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Velo-palatal obturator prosthesis after maxillectomy following squamous cell carcinoma: a case report

Proteza zasłonowo-podniebienna po usunięciu szczęki w następstwie raka płaskonabłonkowego: opis przypadku

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Summary

The maxilla plays a primordial role in mastication, deglutition, and phonation. Maxillary defects can be the result of congenital factors, trauma, osteonecrosis, or even tumour pathology. The most common malignant tumours of the upper aero-digestive tract are squamous cell carcinomas. Soft and hard tissues defects resulting from resective surgeries of theses carcinomas cause damage on the functional, aesthetic, and psychological level. The treatment of post-maxillectomy defects includes different options, such as reconstructive surgery or rehabilitation with an obturator prosthesis. The treatment option depends on each clinical situation. The use of the removable obturator prosthesis offers several advantages by allowing the restoration of oral functions and improving patients' quality of life. We, herein, report an approach to fabricate a rigid maxillary obturator prosthesis for a partially edentulous female patient with a velo-palatal defect. The removable prosthesis is composed of two rigid obturators, one is palatal and the other is velar. The obturator prosthesis made it possible to close the oro-nasal communication and to improve swallowing, speaking and chewing.

Streszczenie

Szczęka odgrywa podstawową rolę w żuciu, połykaniu i fonacji. Wady szczęki mogą być skutkiem czynników wrodzonych, urazów, martwicy kości, a nawet patologii nowotworowej. Najczęstszymi nowotworami złośliwymi górnego odcinka przewodu pokarmowego są raki płaskonabłonkowe. Ubytki tkanek miękkich i twardych, powstałe w wyniku zabiegów resekcyjnych tych nowotworów, powodują uszkodzenia na poziomie funkcjonalnym, estetycznym i psychologicznym. Leczenie ubytków po usunięciu szczęki oferuje różne możliwości, takie jak chirurgia rekonstrukcyjna lub rehabilitacja z protezą zasłonową. Dobór leczenia zależy od danej sytuacji klinicznej. Zastosowanie wyjmowanej protezy zasłonowej ma kilka zalet, umożliwiając przywrócenie funkcji jamy ustnej i poprawę jakości życia pacjentów. W niniejszej pracy przedstawiamy podejście do wytwarzania sztywnej protezy zasłonowej szczęki u częściowo bezzębnej pacjentki z wadą podniebienną. Proteza wyjmowana składa się z dwóch sztywnych obturatorów, jednego podniebiennego i drugiego welarnego. Proteza zasłonowa umożliwiła zamknięcie połączenia ustno-nosowego oraz usprawnienie połykania, mówienia i żucia.

Introduction

Squamous cell carcinoma is the most common malignant tumour of the upper aero-digestive tract.[1] The average age of discovery varies between 40 and 60 years depending on the authors. The occurrence in young children and adolescents remains rare, around thirty cases have been described in the literature since 1952.[2]

The treatment of this tumour is performed with different modalities depending on its stage, size and extension. When its involvement is advanced, partial or total surgical resection is the only option left. It can be associated or not with radiotherapy depending on the histological grade. In fact, postoperative adjuvant radiotherapy is indicated for high-grade mucoepidermoid carcinoma.[3, 4]

Resection surgery always results in maxillary defects, eventually leading to oronasal or orosinusal communication.[5] It must be followed by a reconstructive surgery or a rehabilitation with an obturator prosthesis to allow the patient to regain their manducatory functions.[6, 7]

The history of obturator prosthesis is well documented. Ambroise Paré was the first to use an artificial device to close a palatal defect as early as the 1500s. Claude Martin described the use of a surgical obturator prosthesis in 1875. Fry described the use of impressions before surgery in 1927.[8]

The restoration of an intra-oral defect with an obturator prosthesis is most challenging due to vast extension, frail mucosa, fluid leakage from nasal cavity, and lack of sound hard and soft tissues to provide support.[9] Several structures can be used to retain the obturator prosthesis such as implants, the remaining skin with or without adhesive, body cavities, and teeth.[10]

In this paper, through a case report, the specificity of a prosthetic rehabilitation of a patient with an acquired maxillary defect requiring the placement of a velo-palatal obturator prosthesis was presented.

Case presentation

A 61-year-old female patient consulted the department of prosthodontics for an oral rehabilitation with functional requests. The patient's medical history revealed that she had had a squamous cell carcinoma of the palate that was subsequently treated with surgical resection and head and neck radiotherapy. The patient complained of chewing and phonation problems associated with nasal leakage of fluids.

The extra-oral examination showed an equality of the levels of the face and a sagging of the right half-face. The lip corner on the right side was convergent in relation to the bipupillary line (Fig. 1). A moderately sufficient mouth opening and a straight mouth opening/closing path were noted.

Fig. 1. Extra-oral views of the patient.

The intra-oral examination revealed a maxillary defect involving the right palatine bone, the soft palate and the upper right alveolar arch with an oro-nasal communication (Fig. 2A). According to Aramany's classification of maxillary defects, it was a Class II defect.[11] According to Benoist's classification of soft palate defects, it was a divided velum associated with partial edentulism (Class IC).[12]

A total of eight maxillary teeth remained from the right central incisor (11) to the second left molar (27). In the mandibular arch, teeth 36, 47, 48, and 38 were absent (Fig. 2A, B,

Fig. 2. Initial situation. A to C – Intra-oral views of arches; D – Panoramic X-ray.

C). The patient had a maxillary bridge from tooth22 to 26. This fixed prosthesis had a poor dentoprosthetic seal.

The osteomucosal-bearing surface showed a flat palate and an extension of the mucous membrane covering the inner side of the cheek to the level of the right edentulous ridge. Saliva examination showed a remarkable viscosity, which is a frequent consequence of radiation therapy.

The radiological examination showed that the radiological crown-root ratio was equal to 1 for all maxillary and mandibular teeth (Fig. 2D).

Examination of the oral functions revealed swallowing and chewing difficulties. Rhinolalia was also noted.

The oral cavity sanitation phase was based on oral hygiene instructions and caries removal on tooth 11.

Basing on combined data from the clinical and radiological examinations, a resin obturator prosthesis was indicated in the maxillary arch. It was composed of a rigid palatal obturator and a rigid velar obturator.

Prosthetic procedures were started with taking impressions. In the maxilla, the commercial impression tray was rectified and tested in the mouth. The undercuts of the palatal defect were blocked using petrolatum applied gauze pads (Fig. 3A) and the impression was taken with irreversible hydrocolloid (Alginate Cavex®) (Fig. 3B). In the mandible, a conventional impression was taken.

An individual impression tray was made on the obtained cast. It was used as a support for an anatomo-functional impression using the FITT

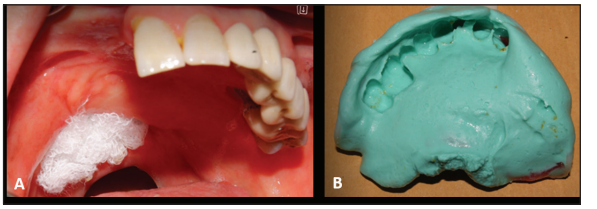

Fig. 3. Preliminary impression. A – Blocking the undercuts of the palatal defect using petrolatum applied gauze pads; B – Impressin taking with irreversible hydrocolloid.

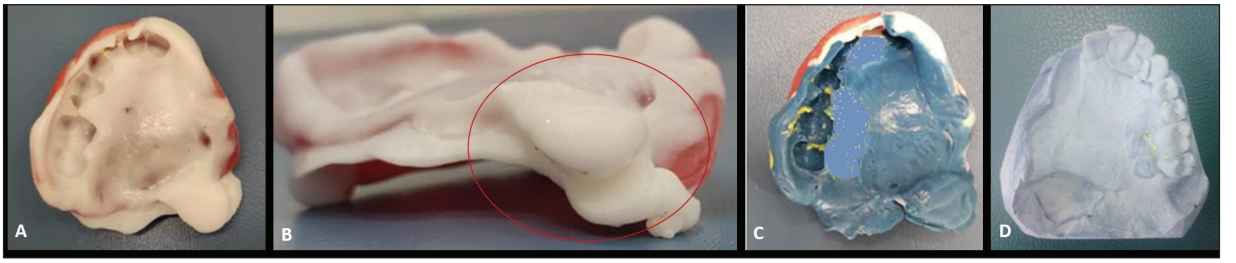

Fig. 4. Anatomo-functional impression taking. A – Anatomo-functional impression using FITT material; B – Impression of the palatal defect; C – Rebasing the impression with light silicone; D – The obtained cast.

material (Functional Impression Tissue Toner) (Kerr®) (Fig. 4A,B). The impression was then rebased with light silicone (Fig. 4C,D).

The occlusion relationships were recorded in centric relation and the correct Occlusal Vertical Dimension. Mounting of resin artificial teeth on wax was performed. The shape, shade and dimensions of these teeth were chosen based on the residual teeth and the available prosthetic space.

After the fitting in the mouth stage, polymerization of the resin was carried out. The prosthesis was hollowed on the external surface, facing the obturator, to light it and prevent possible static instability. Then, the prosthesis was polished and inserted in the mouth (Fig. 5).

The velar obturator was performed secondly. The first step was to create grooves at the external surface of the removable prosthesis, which ensure the retention of flexible wires (Fig. 6A). The latter were fixed by the self-curing resin (Fig. 6B).

The shaping of the flexible wires using needle holders was performed in the mouth (Fig. 6C). During this step, the wires must not interfere with the portor of the defect. A spacing of 3 to 5 mm was desirable (Fig. 6D,E).

In order to check this spacing, the patient performed head rotation movements to the right and left sides as well as extension forwards and backwards.

Then, a plaster key was made to transfer the exact position of these wires (Fig. 7A). The

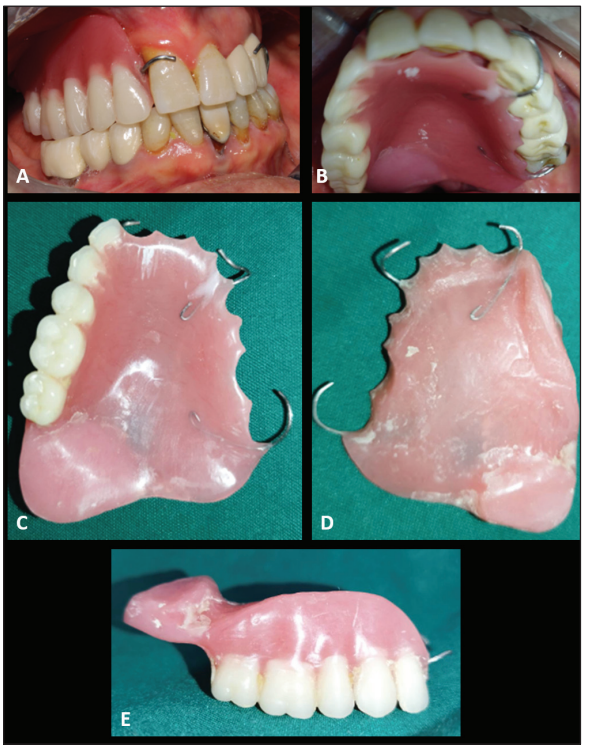

Fig. 5. Placement of the obturator prosthesis in the mouth. A and B – intra-oral views of the prosthesis; C – External surface of the prosthesis; D – Intaglio surface of the prosthesis; E – Lateral view of the prosthesis.

duplicate was made (Fig. 7B). A mesh saddle was sculpted. It was supported by two wires of 1 mm in diameter (Fig. 7C). This saddle would serve as a support for the impression material.

The rods and casting cone were put and the casting was carried out (Fig. 7D). The mesh saddle was repositioned on the cast, and fixed to the prosthesis by the heat-curing resin (Fig. 7E).

After fitting in the mouth, an impression was

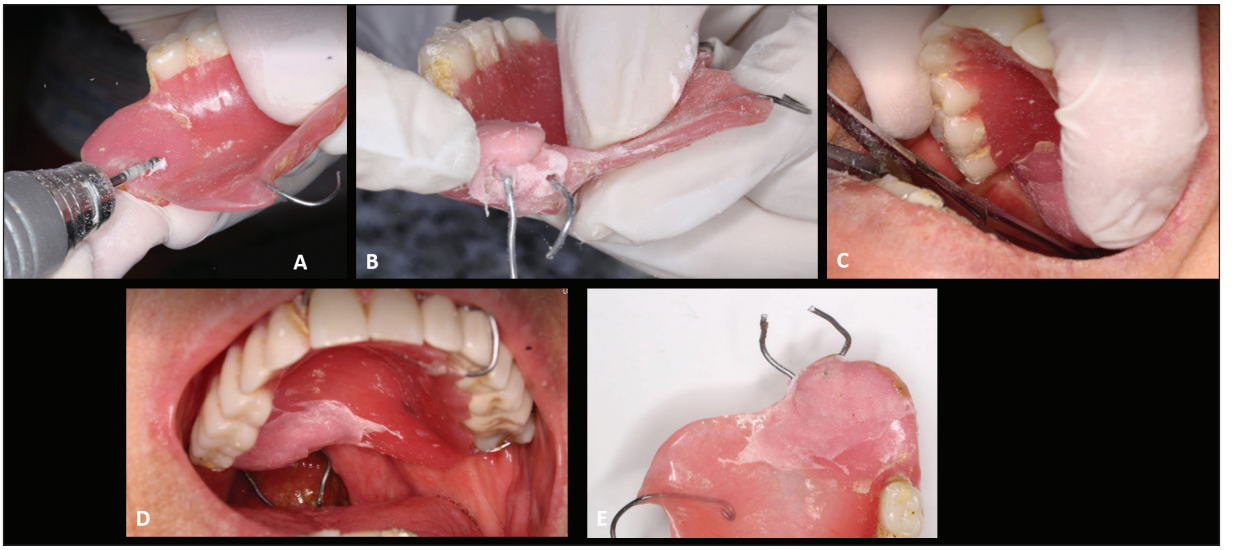

Fig. 6. First step of velar obturator fabrication. A – Creation of the grooves at the external surface of the prosthesis; B – The fixation of flexible wires using the self-curing resin; C: –The shaping of the flexible wires using needle holders; D and E – Flexible wires in place.

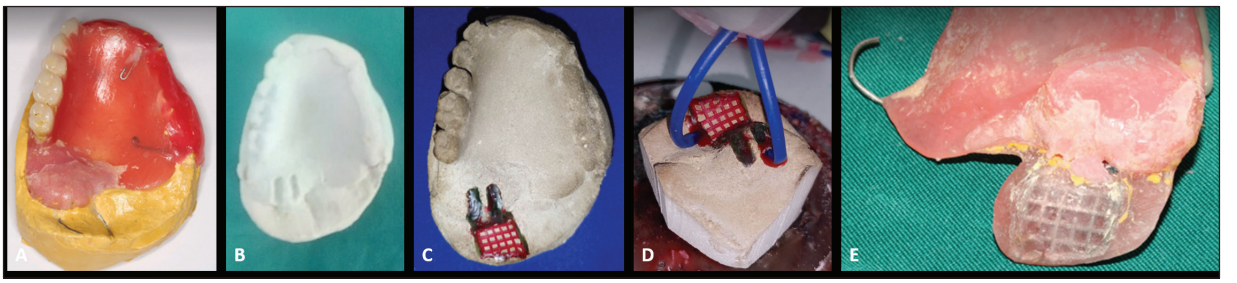

Fig. 7. Second step of velar obturator fabrication. A – Making of the plaster key; B – Making of the duplicate; C – Saddle sculpture; D – Putting of rods and casting cone; E – Fixation of the mesh saddle to the prosthesis.

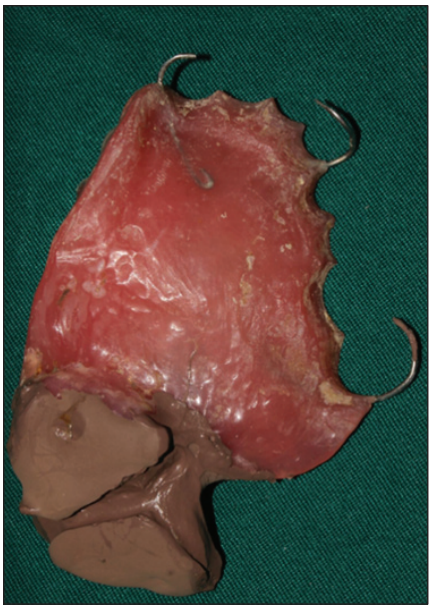

Fig. 8. Impression taking using polysulfide impression material.

made using polysulfide impression material (Fig. 8).

As the impression was being taken, the patient performed the movements already mentioned with the pronunciation of the letter A. This impression was limited to the defect only.

The casting of the impression was done. Then, the mesh saddle and the supporting resin were removed. The mesh saddle was repositioned on the cast. It was coated with the heat-curing resin. This saddle was used to support the velar obturator. The polymerization was then carried out, followed by the placement of the obturator prosthesis in the mouth (Fig. 9).

The patient was satisfied with the final result. Recommendations concerning the maintenance of the prosthesis were given to the patient.

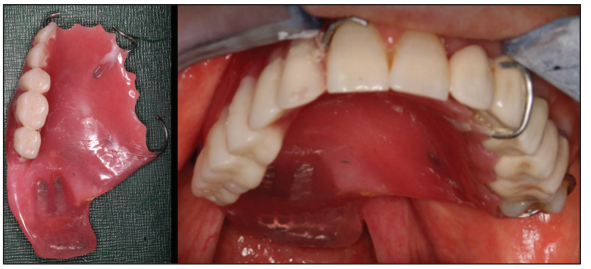

Fig. 9. The placement of the obturator prosthesis in the mouth.

Generally, the prosthesis must be brushed after each meal with a soft toothbrush and then immersed in a solution of digluconate of chlorhexidine for 15 minutes daily and then it must be rinsed thoroughly. Periodic check-ups were scheduled to monitor the stability of the maxillary obturator prosthesis and to detect any complications or mucosal irritations. Should they happen, these complications should be treated well and their healing carefully monitored.

Discussion

The consequences of maxillofacial defects encompass functional, infectious, aesthetic, psychological, and tissular dimensions. Functional disorders manifest as speech and alimentary disturbances due to nasal regurgitation. Infectious complications may lead to chronic sinus infections. Esthetic alterations arise from bone resection, causing sagging of soft tissues. Psychologically, facial disfigurement profoundly affects patients, impacting sensory perception and social integration. Tissular consequences include fibrous retractions and the disappearance of the oral vestibules, compromising prosthetic stability.[13,14]

In order to avoid these severe repercussions and disabilities, the prevailing approach remains the use of a removable prosthesis as a defect obturator. This later was defined by The Glossary of Prosthodontics Terms as "a prosthesis used to close a congenital or an acquired tissue opening, primarily of the hard palate and/or contiguous soft palate and alveolar structures".[5] This prosthesis can only be designed within a surgical-prosthetic symbiosis plan. Hence, prior to initiating treatment, a multidisciplinary consultation meeting involving various specialists (maxillofacial surgeon, prosthodontist, radiologist and social worker) must be held to outline the treatment plan.[10]

Prosthodontic rehabilitation with obturator prosthesis restores the missing structures, occludes oro-antral communications, prevents oronasal regurgitation and facilitates deglutition and speech production.[3]

Other than widely acknowledged advantages resulting from their use, such as reduction in hospitalization time and cost, the potential to obviate or eliminate a second surgical procedure for defect closure and the immediate re-establishment of facial morphology and oral functions is paramount.[5]

Prosthetic rehabilitation is the preferred modality only when surgical intervention is not possible. Patients of advanced age, with compromised general health, extensive defects and impaired blood supply due to radiation therapy may be deemed suitable candidates for prosthetic rehabilitation.[15]

Depending on the time period at which it is given, the obturator prosthesis can be fabricated before the surgery and applied immediately thereafter to protect the surgical cavity. Alternatively, it can be temporary, fabricated a after the surgery allowing time for customization and tissue repair. Restorative, or definitive, prostheses are fabricated after healing. They have all the characteristics of a conventional prosthesis, they are more functional, and result in better aesthetics. The reported case is that of a definitive obturator.[10]

Currently, the most commonly utilized materials for maxillofacial prosthesis are

silicones (flexible obturators) and acrylic resins (rigid obturators).[10]

According to *Maire* et al. (2000), the selection between a rigid or flexible obturator depends on various factors including the patient's range of mouth opening, extent of the surgical defect, the quality of the remaining teeth, the patient's age, and any existing conditions. Generally, rigid obturators are indicated in the presence of teeth, for small surgical defects, and when there is no limitation in mouth opening. These obturators may be attached to a resin palatal plate for patients with few teeth, or to a metal palatal framework with clasps for patients with more teeth.[16]

Flexible obturators are indicated for completely edentulous patients, for large defects, and in the presence of trismus. The prosthesis serves both to fill the defect and to replace missing teeth. As traditional retention methods for complete dentures cannot be utilized, the obturator provides retention for the complete prosthesis by conforming to the undercuts present in the maxillary defect.[16]

In this case, a rigid obturator was indicated because the patient was partially edentulous and the maxillary defect was of moderate size. For the fabrication, the partial denture and the velar obturator were fabricated separately. Velar obturator that resembled a Sürensen velar obturator was made of methyl methacrylate with a chrome-cobalt metal infrastructure for more durability and superior mechanical properties.[13]

The fabrication of velo-palatal obturators involves three main components: a palatal plate, an intermediate "tutor" and an obturator device that aimed to improving velopharyngeal function for enhanced speech and swallowing. Notably, the used obturators provide dynamic closure of the pharyngeal sphincter. Achieving a precise impression is required to establish appropriate fit of the prosthesis. It is necessary to ensure that it neither obstructs the Eustachian tube nor impedes the velar contractions.[17]

In this case, preliminary impression was taken with irreversible hydrocolloid after blocking out the undercuts with petrolatum applied gauze pads. For the master impression, a two-stage procedure was followed: the first impression was taken with delayed setting resin (Kerr®) because there were undercuts. Its elasticity after setting allowed us to disinsert it without tearing or detachment of the impression. It served to construct the removable partial denture (RPD). The second impression was achieved using the RPD itself and stainless steel wires as tutors that were adjusted according to the defect borders. Polysulfide was then used along with a cast saddle for the functional impression of the velar defect. Problems related to gag reflex were encountered.

In the literature, various methods of velar obturator's reinforcement were described. This later can be reinforced by means of a stainless steel wire embedded within the conventional acrylic resin or a thin cast metal framework made of chrome-cobalt (Cr-Co) or nickel-chromium (Ni-Cr) alloys. The use of a stainless steel wire has been shown to exhibit fracture due to extensive cantilever action, weight in conjunction with the velopharyngeal dynamic action of the musculature, risking possible swallowing or aspiration, and has a greater tendency for tongue interference. In this case, the velar obturator was reinforced using a thin cast metal framework. Particular attention was given to the weight and the thickness of the velar obturator. It is important to lighten it as much as possible since an increased thickness and weight are considered as traumatic factors, and may disrupt and interfere with tongue action.[18-20]

The utilization of intra-oral scanners (IOS) presents a promising solution to mitigate challenges posed by the gag reflex during the impression procedure. This innovative approach not only enhances patient comfort

but also streamlines the prosthetic fabrication process, contributing to improved efficiency and overall patient satisfaction.[21] However, some limitations of IOS are noted. Digital scanning can only develop a mucostatic impression by capturing tissues in a passive state. The disruption of the scanning process by the movement of soft tissues alters the morphology of the site, the appropriate prosthesis border extension and the peripheral seal. In the case of large distal extension edentulism, determination of the difference of compressibility between the fibromucosa and the periodontal ligament can be challenging.[22]

Patients who have undergone maxillectomy may demonstrate poor support for the prosthesis, thus possibly impairing its stability and retention capability.[10] The obturator may be displaced superiorly with the stress of mastication, and will tend to drop without occlusal contact. The degree of movement depends on different factors such as the size and the location of the defect, the number of the remaining teeth, the support area of the remaining palate, and the exposure to radiotherapy.[8] The remaining structures most often are unilateral, thus encouraging the movement of the prosthesis with associated stress direct to these remaining structures. This stress can increase bone resorption and may jeopardize the remaining support for an obturator prosthesis.[23]

A reasonable prosthetic design is mandatory to incorporate the most appropriate components to resist the various forces acting on the obturator prosthesis. It also ensures uniform stress distribution to remaining natural teeth and supporting structures within physiological limits.[9]

For the patient with an acquired maxillary defect, it is often necessary to modify, and sometimes violate, some of the basic principles of prosthetic design owing to the basic nature of the defect.[23]

The recesses within the nasal aperture, lateral scar band, anterior and lateral walls of the defect aid in the retention and the support of the prosthesis. Optimal support can be derived from the residual maxilla and adjacent structures within the defect to maintain the stability of the prosthesis.[9]

In cases involving obturator abutments adjacent to distal extension maxillary resection sites, these abutments are susceptible to excessive rotational forces. Consequently, fixed splinting of some or all of the remaining teeth is recommended to effectively dissipate stresses directed towards primary abutment teeth. If the remaining teeth are not parallel with the walls of the defect, and if the palatal surfaces of the teeth are not adequate, guiding planes are established to counteract vertical displacement of the obturator and disengagement of the retentive clasp arms.[8]

With regard to remaining teeth arrangement and opposing occlusal schemes, challenges persist in achieving prosthesis retention from the opposing dentition.[3] Indeed, restoration of occlusion in patients with maxillary defects is a challenging situation as every case is unique in itself. This makes the occlusion one of the most important aspect of stability.[23]

Prioritizing maximal distribution of the occlusal force in centric and eccentric jaw positions is imperative to minimize the movement of the prosthesis and the resultant forces on individual structures. This necessitates the use of acrylic resin teeth with reduced occlusal contact areas. Furthermore, altering the cusp angle of posterior teeth influences the stability of the prosthesis placed on an edentulous resected maxilla.[8]

Moreover, considerations for occlusion extend beyond mechanical factors. The Academy of Denture Prosthetics emphasized that changes in the tissues supporting a maxillofacial prosthesis may occur more rapidly than those supporting a conventional prosthesis. Consequently, frequent re-evaluation of occlusion and base adaptation

is imperative, with corrective measures such as selective occlusal grinding or prosthesis base refitting deemed necessary. For irradiated patients necessitating complete dentures, it is advised to minimize occlusal stress, as recommended by established protocols.[23]

Moreover, while achieving a balanced occlusion is crucial for the stability and retention of the obturator, attention to its weight and design is equally imperative to enhance retention. In fact, the bulb of the obturator prosthesis increases its weight. This later hampers the retention of the prosthesis. To avoid this, it should be made hollow. Various methods for hollowing the prosthesis with the use of different materials such as salt and sand have been well documented in studies.[15]

In cases of large maxillary defects, the movement of the obturator prosthesis is inevitable and requires other forms of retention to limit its rotation.[8] Practitioners can modify the retentive mechanisms through the use of resilient attachments or dental implant retention mechanisms wherever possible.[15]

Using dental or zygomatic implants as supports for obturator prosthesis surely provides a notable improvement in the masticatory function of such patients.[24] The residual anterior segment of the maxilla as well as tuberosities are the privileged sites. However, such treatment cannot always be performed for different reasons such as costs, insufficient residual bone and chemo-radio therapies.[14]

It is evident that surgical reconstruction combined with implant placement offers a significant enhancement to the prosthetic prognosis. However, it must be restricted to patients with extensive substance loss affecting almost the whole palate or more for whom the treatment with conventional obturating prosthesis remains ineffective, particularly in the case of full mouth edentulism or of partial edentulism with remaining teeth having poor prognosis.[14]

Conclusion

There is no doubt that prosthetic rehabilitation procedures still have an important role to play, especially in modest defects in the field of carcinology. However, it is imperative to acknowledge the ongoing dimensional changes in tissues, persisting for at least a year due to scar contracture and wound organization. Such alterations are often accelerated in tissues supporting maxillofacial prosthesis compared to those supporting conventional prosthesis, necessitating frequent re-evaluation of occlusion and base adaptation.

In the contemporary landscape, prosthetic rehabilitation stands to benefit significantly from advancements in microvascular surgery, implantology, and CAD-CAM techniques. These innovations offer promising avenues to surmount existing challenges and achieve enhanced prosthetic integration.

A large number of studies point to the development of new materials and techniques to optimize the treatment of congenital and acquired orofacial defects. There is no doubt that this subject is expected to evolve continuously and probably for quite a long time regarding its complexity.[10,25,26]

Informed consent : written informed consent was obtained from the patient

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