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Critical concepts in craniofacial microsurgical reconstruction

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SUMMARY

Over the last several decades, there have been numerous advances in the fields of aesthetic, craniofacial, and microsurgery. According to Fisher et al. aesthetic units are no longer "skin deep" but are recognized as being composed of both soft and hard tissue. Indeed, hard tissue must complement the soft tissue to recreate the unit. In addition, revisionary procedures have become necessary to achieve the desired result.

We assembled a two-centre, retrospective cohort review of patients who underwent free-tissue transfer of craniofacial defects at the Cancer Institute (Tehran) and the Central Hospital (Baku) from 2009 to 2013. Patients were categorized by anatomic location, complications recorded, and illustrative cases selected. A total of 124 patients with craniofacial defects were identified. 39 female and 85 male patients, with a mean age of 57 years. Etiologies included cancer (95.2%), trauma (0.8%), congenital defects (1.6 %), and benign tumour (2.4%). Free-tissue transfers included 38 fibula, 6 anterolateral thigh, 19 latissimus dorsi musculocutaneous flap, 12 latissimus dorsi muscle flap, 12 osteocutaneous radial, 16 fasciocutaneous, 14 rectus abdominis musculocutaneous, 6 rectus abdominis muscle, one vastus lateralis flaps. The success rate was 96.7% and complication rate was 11.2%. Secondary procedures included fat injection, tissue resuspension, and cutaneous flap excision followed by full-thickness skin grafting or tissue rearrangement. Here, we integrate the critical concepts and provide a patient series illustrating their success.

Key words: cancer, craniofacial, microsurgery, reconstruction

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INTRODUCTION

The head and neck area is a source of varied and challenging tumours. In the past, these were unrespectable or not reconstructable, or both. With the help of sophisticated imaging, better surgical approaches, the operating microscope, micro vascular composite tissue transplantation, interspecialty cooperation (e.g., neurosurgery, neuro-otology, radiation oncology, and medical oncology), and most of all experience, what seemed impossible is now possible. Plastic surgeons have become head and neck and skull base surgeons [1-6]. Over the last several decades, there have been numerous advances in the fields of aesthetic, craniofacial, and microsurgery. According to Fisher et al. aesthetic units are no longer "skin deep" but are recognized as being composed of both soft and hard tissue. Indeed, hard tissue must complement the soft tissue to recreate the unit. In addition, revisionary procedures have become necessary to achieve the desired result.

MATERIALS AND METHODS

We assembled a two-center, retrospective cohort review of patients who underwent free-tissue transfer of craniofacial defects at the Cancer Institute (Tehran) and the Central Hospital (Baku) from 2009 to 2013. Patients were categorized by anatomic location, complications recorded, and illustrative cases selected. A total of 124 patients with craniofacial defects were identified: 39 female and 85 male patients, with a mean age of 57 years.

Etiologies included: cancer (95.2%), trauma (0.8%), congenital defects (1.6%), and benign tumour (2.4%). (Table 1) (Figure 1).

Free-tissue transfers that we used included: 38 fibula, 6 anterolateral thigh, 19 latissimus dorsi musculocutaneous flap, 12 latissimus dorsi muscle flap, 12 osteocutaneous radial, 16 fasciocutaneous radial, 14 rectus abdominis musculocutaneous, 6 rectus abdominis muscle, one vastus lateralis flaps (Table 2) (Figure 2).

Graphical representation of kind of transferred tissue

Tab. 1. Etiologies of craniofacial surgery

Etiology	%
Malignancy	95.2%
Trauma	0.8%
Congenital defects	1.6%
Benign tumor	2.4%

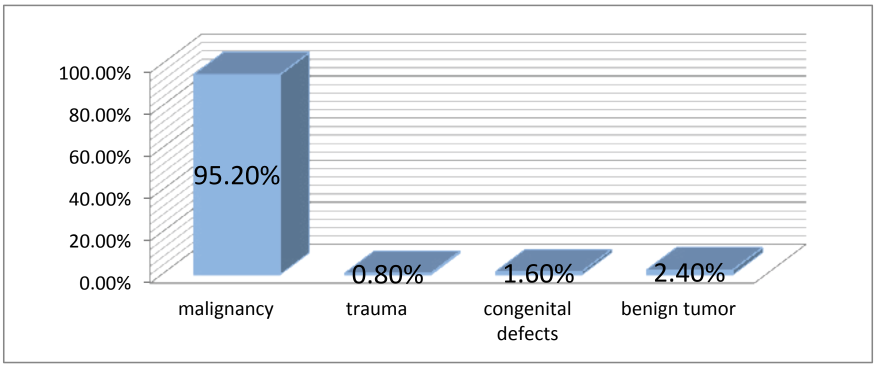

Fig. 1. Graphical representation of etiologies of craniofacial surgery

Tab. 2. Kind of transferred tissue

Transferred Tissue	Number of procedure
Fibula	38
Anterolateral thigh	6
Latissimus dorsi musculocutaneous flap	19
Latissimus dorsi muscle flap	12
Osteocutaneous radial	12
Fasciocutaneous radial	16
Rectus abdominis musculocutaneous	14
Rectus abdominis muscle	6
Vastus lateralis flap	1

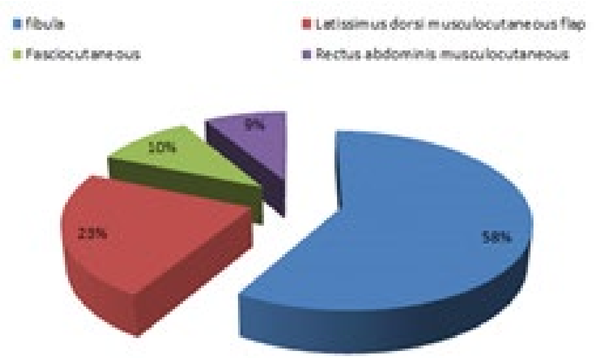

Fig. 2. Graphical representation of kind of transferred tissue

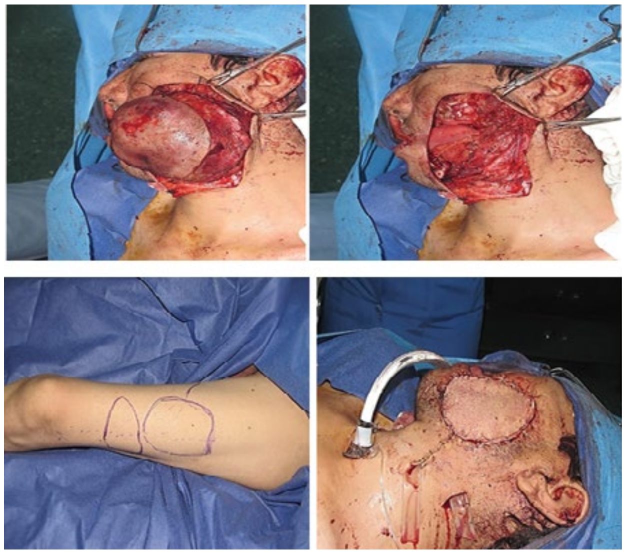

Fig. 3. A 37 years old male with history of recurrent dermatofibrosarcoma protuberance. The tumor resected with 3 centimeters margin. A double paddle anterolateral thigh free flap created. One paddle used for lining and another for coverage of the through and through defect

RESULT

The success rate was 96.7% and complication rate was 11.2%. Secondary procedures included fat injection, tissue resuspension, and cutaneous flap excision followed by full-thickness skin grafting or tissue rearrangement.

Here, we integrate the critical concepts and provide a patient series illustrating their success. In 6 patients was done reconstruction with anterolateral thigh flap. In 1 patient a double paddle anterolateral thigh free flap created. The tumour resected with 3 centimetres margin. One paddle used for lining and another for coverage of the through and through defect (Figure 3).

In 38 patients maxillofacial bone defects were reconstructed with fibula free flap. The one of the patients the defect after maxilloectomy a type 3b was reconstructed with osteocutaneous free fibula flap (Figure 4). Following creation of an osteocutaneous free fibula flap, the fibula bone sandwiched by the skin paddle and used for reconstruction for the palatal arch. The skin paddle used for repair of the bucal and oral lining. Routine reconstruction of subtotal defects of the mandible and orthopaedic rehabilitation supported by dental implants in the mean lasting a year. Single stage surgical treatment with immediate orthopaedic rehabilitation was done by help of preoperative virtual computer simulation in two patients. (Figure 5) 3D investigation of pathological and donor sites, virtual simulation of tumour resection, positioning of the dental implants into fibula, virtual flap bending and transfer, virtual bending of fixing reconstruction plates, and fabrication of navigation templates and bridge prosthesis supported by dental implants were done on Pre-op stage. The surgery included tumour resection, insertion of dental implants into fibula and elevation of fibula osteocutaneuose free flap, rigid fixation within recipient site and immediate loading by bridge orthopaedic device. On 10- month follow-up functional and esthetic results were asses as reasonable. Radiology showed dental implants to be integrated and positioned appropriately. We found that successful rehabilitation of the patients with extensive defects of the jaws could achieve by ablative tumour resection, dental implants insertion prior to flap elevation guided by

Fig. 4. A 32 years old male with history of SCC of maxilla. After resection the resulted defect is a type 3b. Following creation of an osteocutaneous free fibula flap, the fibula bone sandwiched by the skin paddle and used for reconstruction for the palatal arch. The skin paddle used for repair of the bucal and oral lining

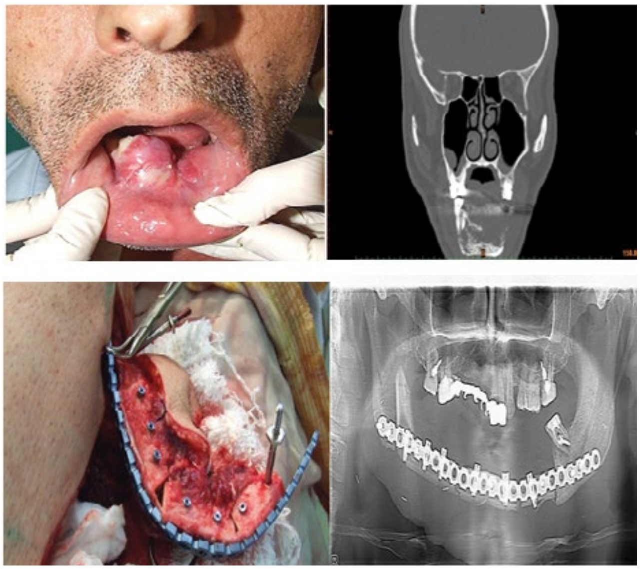

Fig. 5. The patient with clear cell carsinoma of mandible. Mandible was resected and was done free fibula reconstraction and immediate dental implantation

navigation templates, further osteotomy, modelling of the flap according navigation template, flap transfer and rigid fixation within recipient site by prebended plates, with application of prefabricated prosthesis.

DISCUSSION

Reconstructive maxillofacial surgery refers to the wide range of procedures designed to rebuild or enhance soft or hard tissue structures of the maxillofacial region. Reconstructions of jaw and mouth defects represent a challenge to the surgeon [1-5] and are most commonly indicated in patients with oral Squamous Cell Carcinoma (SCC). They are also used in cases of benign tumours, trauma, osteoradionecrosis, and infection, chronic non-union of bone, clefts, congenital deformities and old age [5-7]. The development of antibiotics, improved diagnostic imaging and anaesthesia have heralded a new era of success in maxillofacial reconstruction [1,2,4,6]. In the past twenty years, the development of bone technology [8-12], osseointegration [13-17] and microsurgery [7,18,19] and improved dental prosthodontics have revolutionised maxillofacial reconstruction. Following surgery, early wound closure and the restoration of form, cosmetics and function are the goals of reconstructive surgery [1,6]. This article seeks to review the modern methods employed in the reconstruction and rehabilitation of the form and function of the jaws and mouth such as free tissue transfer, prosthodontics and dental implants.

In 1970s the unique method for reconstruction of craniofacial defects was included fill the entire hole with soft tissue, and failure rate at this method was nearly 40%. At the present time we can achieve to best results in craniofacial surgery by attention to critical concepts in aesthetic craniofacial microsurgical reconstruction. These concepts are:

- Knowledge of aesthetic units of face
- Defect boundaries
- Tissue requirements
- Bone and soft tissue support
- Soft tissue volume
- Timing
- Secondary revision

In most of the approaches using osteotomies that have been discussed, it is not unusual to perform the bone cuts and the bone shifts that are convenient for the particular exposure required. For this, the term exposure by facial disassembly can be conveniently employed. It is this concept, freedom from rigid boundaries and anatomic terms that has allowed the development of newer and safer methods of exposure. This adaptability has helped establish an "as required" approach, much to the patient's benefit. New frontiers have been opened and crossed. Challenges remain, but as technology improve in terms of sophisticated guidance systems, more precise and effective radiation treatment, and new chemotherapeutic agents together with earlier diagnosis, the outlook for previously incurable conditions continues to improve [20].

Maxillofacial reconstruction is of prime importance in the management of orofacial defects caused by disorders such as neoplastic disease. The modern techniques for reconstruction are discussed below. Vascularised Free Tissue Transfer (VFTT), also known as free flap transfer, is now considered the gold standard for maxillofacial reconstruction [4,6]. It involves the harvesting and detachment of tissue with its blood and nerve supply and transferring it to repair a defect, where its blood and nerve supply are re-established by re-anastomosis to suitable recipient site vessels [6]. Success rates are estimated at between 90% and 94% [20,21]. VFTT is advantageous over non-vascularised transfer, as postoperative radiation affects the vascularized flap less severely compared to the non-vascularised flap due to the transferred blood supply. A number of different donor sites are used for VFTT, the selection of which depends on the recipient site and type of tissue being replaced [11, 12]. The future for maxillofacial reconstruction is bright as a wide range of techniques are being developed to improve upon the advances of the past few decades [6,7].

CONCLUSION

Orofacial defects can have detrimental functional and psychological effects on the patient. However, in the modern maxillofacial world, the surgeon has a wealth of techniques to draw upon to manage such defects. The management involves either surgical reconstruction or prosthetic rehabilitation or a combination of both. Microsurgery, osseointegration and bone technology have become the keystones in orofacial reconstruction and major advances in recent years have resulted in more treatment modalities and increased success.

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