

CASE REPORT

Implant-supported bar overdentures in patients treated surgically for head and neck cancer: Two case reports

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Abstract

Prosthetic rehabilitation of patients who have undergone head and neck cancer (HNC) surgery could be very challenging. The aim of this article is to present two HNC clinical cases rehabilitated with implant-supported removable complete dental prosthesis with different types of CB.

KEYWORDS

connecting bar, dental implants, head and neck cancer, implant-supported prosthesis, overdentures

1 | INTRODUCTION

Treatment of patients with head and neck cancer (HNC) is based on resective surgery and/or radio/chemotherapy. The consequences of such management lead to tissue loss (more or less compensated by free fibula or scapula grafts), hyposialia or asialia, increased carious and periodontal risks, limited mouth opening, and microstomia.¹

The survival rate of a fibula flap is around 97%, and the implant survival rate is around 78%, according to a retrospective study with 11 years of follow-up.² Rehabilitating these patients with conventional prosthesis is sometimes impossible due to the wide loss of hard and soft tissue.³ According to the clinical situation, several implant-supported prosthetic options may be considered one of which is complete removable dental prosthesis stabilized over implants with a connecting bar (CB). The aim of this article is to update the indications of connecting bars and their characteristics via two clinical case reports.

2 | CLINICAL CASE No 1

A 48-year-old male patient (Figures 1–8) presented to the Department of Prosthodontics with a history of a myoblastic-type embryonic rhabdomyosarcoma in the right cheek diagnosed at the age of 2. Surgical removal of the tumor had been performed, combined with curietherapy and multiple chemotherapies. Several reconstructions had been implemented over the years (right jugal reconstruction using a back perforating flap, a scapula free flap, bicommissuroplasty, etc).

2.1 | Clinical examination and diagnosis

Extraoral examination of the patient showed a 19 mm limitation of mouth opening between the inferior edge of the upper lip and the upper edge of the lower lip, combined with microstomia and subtotal loss of laxity on the right side (Figure 1). There were a persisting labial inoclusion at rest, a concave subnasal profile (collapse of the

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philtrum), and an asymmetrical smile, with no gum exposure. Temporo-mandibular joint (TMJ) displacements were reduced in propulsion and diduction.

The patient's remaining teeth were extracted 5 years ago (Figure 2). The patient had totally edentulous arches with two mandibular dental implants (Zimmer® TSV 3.7 mm × 10 mm) compensated with complete unstable maxillo-mandibular removable dentures. Despite the severe bone resorption in both jaws, the vertical and horizontal prosthetic space was reduced, due to mouth opening limitation. Tongue mobility was also reduced bilaterally.

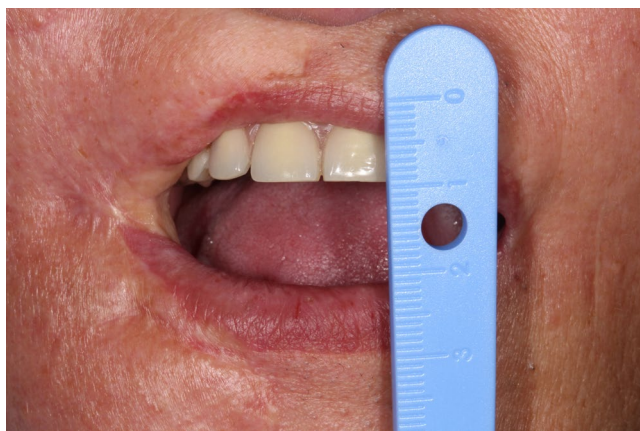


FIGURE 1 Initial situation showing the limited mouth opening

2.1.1 | Treatment planning

The initial treatment plan was set for a complete fixed implant-supported prosthesis in the maxilla and a complete mandibular removable denture stabilized on the 2 existing symphysis implants using ball attachments (Locator Zimmer®).

Given the reduced size of the maxilla and the severe bone resorption, 5 implants were placed, using a surgical guide fabricated according to the patient's original prosthesis: 2 zygoma implants on the left (Nobel®, respectively, 47 mm regarding the first molar, and 50 mm regarding the canine), and 3 standard implants on the right (Nobel®), respectively, 2 implants (4.3 × 10 mm) replacing the first molar and the second premolar, and 1 implant (3.5 × 10 mm) replacing the canine. The diverging axes were compensated using 30°-angulated multi-unit abutments (Nobel®). Immediate implant loading was performed using the patient's initial complete removable denture converted into a fixed implant-supported prosthesis. During the months required for osseointegration, oral hygiene maintenance revealed too difficult for the patient. When reevaluating the different clinical parameters, patient's demand, and indications for different treatment options, we decided to change our initial treatment plan and to set up for an implant-retained bar-supported overdenture. This option was also favored by the patient's need for some lip support⁴ and the non-parallel position of the implants.

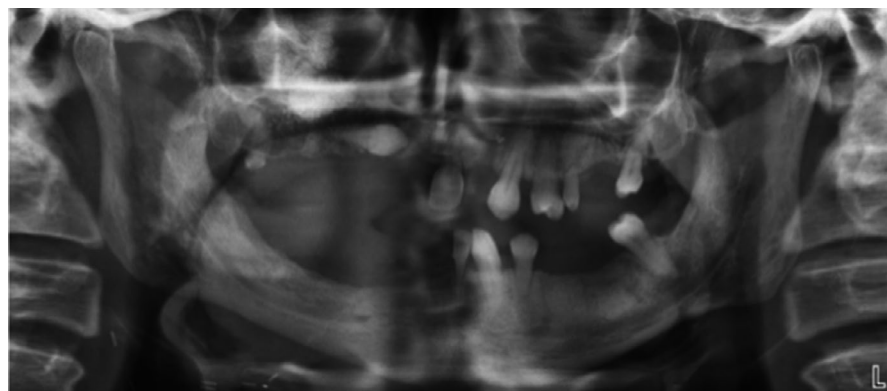


FIGURE 2 Initial OPT before the implants surgery



FIGURE 3 (A) Customized resin acrylic tray divided in two parts. Pink acrylic resin studs were added on the base to ensure the repositioning of the different parts of the tray. (B) Secondary mandibular impression. The acrylic resin key was positioned during molding and impression to ensure the perfect positioning of the two parts of the tray. (C) Secondary mandibular impression

2.1.2 | Prosthetic treatment steps

In the mandible, the first impression was taken using a type 2 plaster (SnowWhite™ Kerr Dental™) and a second impression was made with an individual customized adjusted tray (Figure 3A,B), thermoplastic paste for border molding (Impression Compound™ Kerr Dental™) and regular viscosity polysulfides (Permlastic™ Kerr Dental™) (Figure 3C).

In the maxilla, accurate recording of the implant positions was taken using a customized acrylic resin open tray and type 2 plaster impression (SnowWhite™ Kerr Dental™) combined with light body polyvinyl siloxane impression material (Aquasil™ Soft Putty/Regular Set, Dentsply™) around the impression copings and on the mucosa (Figure 4).

The patient presented atypical facial and oral anatomical landmarks which challenged the options for VDO and occlusal plane orientation. Phonation tests were irrelevant due to the low facial and lingual muscle mobility. Despite the labial inoclusion (due to tissue sclerosis and paralysis), the VDO was recorded at a height equivalent to that of the medium face stage.

The occlusal plane went through the patient's left lip corner leaving the prosthetic teeth partially apparent.

Design of the connecting bar

The CB was fabricated according to the diagnostic teeth setup. We selected a round section ("Ackermann Bar") because the patient did not want too much retention (Figure 2 and Table 1). Elsyad MA et al. showed that a Hader bar provides overall more axial and non-axial retention than a Dolder bar (Figure 9). These 2 types of bars have poor retention in case of lateral forces.⁵ Dos Santos MBF. et al. demonstrated that a round section

bar exerts less tension on the « clips » and prosthetic screws than the Hader bar. However, the latter would exert less tension on the peri-implant tissues than a round section bar.⁶

De la Rosa Castolo G. et al. compared connecting bars with different cross-sections: square, round, rectangular and L-shaped. The square-cut design would deliver the least amount of tension forces to the bone, implants, and screws, as opposed to the rectangular cross-section which would deliver the most tension forces. However, there seems to be no significant difference between the cross-section design of the bars (round, square), and the stress exerted on the implants and on the bone.

The greater the diameter of the bar, the less bone loss. The shorter the distal cantilever, the less bone loss. This CB had a 2 mm diameter and was designed for a maxillary short-arch (with no second molars). In case of a distal cantilever, the stress transmitted to the bone is higher with 30°-tilted implants vs. straight implants.⁷

In this case, the bar is spaced 2 mm away from the mucosa. A CB-mucosa space of 1 or 2 mm allows better stress distribution on implants and peri-implant bone. Joshi S. et al. showed that the higher the CB-mucosa distance, the greater the stress on the peri-implant bone.¹² These studies were performed on 2-implant-retained prostheses. To our knowledge, no study has yet been conducted for 4 or more implants. Moreover, this minimum distance of 2 mm is recommended for the patient's good oral hygiene maintenance.⁸

The CB was validated clinically and radiographically (Figures 5 and 6). The overdenture was then clipped using the less retentive plastic components (yellow). In the mandible, the female parts of the Locators® (Zimmer®) were placed via the direct technique allowing the limitation of prosthetic maintenance⁹ (Figures 7 and 8).

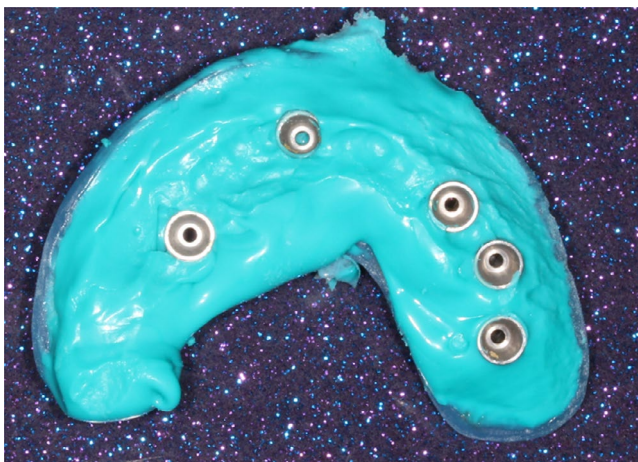


FIGURE 4 Maxillary impression using light body silicone around copings cervical edges and plaster type 2 around the occlusal edges



FIGURE 5 Ackermann connecting bar



FIGURE 6 Radiographic checking of the bar adaptation. OPT was done due to the limited mouth opening



FIGURE 7 Final prosthesis



FIGURE 8 Patient's smile

The plastic clips seem to exert less tension forces than the gold clips on the prosthetic screws and the peri-implant tissues.⁶

The connecting bar material

Several materials have been investigated *in vitro* such as titanium, cobalt-chromium, PEEK, fiber-reinforced resin, and zirconia. One study using a finite element model

TABLE 1 CB characteristics of the two cases

Characteristics of the CB	Case No 1	Case No 2
Type of the CB (cross-section)	Ackermann	Hader
Diameter/height	2 mm	Around 2 mm
Space between CB and mucosa	2 mm	2 mm
Material	Titanium	Titanium
Clips	Yellow	Yellow

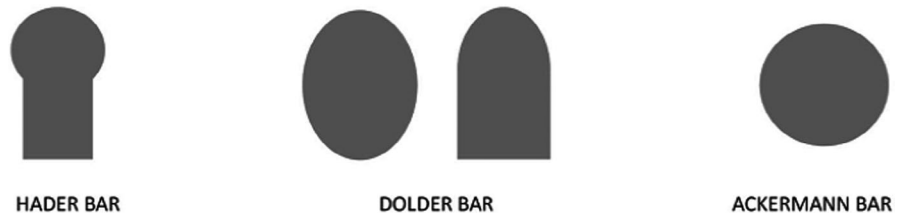
observed that CB material (cobalt-chromium, grade 4 or 5 titanium, and zirconia dioxide) does not seem to have any mechanical effects on the bone.⁷

With 4 mandibular implants, the fiber-reinforced resin CBs seem to deliver less stress to the implants and the peri-implant bone, compared to the cobalt-chromium bars (either machined or fabricated conventionally) and the titanium machined bars.¹⁰ Weinländer M. et al. showed a significant difference in the prosthetic maintenance between a machined bar and a prefabricated round section bar: Connecting bars would need more maintenance and follow-up.¹¹

3 | CLINICAL CASE No 2

A 62-year-old male patient with no general health problem presented an infiltrating squamous cell carcinoma in the anterior lingual floor, which had to be surgically treated with anterior hemiglossectomy and interrupting excision of the mandible (mandibular angles were preserved) (Figures 8, 10 and 11). A free fibula graft was planned to rebuild the mandible. Surgery and implant reconstruction were carried out immediately to anticipate the surgical and prosthetic rehabilitation of the patient. The 3D planning allowed a surgically driven implant placement (CAD-CAM drilling and implant surgical guides) for 6 intrafilar implants (TSVB 10, 3.5 or 4.1 × 16 mm, Zimmer®), and positioning of the fibula graft.

FIGURE 9 Connecting bars and their respective cross-section



PATIENT N° 2



FIGURE 10 Infiltrating squamous cell carcinoma in the anterior lingual floor

A fixed implant-supported prosthesis was planned for the final arch rehabilitation.

3.1 | Rationale for selecting the number of implants

Generally, the number of implants recommended either for a fixed implant-supported prosthesis or an implant-supported bar-retained overdenture varies between 4 and 6 implants (Figure 12). Several studies have evaluated patient satisfaction according to the number of implants placed for implant-supported bar-retained removable dentures; however, these studies were performed on patients

with no history of HNC.¹² Moreover, the greater the number of implants, the less stress will occur on the screws connecting the bar to the implants.^{7,13} With a bar, the implant survival rate would be higher using 6 implants compared to 4 implants.¹⁴

3.1.1 | Clinical examination and diagnosis

Post-surgical situation: The patient presented a totally edentulous maxillary arch and a grafted arch using a fibula graft with 6 implants (Figure 13). Mouth opening was 25 mm between the lips without any evidence of microstomy. The TMJ movements in diduction and propulsion were limited. Intraorally, there was a mild generalized periodontitis in the maxilla. The vertical prosthetic space was reduced, due to the mouth opening limitation and the fibula graft volume which was oversized compared to the original mandible.

3.1.2 | Treatment

We decided to set for a complete implant-supported bar-retained overdenture due to the reduced vertical prosthetic space.¹⁵

A small « custom-made » screwdriver fabricated from the conventional screwdriver (Zimmer®) facilitated the screwing/unscrewing procedures of the implant parts (Figure 14).

The phonation test showed little relevance to determine the OVD in this patient, due to his partial ankyloglossia

FIGURE 11 Initial radiography before surgery



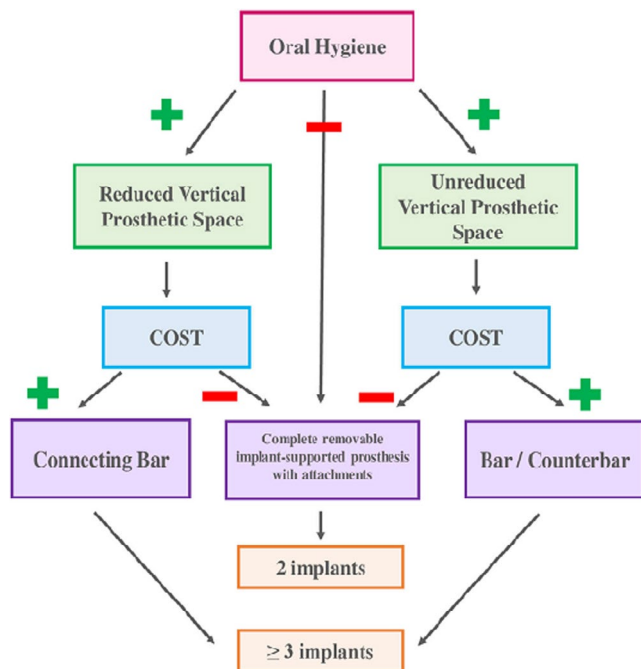


FIGURE 12 Decision tree for implant-supported prosthesis and selection of implant number; The minus sign in “oral hygiene” refers to a poor oral hygiene, whereas the plus sign refers to an adequate oral hygiene. The minus sign in “cost” refers to “expensive,” and the plus sign refers to “affordable by the patient”



FIGURE 13 Mandibula 10 months after initial surgery

following the surgery. The OVD was determined according to esthetic factors and the balance of the medium stage of the face. The occlusal plane was determined according to the patient’s lower lip and corners of the mouth.

An esthetic and functional try-in of the mandibular prosthetic teeth arranged on a wax base was validated with the patient. The distance between the implant heads and the occlusal plane was >11 mm; thus, there was enough space for a CB.⁷ The connecting bar (Hader Bar) and its counter-part located in the inner face of the prosthesis were machined in titanium according to teeth arrangement. The bar was checked radiographically (Figures 15



FIGURE 14 Customized screwdriver. Dental floss was wrapped around the screwdriver to prevent any swallowing incident



FIGURE 15 Hader connecting bar

and 16). Then, the retention parts were placed, once the overdenture was finished (Figures 17–19).

4 | DISCUSSION

Due to the notable lack of literature concerning the choice of the CB in HNC patients and the challenging clinical situation in these cases, practitioners should have good knowledge of the CB characteristics, their indications and consequences on the overdentures and implants/peri-implant tissues (Table 2).

The CBs were made of titanium for all our clinical cases because titanium CBs achieve better stress distribution on implants and peri-implant tissues than the cobalt-chromium CBs.¹⁰

In case No 1, we used yellow clips and an Ackermann bar to prevent excessive retention of the overdenture (patient’s demand). As for case No 2, because Hader bars are the most retentive, we also used yellow clips to avoid excessive stress on the implants.

FIGURE 16 Radiographic checking of the bar adaptation

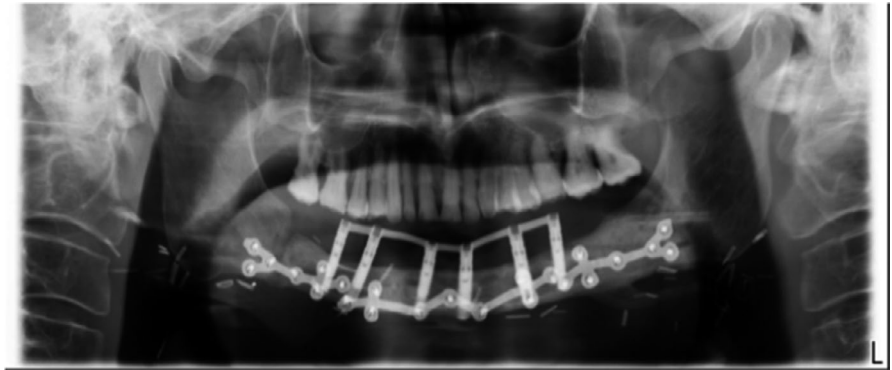


FIGURE 17 Counter bar of the hader bar



FIGURE 19 Patient's smile



FIGURE 18 Final prosthesis

TABLE 2 Comparison between the CB of the two cases

	Ackermann bar (round section)	Hader bar
Axial retention	Lower	Higher
Non axial retention	Lower	Higher
Retention in lateral forces	Low	Low
Stress on implants	Higher	Lower
Stress on clips/prosthetic screws	Lower	Higher

due to the limited prosthetic vertical space. Indeed, the main difficulty of the prosthetic rehabilitation is the “vertical dimension paradox”: Patient No 1 presented a severe bone resorption, and patient No 2 had a subtotal mandibular ablation. Initially, for both cases, we could therefore expect an increased available prosthetic space; however, given the microstomia/mouth opening limitation (and the oversized fibula graft in the mandible for case No 2), the prosthetic space was reduced. Therefore, determining an esthetic and functional OVD becomes difficult. Tissue sclerosis leads to labial inoclusion at rest which is considered as unesthetic. However, the complete removable bar-retained overdenture remains a good alternative to the esthetic challenge (lip support, gummy smile) often observed in HNC surgically treated patients.⁴

Oral hygiene maintenance (often difficult in surgically treated HNC patients) is easier with a complete implant-supported bar-retained overdenture compared to a fixed implant-supported prosthesis, even though, in these complex clinical situations, the limited mouth opening restricts easy prosthetic access.

Even though, the greater the diameter of the CB the less bone loss,⁷ CB cannot be too high in HNC patients

Complete implant-supported bar-retained overdentures need more maintenance and follow-up than fixed implant-supported prosthesis, which is a positive issue when monitoring surgically treated HNC patients.⁴

Studies have shown that patient satisfaction was equivalent between patients wearing a complete implant-supported bar-retained overdenture or a fixed implant-supported prosthesis.¹² However, more data are needed concerning HNC patients satisfaction with complete removable bar-retained overdentures.

5 | CONCLUSION

The implant-supported bar-retained overdenture is a good option for the rehabilitation of such complex situations due to its retention, its stability, but also its easy oral hygiene maintenance and esthetical asset. However, practitioners need to have good knowledge of the different types of CB (cross-section, design, material, dimensions, etc.) in order to make the most suitable choice in each clinical situation.

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CONFLICTS OF INTERESTS

The authors declare no conflict of interest.

AUTHORS CONTRIBUTION

NO was involved in the study conception and design, material preparation, prosthodontic treatments of patient, and wrote most of the manuscript. BP was involved in criticizing the content of the manuscript and helped through the prosthodontics treatments. HC did the final review of the manuscript.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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