Head and Neck Cancer Treatment with Mandibular Overdenture on Implants

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Abstract: Treatments with prostheses on implants must be very well planned and executed, in order to have adequate maintenance and longevity. Thus, the present work demonstrates, through a clinical case report, the making of an overdenture prosthesis on two implants previously installed in the mandible and a conventional complete denture in the upper arch, considering the biopsychosocial principles of the patient. Male patient, 74-year-old, who underwent radiotherapy treatment, attended the Oral Oncology Center – FOA UNESP, for oral rehabilitation, after treatment of squamous cell carcinoma, complaining mainly of masticatory inefficiency due to edentulism. Intraoral clinical examination revealed a healthy gingiva in its entirety. In the maxillary ridge, an adequate bone height of the ridge was observed, however, with a failure in the posterior region on the left side due to surgery performed in the previous oncological treatment. In the lower arch, it was possible to observe bone resorption of the ridges and two implants (S.I.N. Implant System) already installed, parallel and stabilized (monitored by a device named Osstell) in the anterior region of the mandible. The treatment plan was defined by the elaboration of two prostheses, making an upper conventional complete denture and a lower overdenture-type prosthesis, taking advantage of the two implants previously installed in the radiotherapy sessions. After the installation of the prostheses, it was possible to diagnose greater masticatory comfort, improvement in aesthetics and self-esteem, managing to promote quality and longevity in the treatment according to the patient's needs and age, restoring oral health and him.

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Introduction

Tooth loss reflects the care taken with oral health throughout life and cannot be considered merely a consequence of the presence of other oral health problems, such as dental caries and periodontal disease, but also a reflection of socioeconomic factors and/or levels of health education (Sônego et al., 2022).

In the United States, it is projected that by 2060, the number of older adults will exceed the number of children for the first time. The rate of edentulism is still significant, being greater than 17%, and may decrease by 3% by 2050 (Atanda et al., 2022).

This fact may be due to the legacy of a healthcare model based on invasive treatments resulting in an excessive number of extractions, with oral rehabilitation with complete dental prosthesis being the treatment of choice for this condition. Oral rehabilitation with complete dentures aims to restore chewing, phonetics, appearance and, above all, the patient's self-worth and dignity. In addition to restoring self-esteem, complete dentures aim to preserve the alveolar ridges and integrate the patient psychosocially into society. The complete denture with mucous membranes is used in completely edentulous areas and remains adhered to the fibromucosa by means of a saliva film and the adaptation between the edges of the prosthesis and the patient's surrounding tissues (Penitente et al., 2024).

The use of the lower complete dentures is typically less stable and more challenging to adapt than upper dentures. This is due to a lack of surface tension, causing instability of the lower complete denture due to anatomical changes such as reabsorption of the alveolar ridge and the location of muscles such as the orbicularis oris and the tongue muscles (de Caxias et al., 2018).

Therefore, the search for new treatment methods is necessary to ensure better acceptance of the prosthesis by patients. One such method is the use of overdenture-type complete dentures. Overdentures are implant-retained and mucous membrane-supported complete dentures designed to increase the retention, stability and comfort of conventional dentures, since the lack of retention and stability is normally presented by mandibular prostheses. O-rings are fitting systems composed of metal capsules that accommodate rubber or nylon rings, which are housed in the base of the denture and ball attachments, screwed onto the implants. They are relatively simple technically, low cost, restore lip support and allow easy cleaning, but require periodic maintenance to replace the internal ring (Sônego et al., 2017).

When it comes to rehabilitating patients with a history of head and neck cancer, there is still no consensus in the literature regarding this association, due to the involvement of radiotherapy and/or chemotherapy during treatment, which have side effects such as xerostomia, decreased vascular supply, difficulty opening the mouth and swallowing, and difficulty tolerating the prosthesis (Sankar and Xu, 2023).

Osteoradionecrosis can develop in previously irradiated sites where implants are installed, with a significant percentage (Goiato et al., 2010).

Proposal

Therefore, based on the above, a clinical case of a patient after treatment for head and neck cancer will be reported, with the need to perform rehabilitation with a complete lower denture, the overdenture type being chosen, retained by an O-ring retention system, since the patient had implants (S.I.N. Implant System) installed and parallel in the anterior region of the mandible and the production of a conventional complete upper denture, since he has a history of radiotherapy treatment in the head and neck region, with surgery to install implants being contraindicated.

Case report

A 74-year-old male patient, attended the clinic at the Oral Oncology Center of FOA-UNESP/Brazil for oral rehabilitation after treatment of squamous cell carcinoma of the tonsillar region and with extension to the soft palate, uvula, and lateral wall of the nasopharynx, due to the loss of teeth, which were extracted to begin radiotherapy treatment, without presenting any systemic problem worthy of note.

Extra and intraoral examination

The extraoral examination showed a visible loss of vertical dimension. A decrease in lip support was

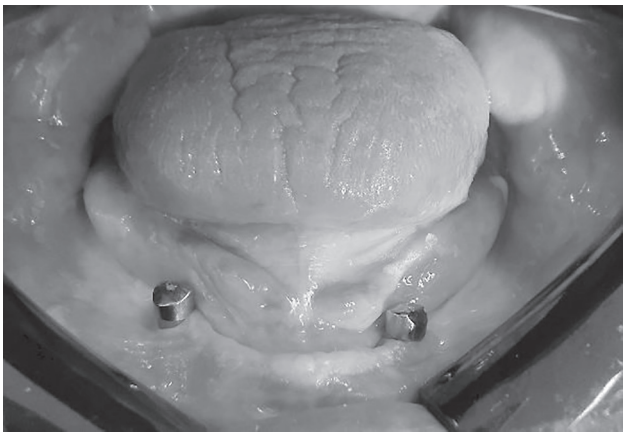

Figure 1: Jaw with healthy gums with two implants (S.I.N. Implant System) in the anterior region of the jaw.

Figure 2: Implant stability quotient value provided by the Osstell device. 76 implant stability.

observed due to the loss of the anterior elements (Figure 1). The intraoral examination did not detect any alteration of the oral mucosa, presence of torus, or any anomaly that would contraindicate the planning and programmed rehabilitation. Bone resorption of the residual jaw ridges was observed, but with a healthy gingiva in its entirety and the implants (S.I.N. Implant System, Brazil) in the anterior region of the jaw stabilized, due to the quality of the bone present (Types I and II). The stability of the implants was monitored by a device called Osstell (Osstell® Mentor, Goteborg, Sweden), which has the function of monitoring the stability of the implant by measuring the resonance of a transducer coupled to the implants at any stage of the treatment and observation period (Hayashi et al., 2010).

The average value on the ISQ scale (implant stability quotient) provided by Osstell was 76 (Figure 2), where the values range from 1 to 100. The manufacturer of the device states that ISQ greater than 70 represents high stability, ISQ between 60 and 69, medium stability and ISQ less than 60 is considered low stability. Therefore, the higher the ISQ, the greater the implant stability (Truhlar et al., 1997; Alsaadi et al., 2007).

In the maxillary ridge, we observed a favourable prognosis, with adequate bone height of the ridge, since the shape and size of the residual ridge are some of the factors that can influence masticatory efficiency, since the ability to fragment food is directly influenced by the stability and retention of the prosthesis. However, there is a defect in the posterior region on the left side due to surgery performed in the previous oncological treatment.

Radiographic examination

To confirm the clinical diagnosis and execute the treatment plan, a panoramic radiograph was requested (Figure 3), which confirmed considerable bone loss in the areas of the upper molars bilaterally and in the posterior areas of the lower edentulous teeth, and the presence of two implants (S.I.N. Implant System) installed, parallel in the anterior region of the mandible. Therefore, based on the radiograph presented, the creation of a complete denture of the mandibular overdenture type was planned, supported by individual O-ring systems on the implants (S.I.N. Implant System) already installed, selected for their bone implantation, considered to have favourable biomechanics, easy maintenance and cleaning, and a reduced potential for mucosal hyperplasia.

Study molding and functional molding

After the clinical examination and analysis of the panoramic radiograph, the study molding was performed using condensation silicone (Zetaplus – Zhermack, Italy). In view of the above, the individual mold was made in the laboratory, with the objective of performing the functional molding. It is important

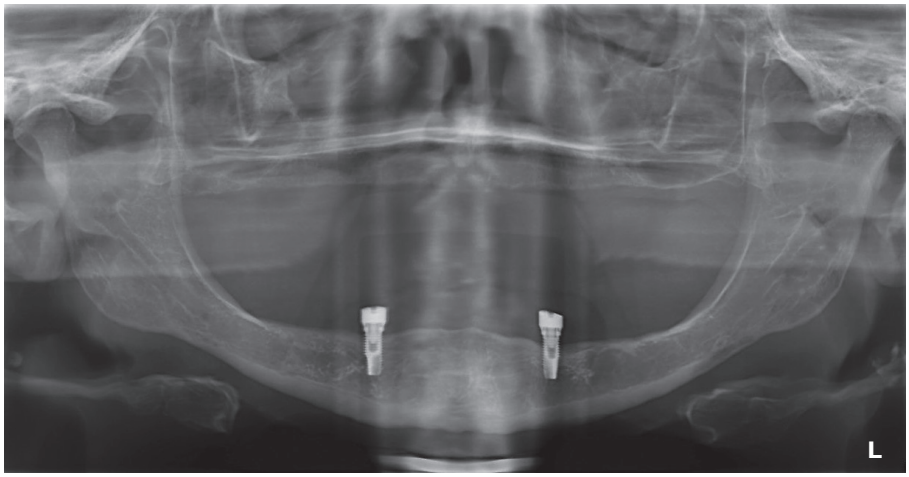

Figure 3: Panoramic radiograph.

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to emphasize the importance of this phase, as it aims to reproduce the tissues of the capable area and determine the extension of the complete denture. This procedure aims to ensure stability and retention of the future prosthesis by sealing the entire periphery of the prosthesis, with the confinement of a thin film of saliva between the prosthesis and the fibromucosa, which in turn promotes lower atmospheric pressure, contributing to retention and, in addition, aims to ensure good seating of the prosthesis on the basal area, resulting in patient comfort by reducing the interposition of food between the prosthesis and the mucosa. In the upper arch, zinc enolic paste was used for internal molding and the addition of molding wax, melted to a liquid state and applied with a brush to the line of the hard palate and soft palate, to compress the area corresponding to the transition zone between the hard and soft palates, optimizing posterior locking, corroborating the retention of the prosthesis in the maxillary arch, since compression can occur in this region, due to the presence of resilient structures, with the sealing of the entry of air during the action of the tensor and levator muscles of the soft palate in physiological situations, such as swallowing and phonetics. Immediately in the mandibular arch, the implant transfer molding was performed with individual open molds with square transfers (Figure 4).

Corrective molding was performed with fluid silicone (Oranwash L Fluid – Zhermack, Italy), which after the polymerization time of the molding material with the transfer materials, these were captured during the removal of the mold and the analogues were immediately adapted to them to obtain the working model (de Moraes Melo Neto et al., 2023).

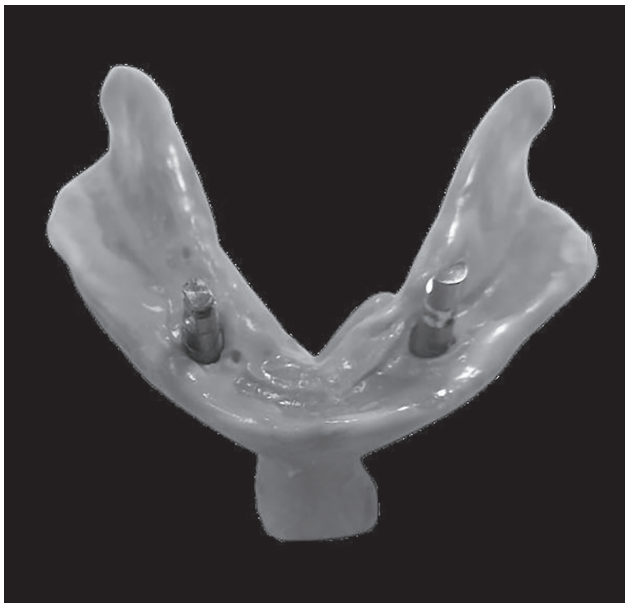

Figure 4: Functional impression of the jaw with square transfers.

Trial base and wax plane

The trial base and wax plane were made. The upper wax plane was oriented. Lip support was evaluated, with no need to reduce the volume of wax with the spatula 36 or increase it with a wax blade, also evaluating the buccal corridor and the exposure of wax at rest and smiling. Then, the parallelism was made with the fox ruler, positioning it parallel to the bipupillary line from the front of the patient and on the side, from the wing of the nose to the tragus, both were parallel to the prosthetic plane.

Assembling the facebow

In this step, the upper wax plane was adapted to the fork, by adapting a wax sheet over it. The plane was joined to the fork by depositing molten wax at the junction of the two on the palatal side. Once this was done, the assembly (wax plane and facebow fork) was taken to the patient's mouth and the facebow was connected to the assembly by inserting the fork into the "universal joint" of the facebow. Next, the olives (plastic parts at the ends of the facebow) were introduced into the external auditory canal and the patient was instructed to hold them with forward pressure. The next step consisted of adapting the nasal relators, which were attached to the facebow and placed against the nasal saddle. Once this was done, and with the trial base well attached to the support area, the screws were tightened. Then, the assembly was removed from the patient, loosening the lateral and central screws of the bow. The next step was to transfer the orientation plane to the articulator, with the model superimposed on the test base.

Recording the vertical dimension of occlusion (VDO) and defining the height of the lower plane

The method used to determine the patient's vertical dimension of occlusion was the two-point method. The patient was positioned in the dental chair in an upright position, forming a 90° angle. Two points were marked on the patient's skin, on the median line: one at the tip of the nose and the other at the base of the chin. Using a compass, the distance between these two points was measured, with the patient's mandible at rest. From the measurement obtained, 3 mm was subtracted, corresponding to the free functional space, thus determining the vertical dimension of occlusion. The reference lines were drawn, tracing the midline, canine line and high line of the upper lip, marking with the patient smiling and using a colour scale, the appropriate selection of teeth was performed. The upper wax plane was placed in the patient's mouth, already oriented (parallel to the prosthetic plane and the bipupillary line), with the occlusal surface isolated

with petroleum jelly. The lower wax plane was then plasticized and placed in the mouth, asking the patient to close it slowly.

The plasticized wax was being "kneaded" while it was observed when the tips of the compass coincided with the marks on the patient's skin. Given the above, the mandible was observed in the VDO position, and that the height of the lower plane was defined. Phonetic, physiognomic and functional tests were performed to certify that the VDO was correct (de Sousa Ervolino et al., 2023).

Recording of the central relation (CR) and subsequent fixation of the orientation planes and assembly of the lower model in the articulator

To reestablish the CR, the technique of coincidence between the lines marked between the maxillary and mandibular planes was used, in the midline region and in the canine region. The patient was asked to open and close the mouth with the antagonistic wax planes and if this coincidence between the 3 lines occurred there, the relationship in the horizontal mandibular direction would be determined and the patient's occlusion would be reestablished so that the teeth could be assembled in this position. The patient was then asked to remain firmly in the position and the planes were fixed together using metal clamps (one on each side), close to the level of the canines. The set was removed from the mouth and then transferred to the articulator. Since the upper model was already mounted on the articulator with the aid of the facial bow, the lower model was mounted. The indexing was performed on the articulator and the base was isolated with solid petroleum jelly, and then it was mounted with a sufficient amount of stone plaster (de Sousa Ervolino et al., 2023).

Mounting of artificial teeth

Once the mounting on the articulator was completed, the patient was sent to the prosthetist for the mounting of the artificial teeth (Figure 5). The teeth were selected according to the patient's profile, who has a longilinear body type and trapezoidal arch. Using the BIOTONE brand (Biotone Dentsply do Brasil) mold chart, the 2D – 2D – 30M – 30L model in colour 69 was chosen. The artificial teeth were fitted with a functional and aesthetic test, which was approved by the patient.

Installation of the conventional complete denture and the overdenture complete denture

After the acrylic hardening of the prostheses by the prosthetist, the prostheses were finally installed in the upper and lower arches (Figure 6). In the lower arch prosthesis, two male abutments, each 1.0 mm high, were screwed into the implants using 3.75/4.0 mm external hexagon connection implants (S.I.N. Implant System) with a more spherical projection and a torque of 25 N (Figure 7), with a narrower neck to fit into the female, which is attached to the base of the prosthesis. The female, composed of a metal capsule that has a recess called an internal cavity, which is where the rubber ring was fitted. After fitting the lower

Figure 5: Front view of teeth mounted on ASA articulator.

Figure 6: Acrylic mandibular overdenture with the O-rings in position.

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Figure 7: Screwing the O-rings with a torque of 25 N into the implants.

prosthesis, the upper complete denture was installed, the brakes and bridles were evaluated, checking the seating of the prosthetic base on the support area, the occlusal contact, the aesthetic and phonetic evaluation, observing an excellent adaptation, retention and aesthetics, which left the patient very satisfied. After the installation was done, the patient was instructed on hygiene and care of the prosthesis. After 7 days, the patient returned for prosthesis control, requiring the application of compression-evidencing paste on the lower prosthesis, with the need to wear a thin internal layer of the base of the lower prosthesis that was exposed by removing the paste. After the occlusal adjustment and minimal wear on the internal base of the lower prosthesis, a harmony of the occlusal contacts was observed and absence of evidence of compression. Therefore, another appointment was scheduled to check the prosthesis, and the patient attended with no complaints about the prosthesis.

Discussion

As a treatment option for edentulism, the conventional complete denture represents a viable and safe alternative for most elderly patients. A large part of this population characterizes this type of rehabilitation as satisfactory. However, there are those who are dissatisfied due to difficulties with adaptation, especially in relation to the mandibular complete denture. In these cases, rehabilitation with implant-retained complete dentures is a treatment modality that can minimize this dissatisfaction. An implant-supported mandibular complete denture allows for better masticatory efficiency and quality of life compared to the conventional mandibular complete denture. Thus, since the patient already had the implants (S.I.N. Implant System) installed and parallel in the anterior region of the mandible, the O-ring system was chosen given the most commonly used retention systems in overdentures. This retention system was chosen because it offers advantages such as ease of manufacture, as it does not require more complex and costly technical procedures, such as casting a metal structure (bar), simplifying both the laboratory and clinical processes. Its cleaning system is simpler for the patient to perform when compared to the bar-clip system. Since the patient was elderly, motor coordination is closely related to the quality of cleaning of the prosthetic device, and this type of prosthesis became the most recommended, also due to the visual acuity observed, and with the isolated implants, cleaning is easier for the patient (Goiato et al., 2017a).

An analysis of the biomechanics of the ring system was studied, an *in vitro* study on the O-ring system showed the lowest number of high-intensity stresses in the photoelastic image and strain gauge analysis compared to the other retention systems with the bar clip. The O-ring retention system has good retention and optimum biomechanical distribution of axial and lateral forces on the implants, which contributes to their maintenance, masticatory efficiency and social interaction, and is more comfortable than conventional complete dentures. Electromyography evaluation of masseter and temporalis, bite force, and quality of life in elderly patients during the adaptation of mandibular implant-supported overdentures (Goiato et al., 2017b; Sônego et al., 2017).

The better distribution of stress when overdentures are subjected to compressive loads can be explained by the rubber O-ring on the female component, which absorbs and reduces deformations (Goiato et al., 2017b).

Therefore, this case proved to be an efficient treatment option, using implants (S.I.N. Implant System) already installed, stabilized and in a parallel situation for perfect insertion and removal of the overdenture prosthesis. This approach offered enhanced chewing efficiency, increased bite force, and, therefore, greater confidence in using the prosthesis, which was particularly important since the patient had no prior experience with dentures use (Sônego et al., 2017).

Since it was impossible to make prosthesis on implants in the patient's upper arch, due to his history of radiotherapy treatment, which contraindicated implant installation surgery, the conventional complete denture was successfully made. Its functions were performed correctly, respecting all the manufacturing steps according to the literature, especially the step that requires the greatest attention from the

dentist in the making of the prosthesis, which is the determination of the vertical dimension of occlusion, as it will influence the final result of the treatment (Sônego et al., 2017).

Dental implants placed in the irradiated area of the head and neck region have a good survival rate, but rigorous follow-up is necessary to avoid complications and thus reduce potential failures. However, since many irradiated patients are rehabilitated with implant-supported prostheses, clinical risk assessment is important. The results showed a large variation in the total dose of radiation received, which can be detrimental to the installation of implants and can cause osteoradionecrosis (Granström, 2005; Smith Nobrega et al., 2016). The use of hyperbaric oxygen therapy (HBO) would be indicated, as this treatment improves bone repair and aids the osseointegration process through stimulation of the irradiated tissues and a significant increase in oxygen content in areas prone to osteoradionecrosis. Another important factor is the waiting time between the last radiotherapy session and implant surgery, which can be up to 240 months (Granström, 2005; Smith Nobrega et al., 2016).

To obtain the ISQ value, it is measured at four points on the SmartPeg (mesial, distal, vestibular and lingual/palatal) and has an average value. According to Osstell guidelines, for ISQ values below 60 (low stability), the implant should be monitored, because ISQ < 60 may suggest the possibility of osseointegration failure. In this situation, ISQ values above 65 (medium-high stability) or with an ISQ value of 70 or higher (high stability) mean that the implant has very good stability and osseointegration, as seen in the clinical case in question with an ISQ value of 76, confirming successful osseointegration for prosthetic rehabilitation with an overdenture (do Vale Souza et al., 2021; The Evidence-based Osstell ISQ Scale – Clinical Guidelines – available at: https://www.osstell.com/clinical-guidelines/ [accessed January 10, 2025]).

This measure determines the correct reestablishment, returning the stomatognathic system to a harmonious function of the muscles of the lower third of the face, improving facial appearance, restoring the patient's chewing, speech and swallowing functions, providing a better quality of life.

Conclusion

In view of the above, it can be concluded that implant-supported overdentures were an adequate alternative for the oral rehabilitation of a patient who had undergone radiation in the head and neck region, since the patient had previously installed implants. They have the following positive aspects: minimization of bone resorption, sensory feedback, stability and distribution of forces, in addition to having an optimistic effect on the patient's psychological well-being, since they will not be edentulous. Therefore, on the day of the installation, the patient was given adequate instructions on oral hygiene, diet, such as eating soft foods cut into small pieces and chewing them bilaterally, and the need to maintain the overdenture prosthesis, annual evaluation of the central screws of the implants (torque check, since one of the causes of screw loosening is the removable characteristic of the overdenture) and finally, regular replacement of the rubber rings at the base of the overdenture due to wear observed according to use, aiming at the longevity of the work performed and improving the patient's quality of life.

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