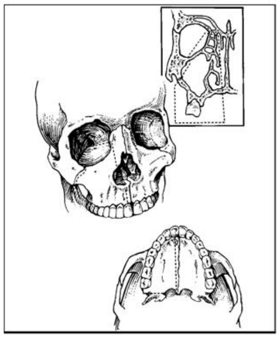

Fig.4: Total Maxillectomy