

## Management of an irradiated patient using a complete removable prosthesis – a specific clinical approach

### Rehabilitacja protetyczna z zastosowaniem protezy całkowitej u pacjenta po radioterapii – specyficzne podejście kliniczne

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radiotherapy, radiation effects, xerostomia, oral rehabilitation, complete removable prosthesis

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#### HASŁA INDEKSOWE:

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#### Summary

Radiotherapy is a commonly applied treatment modality for head and neck malignancies. Despite its proven effectiveness in improving cure rates, it is associated with several complex oral complications that may confound treatment planning for prosthetic rehabilitation. The most common intraoral adverse effects include xerostomia, mucositis, dental caries and osteoradionecrosis.

Prosthetic rehabilitation with removable dentures in irradiated patients presents specific clinical challenges. These difficulties result from tissue fragility, chronic limitation of mouth opening, reduced salivary flow, increased susceptibility to fungal infections, and the persistent risk of osteoradionecrosis. Such conditions complicate prosthetic management and require the application of specific precautionary measures, particularly in the area of removable prosthodontics.

The aim of this paper is to present, through a clinical case, the specific characteristics and

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#### Streszczenie

Radioterapia jest powszechnie stosowaną metodą leczenia nowotworów głowy i szyi. Pomimo udowodnionej skuteczności w poprawie wskaźników wyleczeń, wiąże się z kilkoma złożonymi powikłaniami w obrębie jamy ustnej, które mogą utrudniać planowanie leczenia w zakresie rehabilitacji protetycznej. Do najczęstszych niepożądanych skutków irradacji w obrębie jamy ustnej należą: suchość jamy ustnej, zapalenie błony śluzowej, próchnica zębów i osteoradionekroza.

Rehabilitacja protetyczna z zastosowaniem protez ruchomych u pacjentów napromieniowanych stwarza szczególne wyzwania kliniczne. Trudności te wynikają z kruchości tkanek, przewlekłego ograniczenia swobody otwierania ust, zmniejszonego wydzielania śliny, zwiększonej podatności na infekcje grzybicze oraz utrzymującego się ryzyka osteoradionekrozy. Takie schorzenia utrudniają leczenie protetyczne i wymagają stosowania środków ostrożności, szczególnie w przypadku leczenia protetycznego z zastosowaniem protez ruchomych.

*precautionary measures required at the various stages of fabrication of a complete removable prosthesis in an edentulous patient who underwent irradiation of the oro-facial region.*

*Celem niniejszej pracy jest przedstawienie na przykładzie przypadku klinicznego specyficznego podejścia i środków ostrożności wymaganych na różnych etapach wykonania całkowitej protezy ruchomej u bezzębnego pacjenta po radioterapii, u którego wykonano napromieniowanie okolicy ustno-twarzowej.*

## Introduction

Radiotherapy, alone or associated with surgery or chemotherapy, has produced a significant increase in cure rates for many malignancies of the head and neck region.<sup>1</sup> However, high doses of radiation in large areas, including the oral mucosa, skin, maxilla, mandible and salivary glands may result in several undesired reactions that manifest themselves during or after the completion of therapy. This damage is caused by the ionizing radiation in normal tissues located in the radiation field.<sup>2</sup>

Xerostomia, mucositis, dysgeusia, soft tissue necrosis, trismus and the permanent risk of osteoradionecrosis are some of radiotherapy's complications, significantly affecting patients' quality of life and making prosthetic rehabilitation challenging and difficult.<sup>3,4</sup>

Taking into account the deterioration of the quality of life of patients with complete edentulism, multiple dental extractions must include a prosthetic rehabilitation project. Therefore, the management of the irradiated patient is specific, it must restore the various oral functions, the aesthetics and must take into account the various complications to which the patient is subjected. The prosthetic restoration must be the least traumatic during all stages of prosthetic realization.<sup>4</sup>

This article describes the specific clinical considerations and measures required

throughout the various stages leading to the fabrication of a complete removable prosthesis in an edentulous patient following radiotherapy.

### *Clinical case presentation*

#### *Clinical examination*

A fully edentulous 41-year-old male patient presented to the department of prosthodontics, requesting a complete prosthetic rehabilitation.

The interview revealed a history of an oral cancer (neoplasia) treated with transcutaneous radiotherapy exclusive (70 Gy), performed five years before. The patient reported a persisting discomfort during mastication and deglutition, due to inadequate salivary impregnation of the food bolus.

Extra-oral examination demonstrated a decreased vertical dimension, angular cheilitis with dryness of the cutaneous portion of the lips and limited oral opening (Fig. 1-3).

The intra-oral examination showed a fully bimaxillary edentulous patient. Thin, fragile, and telangiectatic oral mucosa, atrophic and depapillated tongue and clinical signs of xerostomia: smooth, shiny, dry mucosa, inflammatory fissuring, epithelial atrophy (Fig. 4,5).

#### *Radiological examination*

The computed tomography scan revealed the presence of post-radiation osteolytic geodes of variable extent involving the maxillary and mandibular regions.



*Fig. 1. Decreased vertical dimension.*



*Fig. 2. Angular cheilitis with dryness of the cutaneous portion of the lips.*



*Fig. 3. Limited oral opening.*



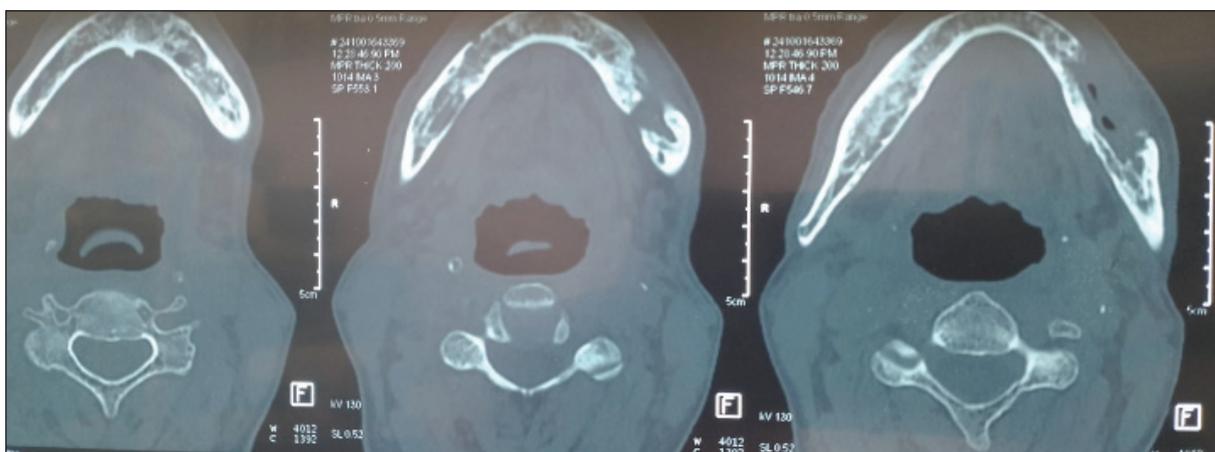
*Fig. 4. Dry and thin mucosa.*



*Fig. 5. Depapillated tongue.*

#### *Difficulties*

- depressed, malnourished, and debilitated patient,
- oral dryness affects prosthetic retention and makes the mucosa more susceptible to trauma, mycotic infections, and stomatitis
- chronic limitation of mouth opening restricts access for oral hygiene and the



*Fig. 6. The CT scan shows the presence of post-radiation osteolytic geodes involving the mandibular region.*



**Fig. 7.** Fabrication of a custom tray using wax.

various instruments and materials required throughout the prosthetic workflow – a constant risk of mucosal necrosis and osteoradionecrosis.

#### *Treatment plan*

The treatment plan included a conventional complete denture, which can restore aesthetics and function, preserve the long-term integrity of the supporting tissues and ensure psychosocial and family reintegration.

#### *Therapeutic approach*

During the various prosthetic stages, a thin layer of petroleum jelly was applied to the patient's lips, and the mucosa was continuously moistened with water to facilitate handling, prevent adhesion of the impression materials to the dry mucosa.

#### *1 Impressions*

The fabrication of removable denture prostheses requires an accurate impression of the denture-bearing area and a record of appropriate anatomic landmarks. Even though stock impression trays are available in various sizes and shapes, the insertion of stock trays may be impossible if there is severe trismus.



**Fig. 8.** Non-compressive preliminary impressions with fluid alginate.

In this case, insertion of the impression tray was very difficult. Therefore, we attempted to fabricate a customized tray using wax: the wax was softened and then molded intraorally. The excess was subsequently removed, and the final impression was taken with alginate – an elastic impression material that can accurately record undercut areas and may be used in a fluid consistency without causing trauma to the oral mucosa which is dry and fragile (Fig. 7,8).

After casting the primary impressions, the customized trays were fabricated. Beads are constructed on these trays with minimal height in order to avoid any trauma during insertion and removal because of the limitation of mouth opening.

The border molding was made using an elastic, non-rigid material (silicone heavy body) to avoid any tissue injury that a thermoplastic material (Kerr compound) might cause (Fig. 9).

The secondary impression was taken using a hydrophobic material (polysulphides), selected



**Fig. 9.** Border molding with elastic material (silicone heavy body).



**Fig. 10.** The secondary impression.



**Fig. 11.** The prosthetic tooth arrangement respecting the concept of bilaterally balanced occlusion.



**Fig. 12.** Elimination of any overextension and any excessive contour.

because of the severely xerostomic oral mucosa, to ensure optimal material adaptation and accurate tissue registration (Fig. 10).

### *2 Recording the interarch relationships*

The occlusal rim height was adjusted according to aesthetic and phonetic criteria. Given the patient's limited mouth opening, the vertical dimension of occlusion was slightly reduced to facilitate prosthesis insertion and bolus accommodation. However, this reduction should not be excessive, as it may lead to commissural cheilitis and, consequently, candidiasis.

### *3 Arrangement of prosthetic teeth*

The prosthetic teeth were selected in resin rather than ceramic, as they are easier to adjust,

absorb occlusal forces more effectively, and are therefore less traumatic to the mucosa.

The prosthetic tooth alignment follows the concept of bilaterally balanced occlusion.

The teeth are positioned to prevent biting injuries and trauma to the irradiated mucosa (fig. 11).

### *4 Intraoral fitting of prostheses*

During prosthetic insertion, any compression or extension is carefully removed (Fig. 12). Occlusal equilibration was meticulously performed to prevent occlusal overload (Fig. 13). The prosthesis margins and intaglio surface were carefully polished to achieve a smooth finish (Fig. 14).

The patient was instructed to remove the prosthesis at the onset of any pain, and informed



**Fig. 13.** Meticulously performed occlusal equilibration.



**Fig. 14.** Final complete denture finished and polished.



**Fig. 15.** Aesthetic outcome of the conventional complete denture.

of the necessity of periodic follow-up visits. Prosthesis wear should be limited to mealtimes during the initial days.

In irradiated patients, maintenance and follow-up constitute a critical phase of treatment due to the increased risk of serious complications. Education and reinforcement of oral and prosthetic hygiene control are provided during follow-up appointments.

At recall visits, the patient expressed satisfaction with the improved aesthetics and function provided by the prostheses (Fig. 15). However, he reported persistent oral dryness and mucosal hypersensitivity. Accordingly, the following recommendations were provided: frequent hydration with constant access to a water bottle, intrabuccal sprays of mineral water or artificial saliva, application of vegetable oil

to the oral mucosa to enhance comfort, and the use of mouth rinses free of irritant solutions.

## Discussion

### *Removable prosthesis*

Radiotherapy reduces the amount of saliva. Due to the occurrence of vascular changes, the patient's mucosa becomes atrophic, sensitive and prone to ulcers. Considering these conditions, to avoid causing trauma, Oelgiesser advised it was better to prevent the administration of removable dentures to the patient to avoid soft tissue damage, bone exposure and osteonecrosis, so fixed prostheses were preferred.<sup>5</sup> Gerngross found that post-prosthesis insertion complications in patients who had received complete denture after radiation therapy were 1.7 times more frequent than in others, while most of these patients had greater than 5000 cGy.<sup>6</sup> Curtis believed removable prosthesis were acceptable with some consideration in irradiated patients: the use of nonpressure technique and spaced trays for impression taking, use of monoplane teeth, instruction to the patient to remove denture during night and when detecting soreness, removing rough projection from tissue surface and the use of soft liners.<sup>7</sup>

Well-fitting dentures rarely cause osteoradionecrosis.<sup>8</sup> The recovery period

between radiotherapy completion and denture provision may depend on the surface area of denture-bearing tissues, but denture provision within six months or after one year are unlikely to differ in complication rates.<sup>6</sup>

Xerostomic patients should also be advised to drink plenty of water (a minimum of eight glasses) daily.<sup>9</sup> Denture adhesives should be added to the dentures for additional stability and retention, which becomes a problem, especially during mastication. Non-anatomical teeth should be used to avoid trauma to the alveolar ridge, bearing in mind the chances of occurrence of osteoradionecrosis. Artificial saliva may be helpful and long-lasting (4–6 h) when no other food or liquid is ingested. In addition to moisture replacement, artificial saliva provides lubrication for denture retention, enhances the natural ability to cleanse dentition and helps to normalise the pH of the resting saliva and mucosa. Glycerine can also be used as a salivary substitute. Gustatory stimuli such as sugarless candies and sugarless chewing gums may be helpful in managing xerostomia.<sup>10,11</sup> Prescribing a Pilocarpine tablet 5 mg three times a day is also beneficial for the xerostomic patient.

#### *Implant-supported prosthesis*

Radiotherapy is not considered as a contraindication for implant insertion. However, the waiting period of 13 to 24 months after radiotherapy is recommended. The success rate of treatment in irradiated mandibles was similar to the success rate in areas of the jaw that did not receive radiotherapy.<sup>5</sup> Shaw concluded that mandibular implants were more successful, and with the exception of a few soft tissue problems, most patients have successful prosthetic treatment; more failures were detected with bone grafted implants and maxillary implants. Radiotherapy does not appear to have a negative effect on implant longevity. It seems hyperbaric oxygen has not been of much benefit.<sup>12</sup> For

better osteointegration, loading of the prosthesis should be delayed for six months instead of the traditional three to four months for the mandible.<sup>13</sup> It is also recommended that primary placement of implants before radiotherapy leads to predictable osteointegration.<sup>14,15</sup>

Implants placed in irradiated bone are more than twice as likely to fail as those in non-irradiated bone.<sup>16,17</sup> A 2016 meta-analysis reported survival rates of 84% in irradiated bone and 95% in non-irradiated bone.<sup>17</sup> Timing of placement and nature of the bone (native versus grafted) did not seem to be a significant risk factor, although this was based on observational studies with lack of control for confounding factors.<sup>17</sup> Careful patient selection to optimize outcomes and detailed pre-operative discussion to manage expectations are critical for implant placement in general, and especially when considering the uncertainties for implants in irradiated bone.<sup>18</sup>

## **Conclusion**

The prosthetic management protocol of head and neck irradiated edentulous patients suggested in this work aimed to improve the approaching of these cases, which require special attention and knowledge by dental professionals. Early or late radiotherapy sequelae persist throughout years and the dentist should be able to decide how to minimize pain and morbidity of these patients, as well as pinpointing the moment to step in.

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