Case Report

AUTOGENOUS TRANSPLANTATION OF AN ECTOPIC LOWER CANINE: CASE REPORT

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ABSTRACT

Dental autotransplantation or autogenous dental transplantation is defined as the surgical removal from one site and insertion in another site of a dental element from one position to another, within the same person. The indications are advanced caries, trauma, agenesis, and severe ectopias. In our case, we tried to provide a therapeutic alternative to an ectopic canine that is very difficult to recover orthodontically, through reimplantation in the correct eruption site. An 11-year-old patient had the left lower canine in mesial ectopic inclusion, difficult to recover orthodontically, with persistence of the deciduous canine in the arch. Autogenous transplantation of the definitive canine was performed in the post-extraction socket of the deciduous canine, in the same operating session, and splinted for 2 weeks. One month and 11 months follow-up, there was absence of mobility, good integration with the periodontal tissues, absence of ankylosis with good representation of the periodontal ligament on the radiographic examination, absence of recessions and/or pathological probing. Tooth auto-transplantation can be considered an alternative oral rehabilitation approach for some clinical situations. Autotransplantation can be a valid therapeutic alternative in selected cases; however, the high failure rate must be carefully evaluated in the treatment planning phase. It would be desirable to have studies that can provide follow-up for many years and possibly be able to draw up an operating protocol that can provide evidence of correlation with the result.

KEYWORDS: *dental autotransplant, ectopic canine, impacted canine, retainer*

INTRODUCTION

One of the most frequently malpositioned teeth in the dental arch is the canine (1). Surgical exposure, with or without orthodontic treatment, is generally performed in children and adolescents. In these patients, tooth transplantation might be a treatment of choice (2). Tooth auto-transplantation is regarded as a valuable treatment approach based on the utilization of the patient's own tooth (3). Dental autotransplantation or autogenous dental transplantation is defined as the movement of a dental element from one position to another, within the same person (4).

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The key to the success of the tooth transplant procedure depends on understanding and respecting some biological principles, such as an intact and vital periodontal ligament. All authors agree that the preservation of the integrity of the periodontal ligament on the donor element represents the basis of clinical success (5). To maintain its vitality, it is essential to perform an avulsion of the tooth that is as atraumatic as possible, reduce extraoral residence times to a minimum, and avoid osmotic shock to the ligament.

Recipient sites with infections in the periapical area are contraindicated for this treatment. However, in the case of mild signs of periapical inflammation of the recipient site, curettage of the most apical region of the alveolus seems to prevent any significant influence on the prognosis of the transplant (6). In order to limit infectious complications, almost all studies on post-traumatic reimplantations and dental autotransplants include an antibiotic coverage scheme.

For the transplant procedure, it is necessary to have a healthy donor element of the appropriate size available, comparing its dimensions with those of the recipient site during the planning phase of the operation, through clinical and radiographic examinations. Some adaptations of the recipient site can be performed in a more or less straightforward way: if the mesiodistal diameter of the recipient site is insufficient to accommodate the donor element, it is possible to intervene orthodontically to generate space before the transplant; if, however, it is the bucco-lingual thickness that is lacking, a bone graft or a greenstick fracture may be alternatives to be evaluated. Finally, the apical-coronal diameter must be carefully assessed via radiographs, comparing it with the length of the roots of the donor tooth. If necessary, a vertical preparation of the socket can be performed to increase the depth of the recipient site (7).

A semi-rigid extracoronal splint guarantees stability during the post-operative period (14-30 days). It is necessary to avoid excessively rigid splinting to allow some functional movement of the element during the healing phase to stimulate the activity of the periodontal ligament cells and bone repair. It has been shown that long-term rigid fixation applied after external trauma leads to a greater incidence of dentoalveolar ankylosis compared to less rigid short-term fixation (8).

One of the most widely used radiographic classifications for staging root development is the classification system established by Moorrees et al. (9), where stages 1 to 4 represent the developmental quarters of the expected root length, stage 5 represents the full length with a patent foramen, and stage 6 represents the full length with a closed apex. In general, the transplant of a germ with less than half-formed roots seems to compromise further root development and result in root reabsorption phenomena. In contrast, the surgical manipulation of elements with fully developed roots is possible. Still, the increased length of the donor element makes the surgical procedure more complicated both during the atraumatic avulsion phase and in the positioning of the transplant in the donor site. According to Tsukiboshi (10), the transplant should be performed when an element is at its maximum root length but still has the potential for pulp regeneration (radiographic apex > 1mm).

Last but not least, patient selection is significant for the auto-transplantation success. Candidates must be in good health, demonstrate excellent oral hygiene, and be amenable to regular dental care; otherwise, the successful outcome of auto-transplantation could be jeopardized. Patients must be able to follow post-operative instructions and be available for follow-up visits; co-operation and comprehension are essential to ensure predictable results (11).

Hale (12) suggested preoperative radiographic measurements of the transplanted element (mesiodistal dimension) where there was no acute infection in the recipient site, a splinting time of 2 to 3 weeks for the transplanted tooth, and the local administration of penicillin G in the recipient site.

CASE REPORT

An 11-year-old patient comes to our attention with persistence of element 73 in the mandible and absence of 33. Following a radiographic investigation with orthopantomography of the dental arches, it was possible to verify the state of inclusion of element 33, located in an ectopic mesial position with part of the crown having passed the mandibular midline. This position made the element difficult to recover orthodontically, with the associated risk of damage and lower incisal rhizolysis. Given the patient's unwillingness to undertake orthodontic treatment and the good level of oral hygiene and compliance demonstrated, we opted for the recovery and autotransplantation of the 33, which included following the avulsion of 73 (Fig. 1).

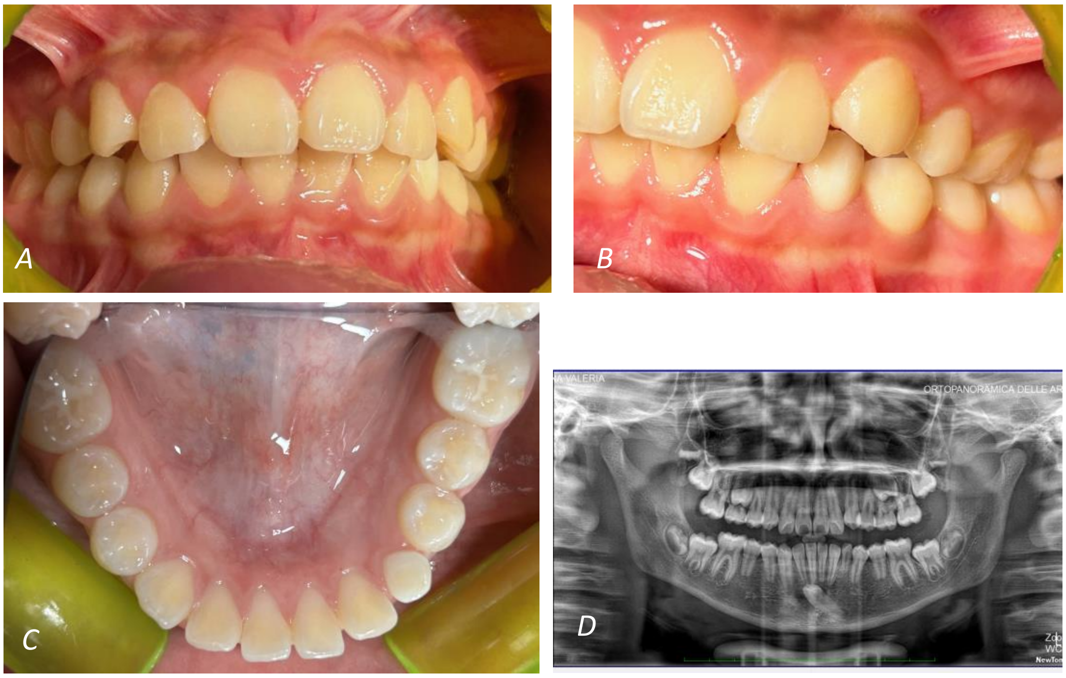

Fig. 1. *Pre-operative pictures and radiograph. A): pre-surgical frontal picture; B): view of the deciduous canine; C): occlusal view of lower arch; D): initial orthopantomography.*

First, avulsion of element 73 was performed. Subsequently, we proceeded with the recovery of element 33. Following a full-thickness intrasulcular flap in the vestibular median mandibular area, dissection, and osteotomy, we proceeded with avulsion of element 33. The post-extraction site of 73 was expanded both vertically and transversely through preparation with drills and greenstick fracture to increase the depth and width of the replantation site. Following washing with physiological solution, element 33 was reimplanted in the dimensionally adapted site of 73.

Element 33 was simultaneously stabilized with the adjacent dental elements using a semi-rigid retainer with braided steel wire extended from 31 to 34. This retainer was left in place for two weeks and then removed. Element 33 immediately showed good integration and a lack of mobility (Fig. 2, 3).

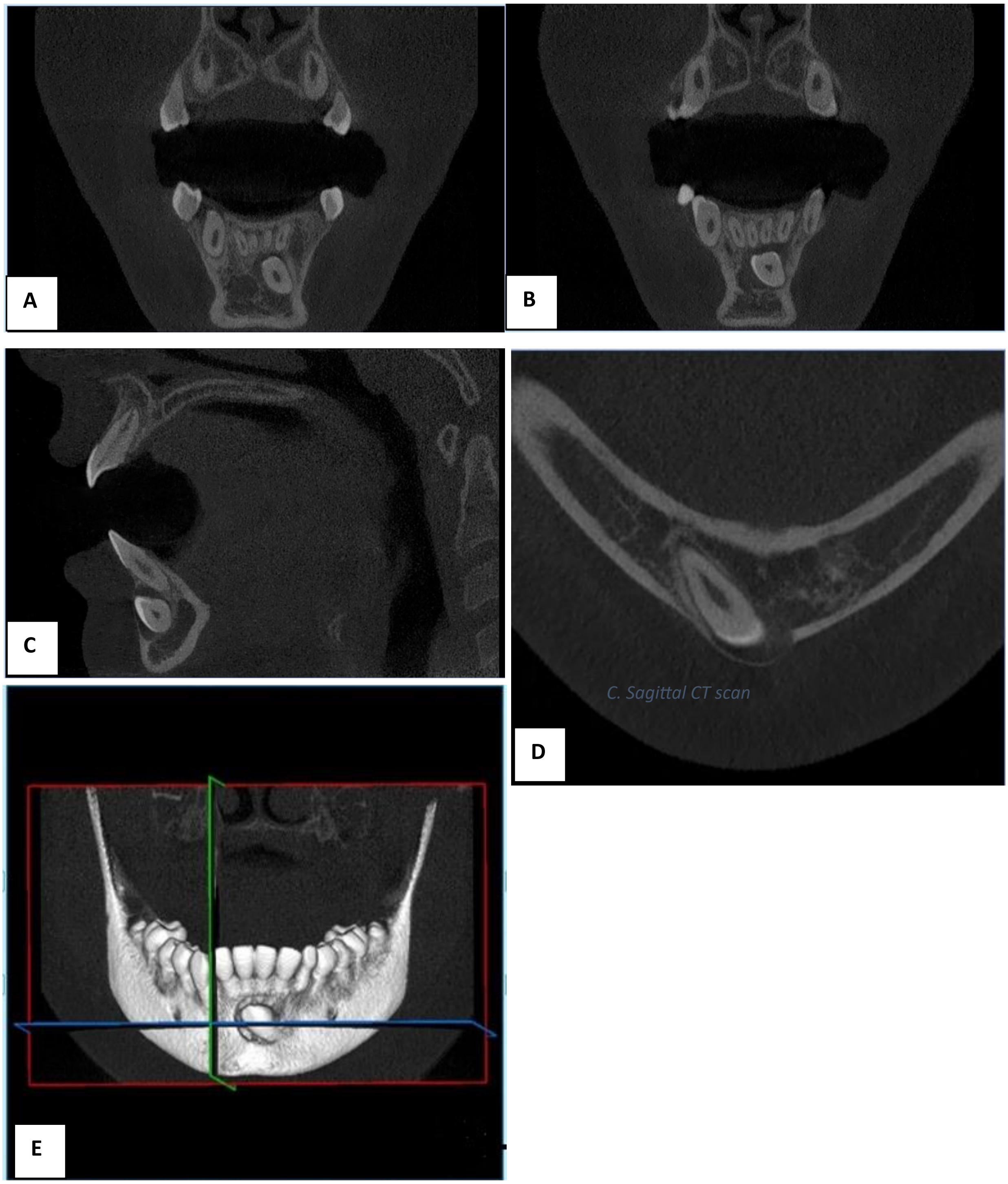

Fig. 2. *Pre-operative CT scan. A): axial CT scan; B): axial CT scan; C): sagittal CT scan; D): transverse CT scan; E): volumetric view CT.*

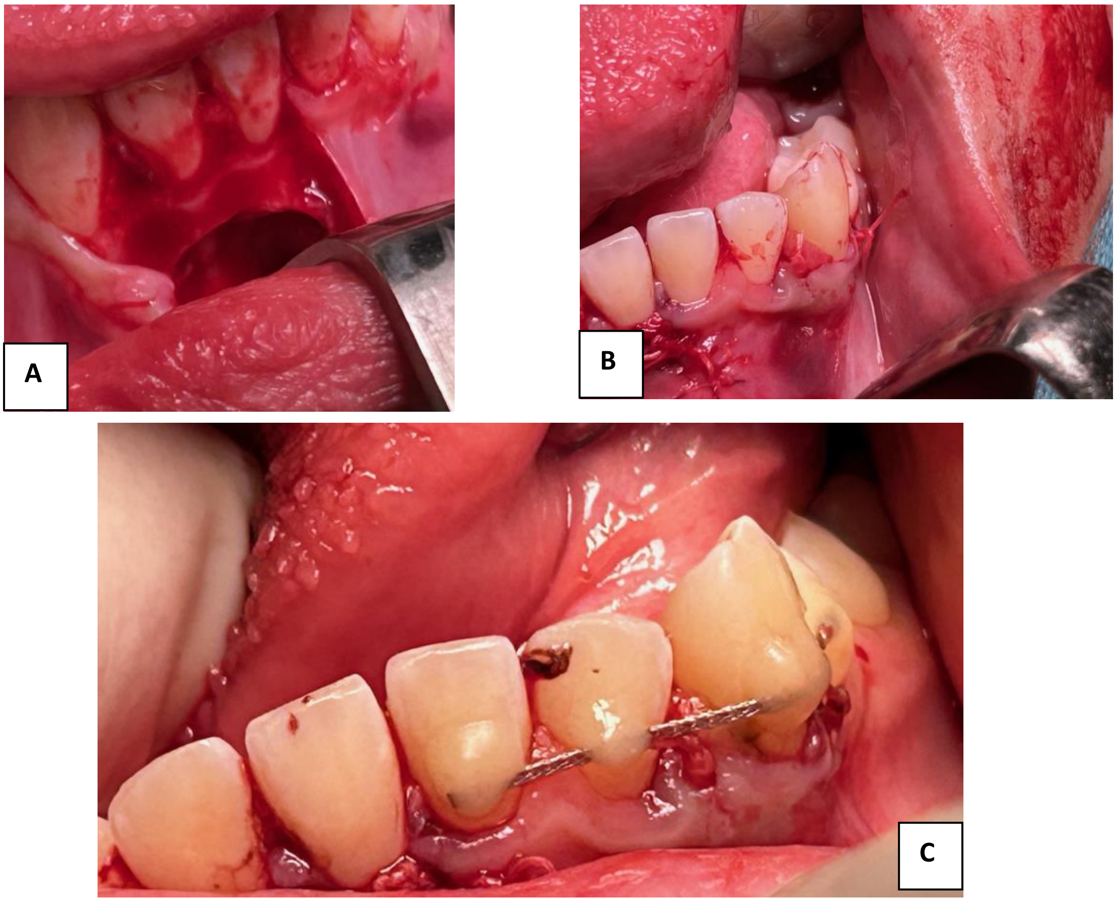

Fig. 3. *Intra-operative pictures. A): intraoperative picture; B): transplanted canine; C): dental splinting.*

All treatment was performed under antibiotic prophylaxis. The patient was previously subjected to antibiotic therapy 1 day before surgery, and for the following 7 days; the antibiotic choice was Amoxicillin 1 gram tablets, with a dosage of 1 tablet every 8 hours for 8 days. After 2 weeks, the element showed a positive response to the cold test; therefore, it was decided to postpone root canal therapy.

Follow-ups were performed at 1 month and 11 months. At the 11-month follow-up, a new orthopantomography of the dental arches is examined, an objective examination and vitality test are performed and the following is noted: absence of mobility, good integration with the periodontal tissues, absence of ankylosis with good representation of the periodontal ligament on the radiographic examination, absence of recessions and/or pathological probing (Fig. 4, 5).

Fig. 4. *Intraoral X-ray after 1 month.*

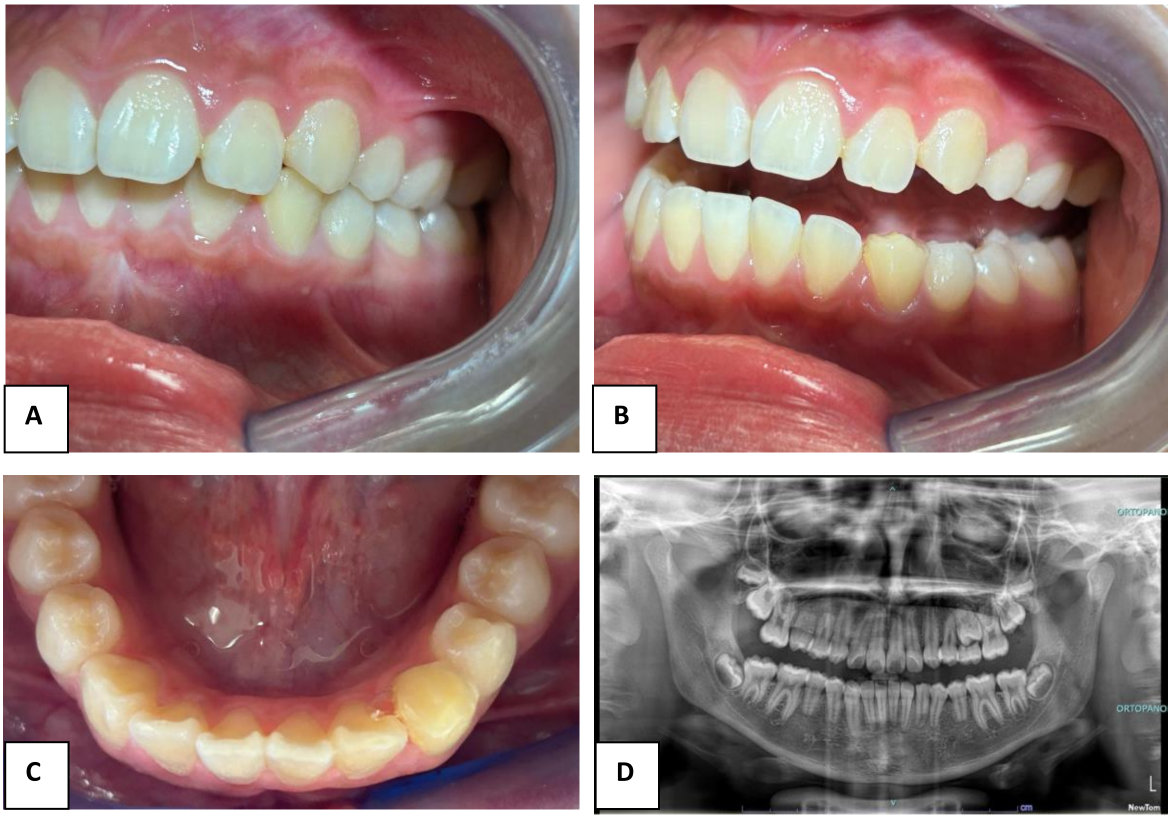

Fig. 5. *Follow-up after 11 months; A): final view of definitive canine; B): definitive canine after transplantation; C): final occlusal picture; D): final orthopantomography;*

Element 33 responded positively to the vitality test. Therefore, it was decided not to perform root canal therapy but to monitor the dental element over time with follow-up every 6/8 months.

However, we know that the pulp tissue very often becomes ischemic after tooth avulsion. If the root apex is large (in our case, more than 1mm), the blood vessels and pulp cells around the apex (within Hertwig's epithelial sheath) proliferate into the pulp cavity in a coronal direction after reimplantation.

Since this proliferation proceeds at a rate of about half a millimeter per day, the pulp cavity fills with viable tissue within a few months of replantation. However, the regenerated pulp tissue rarely functions as before, and what is frequently observed is a progressive obliteration of the pulp canal, due to the rapid deposition of hard tissue (osteodentin). The pulp may respond positively to viability tests in the weeks and months following replantation, but its future is uncertain (13). Therefore, we decided to monitor vitality every 6/8 months; if this is not maintained or there are signs of root resorption, we will proceed with root canal therapy of the element.

DISCUSSION

Our patient underwent transplantation of a mandibular canine to its normal position. He had a successful outcome after 11 months of follow-up, in terms of meeting the criteria established by Kristerson and Lagerström. However, there was a normal response to electrometric pulp testing, and the patient had normal periodontium, complete root development, and no radiographic signs of external root resorption or a periapical lesion. Recently, there has been an increasing interest in tooth auto-transplantation in Dentistry (13, 14). Systematic reviews have reported high survival rates averaging between 75.3%-91% (15) and 93%-100% (16).

The outcome of autotransplantation was studied extensively, and a strong relationship was found among periodontal healing and the stage of root formation, the status of the pulp, and the length of extra-oral storage (17).

In 1990, Andreasen et al. (18) presented a radiographic study in human beings; their findings indicated that the periodontal healing is normal in 100% of the teeth in root stage 0, normal in 96% of teeth in root stage 2, normal in 70% of teeth in root stage 5, and normal in 55% of teeth in root stage 6. They also showed that periodontal healing could be partial (when the periodontal ligament could be traced partially around the root) or complete.

Partial periodontal healing was found 4 weeks postoperatively. However, the majority of the transplants exhibited complete periodontal healing at 8 weeks postoperatively.

The relationship between pulp vitality and periodontal ligament healing suggested that most teeth with vital pulps had normal periodontal healing. Regarding extraalveolar storage, 97% of the teeth that remained in an extraoral location for 11 to 30 minutes had normal periodontal healing.

In another part of the same study, Andreasen et al. (19) examined the tooth survival and pulpal healing after autotransplantation. Pulp canal obliteration was found in almost all the teeth with a positive response to pulp testing. Only 3 teeth had a positive pulp reaction and no pulp canal obliteration. Furthermore, 90% of the teeth reacted positively to electrometric pulp testing. In 6% of the teeth, a previous positive response became negative.

Tooth auto-transplantation can be considered an alternative oral rehabilitation approach for some clinical situations (especially in young patients). It induces bone formation, and re-establishing a normal alveolar process permits tooth movement to distant or opposite sides of the dental arch or even to the opposite jaw (20). This treatment option may also be valued as a temporary measure in young patients because it replaces missing teeth to keep the ridge volume of bone for at least 5 years, and in case of a failure, an intact area remains a possibility for implantation.

According to Iannidu and Markis (17), transplantation could be the treatment of choice in the edentulous areas of the oral cavity when the following specific criteria are met:

1. age (young patients with half-developed to three-quarter–developed roots);
2. extra-alveolar time less than 30 minutes;
3. minimal splinting;
4. absence of trauma to the periodontal ligament;
5. endodontic treatment in teeth with fully developed roots and a previous transplantation.

CONCLUSIONS

In our case, all the criteria mentioned were respected, with the exception of endodontic treatment, as the root was not yet fully developed, and the element responded positively to vitality tests. After 11 months, we obtained a satisfactory result, although it is still premature to be able to affirm that it was a success due to the short post-operative follow-up.

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Case Report

SUBCUTANEOUS EMPHYSEMA AFTER BICHECTOMY: A CASE REPORT

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ABSTRACT

This case report aims to report a clinical case of subcutaneous emphysema after a surgical procedure of bichectomy, which occurred in the postoperative period after the patient reported a severe sneeze. In addition, it is intended to clarify how to reach a correct diagnosis, its treatment, and how we can avoid such complications in the dental clinic. A Caucasian 22-year-old female patient was referred and attended the Dentistry Clinic in Rio de Janeiro/RJ, Brazil, for a bichectomy, aiming to better harmonize her face. However, the patient returned around 4 hours after the surgical procedure, reporting increased volume after stuffing the nose and sneezing. On physical examination, the patient was diagnosed with subcutaneous emphysema and treated without further complications. The present case report used antibiotic therapy and daily follow-ups with the patient. She did not have pain complaints, infections, or involvement of adjacent fascial spaces. Her full recovery took place within 12 days. The professional must understand the risks involved in the surgery and, in case of a complication, know how to treat it to obtain the solution correctly.

KEYWORDS: *subcutaneous emphysema, dentistry, bichectomy, oral surgery, intraoperative complications*

INTRODUCTION

Subcutaneous emphysema is a rare complication that can occur after dental procedures. It is defined as a passage of air or other gases into soft tissues (1, 2). The most common causes are related to the use of high-speed pens and triple syringes; however, several factors such as facial trauma, vomiting in the trans or postoperative period, the fact of blowing your nose with force, playing a wind instrument and strong sneezing can also cause this complication(1, 2).

Clinically, it presents as a sudden increase in hemifacial volume, generally innocuous, associated with erythema, adenopathies, and its pathognomonic sign of crackling during palpation in the region. This sign differentiates subcutaneous emphysema from other complications, such as facial cellulitis, allergic reactions, angioedema, or hematoma

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(2-5). In most cases, it is self-limiting, resolving independently without any surgical intervention. In some specific cases, a secondary infection may happen, where site incision and drainage are indicated (4).

Thus, the objective of this case report was to present a subcutaneous emphysema case after a surgical procedure of bichectomy, which occurred in the postoperative period, after the patient reported a severe sneeze. In addition, it is intended to clarify how to arrive at a correct diagnosis, its treatment, and how we can avoid such complications in the dental clinic.

CASE DESCRIPTION

This case report had the informed consent signed by the patient. A female patient, leucoderma, 22 years old, was referred and attended the esthetic dentistry clinic Iolanda Roy (Rio de Janeiro/RJ, Brazil) for a bichectomy procedure. The aim was better harmonization of her face. Thus, the professional performed a clinical evaluation of the patient, where allergies to medicines and/or basic diseases were not found; in addition, the patient reported non-use of any continuous medication. The vital signs were: blood pressure 120x80 mm/Hg, respiratory rate 16 rpm, and heart rate 76 bpm. After her facial analysis, the professional indicated that her esthetic-surgical procedure should be performed under local anesthesia in an outpatient manner.

Preoperative prescription of a drug was performed with Dexamethasone 4 mg (2 tablets, one hour before the surgical procedure) to prevent edema in the postoperative period. The procedure began with the application of topical anesthetic to the alveolar mucosa with 20% benzocaine (Benzocaine, DFL, Rio de Janeiro/RJ, Brazil) in the region for 1 minute and followed by anesthetic blockage of the upper posterior alveolar nerve with 1.8 mL of anesthetic solution and blocking of the oral nerve with 0.3 mL, both bilaterally using 2% Lidocaine Hydrochloride with epinephrine 1:100,000 (Alphacaine 100, DFL, Rio de Janeiro/RJ Brazil), deposited through a short dental needle 30G (Uniject, DFL, Rio de Janeiro/RJ, Brazil). After 10 minutes, the effectiveness of the anesthesia was confirmed. Then, the procedure was initiated using the Stuzin method, where a 2 cm vertical incision was made in the lower region of the upper vestibule near the second upper molar, followed by a delicate surgical detachment, with the use of a curved hemostatic clamp until the fat is directly visible. The professional apprehended the structure with a straight hemostatic clamp and removed the vestibular portion of the Bichat ball by slight traction in an anteroinferior direction (Fig. 1 A-D).

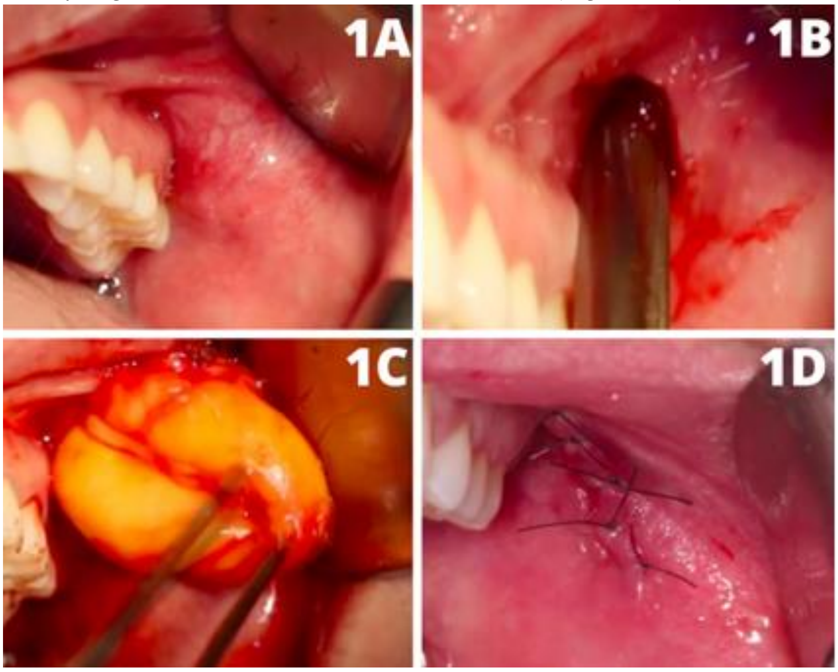

Fig. 1. ***A)***: *Visualization of the region before the incision;* ***B)***: *Penetration of curved hemostatic tweezers to initiate surgical disclosure to expose the Bichat ball;* ***C)***: *Bichat ball exhibition;* ***D)***: *Surgical synthesis performed with simple stitches.*

The surgical warehouse was watered with 20 mL of 0.9% saline (Eurofarma, Rio de Janeiro/RJ, Brazil), followed by a review of hemostasis and synthesis of the region with nylon thread 4-0 (Ethicon Somerville, New Jersey USA). There was no intercurrence in the transoperative period.

In the postoperative period, Amoxicillin with Potassium Clavulanate 875 mg was prescribed every 12 hours for seven days to avoid secondary infection; Ibuprofen 600 mg every 6 hours for three days; and Dipirona Monohydrate 1g every 06 hours for two days. For the maintenance of oral hygiene, chlorhexidine at 0.12% every 12 hours for ten days was prescribed. In addition, the patient was instructed on specific post-operative care for this type of procedure, such as avoiding sneezing by filling the nostrils, sleeping with a head higher than the body, and applying ice to the face after applying petroleum jelly four times a day.

After approximately 4 hours of the surgical procedure, the patient returned, reporting an increased volume after stuffing her nose and sneezing. On physical examination, the patient presented an increase in volume in the parotid regions, and during local palpation, it was seen to be subcutaneous emphysema since the region had the appearance of a "dry leaf" (Fig. 2). The patient did not report complaints of pain or distress.

Therefore, medication and postoperative care were maintained with uncomplicated regression over the 12-day period (Fig. 3). The patient was followed for about 14 months, with no recurrence of the complication.

Fig 2. *The frontal view of the patient returning to the dental clinic shows an enlarged volume in the parotid and orbital region on the right side.*

Fig. 3. *Frontal view 12 days after the surgery.*

DISCUSSION

The manifestation of subcutaneous emphysema followed by dental procedures is often associated with the use of high-speed turbines during extraction procedures or even with the use of an air jet with a triple syringe. However, its appearance may come from oroantral communications, associated with the Valsalva maneuver, prolonged procedures, or even through the intraoral pressure exerted by the patient in the postoperative, the latter being related to the clinical case of this article (2, 5, 6).

Surgery for resection of the adipose body of the cheek, often indicated for esthetic-functional purposes, promotes a reduction of the volume of the middle third of the face and is likely to be performed with local anesthesia in an outpatient setting. The surgical technique involves tissue diffusion and traction of the Bichat ball, located externally to the buccinator muscle and facing the anterior margin of the masseter muscle. The procedure is considered simple and of short duration; however, the potential risks must be weighed beforehand (7, 8).

Although rare, complications can occur, such as bruising, infections, involvement of the parotid gland duct, and facial paralysis (7). Subcutaneous emphysema, although extremely rare, is not ruled out due to anatomical plane dissection during bichectomy. Thus, the patient should be guided in postoperative care, such as sneezing with the open mouth and avoiding musical instruments that require blowing, in addition to the usual care in oral surgeries (2). Moreover, careful surgical management, without lacerations, suturing with well-matched edges can provide an uneventful postoperative.

Early diagnosis decreases the risk of secondary complications and favors intervention, which is palliative (5). The onset of resorption of emphysema occurs in 2 or 3 days, with complete remission between 7 and 14 days (1-3, 5). In the reported case, there was a significant improvement only after the seventh day and total remission on the twelfth day. The treatment was symptomatic, with analgesics, in case of pain (3).

The authors recommend antibiotic therapy to avoid secondary infections, such as necrotizing fasciitis (1, 2, 5). In this reported case, we started the antibiotic therapy with amoxicillin for seven days due to a possible infection, as there is the presence of a dead space due to the extraction of the Bichat ball.

CONCLUSIONS

The present case was performed as in the antibiotic therapy presented, and the patient was monitored, without complaints about pain, infections, or involvement of adjacent fascial spaces, with complete recovery in 12 days.

The professional must understand the risks involved in the surgery and, in case of a complication, know how to treat it to obtain the solution correctly.

Declaration of conflict of interest

The authors declare that they have no conflict of interest in relation to this scientific article.

Informed consent

All patients involved in this study provided written informed consent, authorizing the use of their before-and-after photographs for scientific publication, conference presentations, and educational materials. Privacy protection was ensured, guaranteeing that no personal data allowing direct identification would be disclosed.

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Case Report

OCCLUSAL PLANNING. AIMING AT A COMPREHENSIVE APPROACH TO NEUROMUSCULAR AND ARTICULAR DISORDERS OF THE ORAL APPARATUS, SUPPORTED BY SEMIOTIC AND ELECTRONIC DIAGNOSTIC INSTRUMENTS

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ABSTRACT

Over the years, numerous research studies have been conducted on craniofacial disorders, highlighting differing opinions, largely due to the varying angles of professional practice employed. With the utmost respect for the well-grounded studies that deepen our understanding of the role of central engrams in the onset of temporomandibular joint (TMJ) and muscular disorders, as well as their therapies, our article aims to raise awareness about the anatomical structures involved in the maxilla-mandibular relationship and their impact on the neuromuscular health of the oral apparatus. Here, the procedures of occlusal therapy based on neuromuscular deprogramming, electronic detection of occlusal contacts, mandibular movements, muscle activity, and slight additional and subtractive corrections to the teeth are described, synthesizing the consolidated international literature.

KEYWORDS: *disorders, neuromuscular, temporomandibular joint, articular, craniofacial, mandibular, muscle, teeth*

INTRODUCTION

Due to its vital function tied to alimentation, the mandible, being a mobile body, interrupts the muscular continuity on the anterior side of the body, whose efficiency is achieved through a complex mechanism of muscles and tendons, which provide stable points of traction for the anterior muscles when needed.

We must take into account the masticatory muscles not only for their masticatory function, but as part of a system of muscles which, further than mastication, have the role of firmly anchoring the mandible to the upper jaw during the following functions:

- swallowing
- aid the anterior chain muscles through connection to the hyoid bone

During these fundamental functions, the mandible must hold a stable balance with the upper jaw. This relationship is mediated by the teeth when present. The teeth stop the jaw during its upward movement.

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Swallowing

During the oropharyngeal phase of swallowing, performed in apnea, the elevator muscles contract in order to push the mandible against the upper jaw, stopping at the intercuspation of the teeth. The position of the mandibular condyles in the TMJ depends on this stopping position. At the same time, the suprahyoid lowering muscles contract to lift the expanded tongue so as to push the food bolus towards the back of the pharynx and convey it towards the esophagus. The same thing happens thousands of times a day when swallowing liquids (1). At this moment, the teeth bear the maximum stress, and if this stress is not properly balanced, numerous consequences can occur, both on the teeth and on the muscles and temporomandibular joints (TMJs).

As an additional note, the expansion of the tongue that occurs during the oropharyngeal phase of swallowing invades all the empty spaces when teeth are missing and, therefore, it is especially critical for:

a) its interposition between the teeth, which prevents their correct eruption;
b) newly placed implants if they protrude into the mouth (2).

Aid the anterior chain muscles in traction on the hyoid bone

When an effort is performed, numerous muscles are regularly involved. When this effort regards arms and chest, the effectiveness of the anterior muscular chain requires the mandible to be firmly clenched to the upper jaw, so as to allow the hyoid bone to be stably blocked to mandible and cranium by the suprahyoid muscles, letting the infrahyoid muscles stabilize the clavicula and the sternum, on which the muscles of the chest can then exert an effective traction. If we watch the weightlifters during their performance, they clench their teeth. This happens when apical efforts involving the anterior muscular chain are performed (3).

Anterior muscle chain

When the human being makes an extreme effort involving the muscles of the chest, he tights the lower jaw against the upper one (4). This is due to the fact that, during this function, the suprahyoid muscles firmly anchor the hyoid bone to the mandible (mylohyoid, anterior digastric, geniohyoid) and to the temporal bone (posterior digastric, styloid), allowing the infrahyoid muscles (sternohyoid, omohyoid, thyrohyoid) to operate traction on an extremely stable bone, then stabilizing the lower bones (sternum, clavicle, scapula), so as to let the muscles of the chest and arms swell adequately to carry out their effort (Fig. 1).

Fig. 1. *During extreme efforts the teeth are tightened on the antagonists to allow the functionality of the anterior muscular chain.*

Balanced occlusion is necessary to ensure that the mandible is a stable traction point for the suprahyoid muscles. The mandible clenched on the maxilla represents the terminal part of the anterior muscle chain. If the contact between the upper and lower teeth is not well distributed, the lower jaw cannot reach a stable position and, consequently, the underlying muscles cannot work efficiently. This fact explains why weightlifters often wear a mouthguard during their exercises.

If the back teeth are missing, there is no fixed opposition to the elevation of the lower jaw. The condyles lift upward, compressing the joints. The relationship between the jaws is incorrect, and the elevator muscles suffer a loss of trophism due to a lack of functionality. Additionally, if the physiological dynamic movements of the jaw are hindered by interference from the teeth, a neuromuscular response is activated, which can lead to muscle and joint disorders (5).

The role of glial cells and the myelin sheath in traumatic occlusion is currently being studied. Clemente-Napimoga et al. demonstrated that experimental traumatic occlusion (ETO) induces altered neuronal patterns and suggestive activation of satellite glial cells (6).

MATERIALS AND METHODS

Treatments

The most commonly used therapy for unbalanced occlusion between upper and inferior teeth is the use of a bite capable of providing a better relationship between the jaws (7). Due to bite thickness, compatibility with any single patient should be carefully evaluated. A free-way-space higher than the average is suggested, not to produce clenching responses. One means to detect the amount of the patient's free-way space is mandibular kinesiography. A magnet is applied to the base of the crown of the lower incisors, and its movement, in relation to three other magnets, is converted into images on a screen using an oscilloscope (8). Normally, 2nd-class and deep-bite patients got a free-way-space higher than average (Fig. 2).

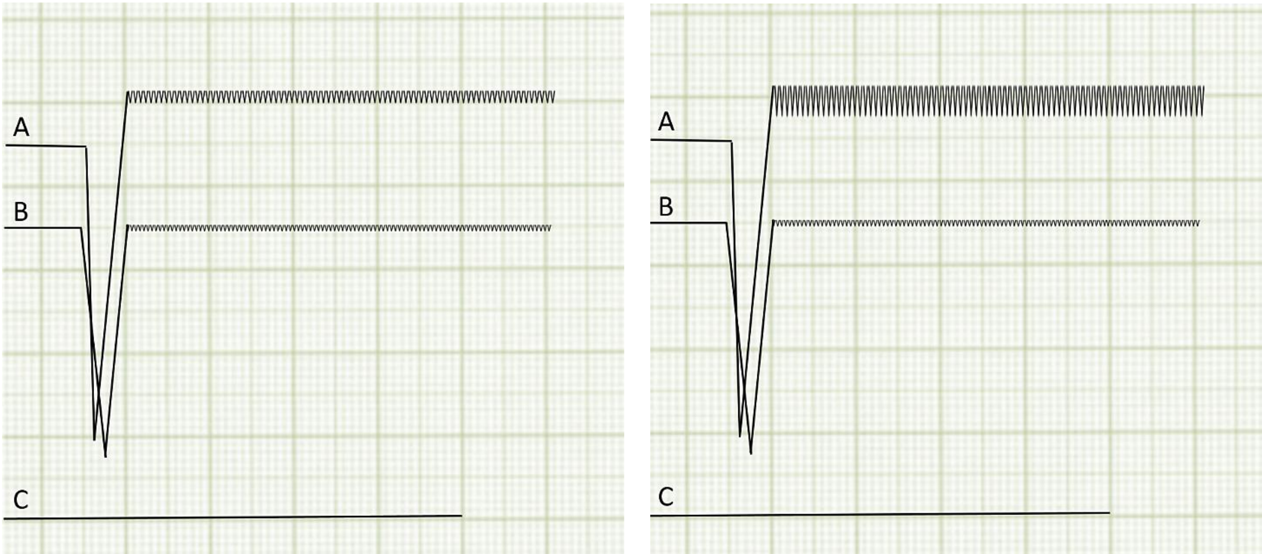

Fig. 2. *Mandibular Kinesiography (**scheme**). The patient on the left has a 2mm free-way space (A) and a 1 mm overjet (**B**). The patient at right has the same overjet (**B**), but a wider free-way space (**A**).*

Kinesiographies performed on 20 consecutive patients in the Dr. Dal Carlo dental office show that 65% (13/20) have 1 to 3 mm of free-way-space, and 35% have more than 4 mm of free-way-space. In approximately one-third of these cases, a shim may be applied between the teeth.

In situations of advanced craniomandibular disorders, particular bites have been studied to correct the harmful action of the tongue and train the patient to use new closing trajectories. The results of this therapy appear encouraging, although documentation on the long-term effects of altering the relationship between the jaws remains scarce (9).

Regardless of the type of bite used, the aim of the therapy should be to prosthetically restore the patient's physiological functions in a stable way. When planning new fixed prostheses that cover the entire arch, it is advisable to conduct a thorough study of each patient's correct jaw function to prevent pathologies associated with an incorrect jaw relationship. This is especially important when immediately loading dental implants.

Occlusal planning

When faced with a symptomatic patient in whom signs of parafunctions are evident, the treatment can follow different paths, depending on the indications of the different research schools.

The experience of the Spanish and Chilean university research group with selective grinding on occlusal splint aimed at obtaining a balanced static and dynamic occlusion was very encouraging, treating the symptoms of TMJ in most cases (10).

Extensive experience with immediate loading of full-arch implant cases (11, 12) has led our research team to ascertain the importance of correct centric relation and anterior guidance, especially when bone is sparse, and the upper jaw is smaller than the lower jaw (Fig. 3) (13).

Fig. 3. *Patient BK, age 55, Caucasian, female. Implant-prosthetic rehabilitation of the entire upper arch of a patient with poor bone and crossbite. Static and dynamic occlusion recording was followed for months.*

When facing a clinical case in which an implant rehabilitation is needed, it's also mandatory to analyze the position of the tongue during swallowing, so as to prevent harmful effects due to its expansion. The tongue is interposing between the teeth in open bite cases (14).

Occlusal therapy

In 1974, Niles Guichet published the following sentence in his book entitled "Occlusion": "The dentist can, by modifying the occlusion, eliminate irritating occlusal plugs, thus allowing the muscles to relax" (15).

The goal of the occlusal therapy should be to restore (or create, if it was not there) the organic occlusion in a patient who exhibits signs and symptoms of malocclusion. The symptoms that usually lead patients to visit the dentist generally concern toothache, muscle pain, joint pain, joint noises, and grinding noises. It is therefore necessary to ascertain: the absence of teeth, prosthetic materials, structural damage to the teeth, stability of the teeth, periodontal health, generalized or localized, muscle tone, right/left balance, and jaw movements.

Pathologies, drugs, and eventual vicious habits must be carefully considered. To obtain this information, anamnesis, semiotics, and electronic instrumentation are recommended. After this first phase, which is useful for defining the pathology, a therapy can be planned.

The primary objective is to reproduce in the patient the same conditions in which the pathology is expressed. If the pathology acts, as often happens, during sleep, we must reproduce similar sleep conditions with the patient awake. In fact, when the patient is awake, a CNS protection system is activated to avoid harmful contact, based on the proprioception of teeth and muscles. Alternative mandibular pathways are programmed and, therefore, the patient does not perceive the pathological contacts during the waking state. As soon as he wakes up, he retains the memory of these harmful activities for a while, and then the protection is activated. To achieve the objective of reproducing the sleep situation, we use a well-tested methodology: the Pasqualini Stopper.

Pasqualini Stopper

The Pasqualini stopper (Fig. 4) involves creating a little resin ball that is adapted only to the upper incisors, in order to create an anterior shield, to avoid posterior contact, and to let the inferior incisors slide on it (16).

Fig. 4. *The Pasqualini stopper.*

By eliminating contact on the teeth, the muscle tone is lowered. We can easily observe, with the patient seated in our dental chair, that the jaw gradually moves backward, which indicates muscle relaxation. We can add, keeping the Pasqualini stopper in the patient's mouth, the Tens, which helps to quickly relax the muscles. The Jankelson Myomonitor or a similar device is suitable for this use (17).

Static occlusion

The next step is to progressively reduce the stopper until the first pair of teeth comes into contact with each other. At this point, we can work by adding composite materials to the teeth that do not come into contact with the antagonist, or, if the excess contact is on a prosthetic reconstruction, we can reduce the tooth. If the excess contact is on a natural tooth, orthodontics should be evaluated before deciding to modify the tooth. Otherwise, we can collect the occlusal keys to plan a prosthetic rehabilitation at a higher level.

Dynamic occlusion

Once the intervention to balance the static occlusion is complete, we address the dynamic occlusion. Canines and incisors are often abraded. We add materials to recover the anterior guidance.

At the end of the therapy, a new session of diagnostic tests, including Kinesiography (Myotronics, U.S.A.), Electromyography (BTS, Italy), and T-Scan Electronic Occlusal Detection (Tekscan, U.S.A.), is useful for confirming the therapy's outcome and documenting it. To obtain a useful comparison, these tests are also suggested at the beginning of therapy.

Clinical case

A Caucasian patient, T.A., male, 26 years old, was seen to address his nocturnal teeth grinding habits and to investigate gingival recessions around several teeth (Fig. 5). The patient was seen on January 4, 2022. In addition to the patient’s previous reports, a Class III occlusion was noted, no protected anterior guidance. The patient’s head rotation was blocked to the left side. Neck and shoulder pain was reported. Due to obvious signs of occlusal imbalance, a Pasqualini stopper was constructed, an EMG was performed (BTS Bioengineering Milan, Italy), and the patient was scheduled for occlusal therapy.

Fig. 5. *January 4, 2022. Endo-oral occlusion at the first visit.*

February 01, 2022. After muscle relaxation, occlusal therapy was performed, slightly removing premature contacts in centric. The centric contacts were then detected by the T-Scan (Tekscan, U.S.A) device, which allows you to appreciate the minimal differences in contact of the teeth during clenching (Fig. 6) (18).

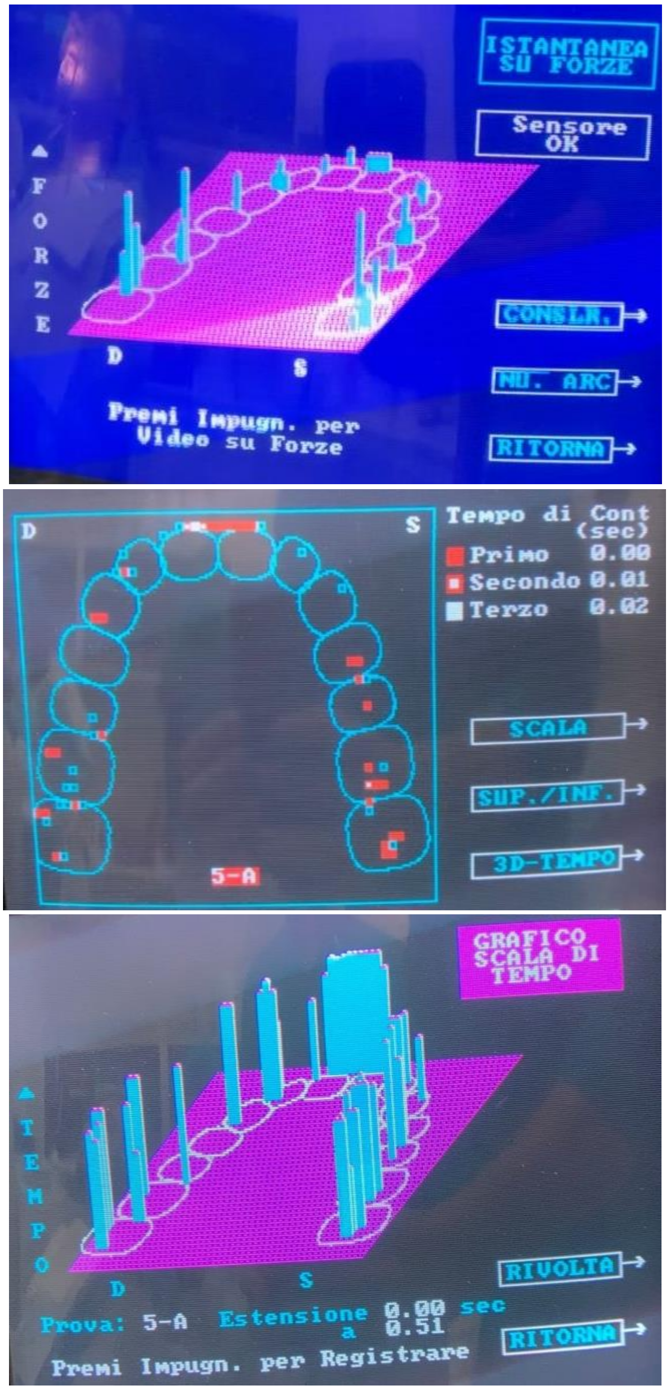

Fig. 6. *February 1, 2022. T-Scan after occlusal therapy.*

February 1, 2022. After confirming the positive outcome of the occlusal therapy in centric occlusion, we proceeded to restore the lateral guidance by adding composite to the canines on both sides (Fig. 7).

Fig. 7. *February 1, 2022. With additional restorations on the canines, the mandible is now able to move laterally without interference.*

February 24, 2022. The patient is scheduled for a follow-up session. He reports a reduction in nighttime grinding habits. Semiotics: bilateral head rotation is ok. Normal tone of the sternocleidomastoid muscles. An EMG is performed, which confirms a significant improvement in muscle balance (Fig. 8, 9) (19).

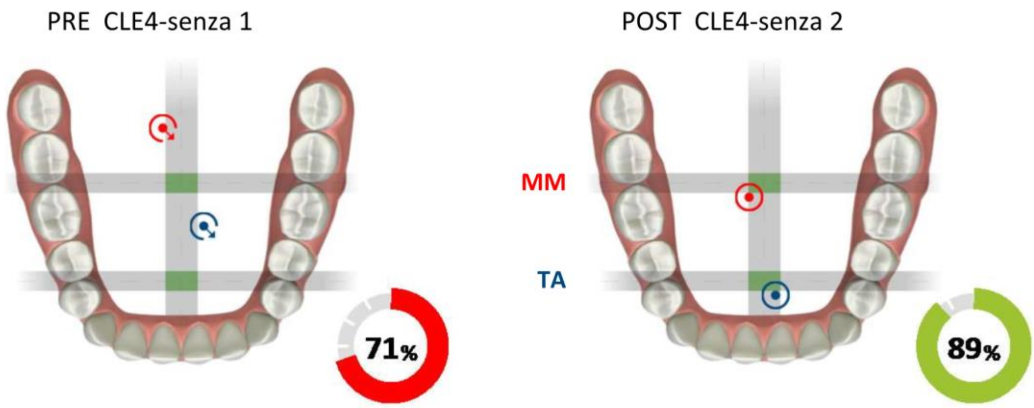

Fig. 8. *EMG before and after occlusal therapy.*

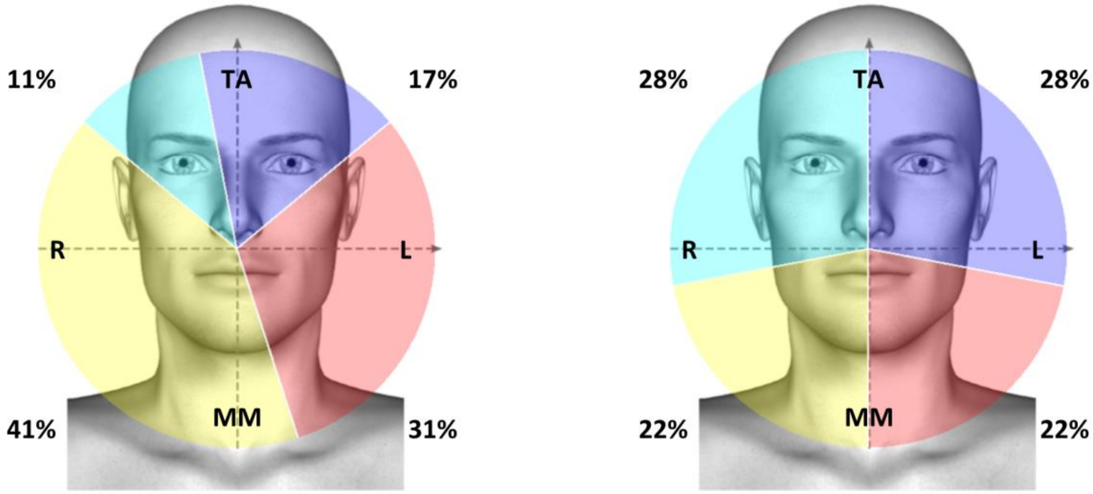

Fig. 9. *EMG before and after occlusal therapy.*

CONCLUSIONS

The relationship between the upper and lower jaw is a fundamental part of the anterior musculoskeletal chain. Therefore, any rehabilitation project must consider the physiological function of this apparatus. If this relationship is unbalanced, corrections are indicated. Prosthetic rehabilitations must be constructed taking care to respect the principles of physiological static and dynamic occlusion. Electronic tools can be useful in achieving this goal with the utmost precision. The occlusal therapy described here represents a proven procedure to increase the stability of the apparatus in non-edentulous patients.

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Review

ORAL MANIFESTATIONS IN PAGET'S DISEASE: A NARRATIVE REVIEW

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ABSTRACT

Paget's disease (PD) is a bone disorder that can affect both single and multiple bones, leading to bone hypertrophy, cortical expansion, and a pathological bone structure that may predispose individuals to fractures. Paget's disease is a complex disorder. Current evidence suggests that genetic factors are crucial in susceptibility, but it is not the only cause. Numerous studies have found a possible association between paramyxovirus exposure and the disease. Today, the role that the paramyxoviruses may play in this disease is still unclear, and the chance that earlier exposure to a viral infection early in life might play a part in PD cannot be totally excluded. This literature review highlights the most common aspects among patients with Paget's disease, including jaw and dental alveoli deformation with possible loss of dental elements, pulp calcification, and the rare occurrence of mandible fractures.

KEYWORDS: *Paget, bone, disease fracture*

INTRODUCTION

Paget's disease (PD) is a bone disorder that can affect both single and multiple bones, leading to bone hypertrophy, cortical expansion, and a pathological bone structure that may predispose individuals to fractures. These consequences result from accelerated skeletal remodeling (1). This disease exhibits a unique epidemiology characterized by its geographical distribution. Specifically, PD is expected in the United Kingdom, North America, Australia, New Zealand, France, and Germany (2). In the last decades, the prevalence has decreased in Europe, as well as the severity of the disease has declined in New Zealand (3,4). PD is more common in males, in certain ethnic groups and in people after the age of 50 years (2).

The development of PD typically occurs in three stages: osteoclastic (lytic) activity is the initial stage, followed by a phase of osteoblastic and osteoclastic (mixed) activity, and finally, a sclerotic/blastic (late inactive) phase, resulting in bone weakness, disorganization, and more pronounced clinical manifestations. These clinical symptoms include joint and bone pain, bending or arching of bones, cranial deformities, fractures, and neurological complications such as deafness, cranial nerve palsy, or spinal compression (5). In the early stages of PD, increased bone deposition follows an excessive bone resorption. The most familiar expression of the disease is skeletal disfigurements, usually present in the skull and lower extremities. Specifically, the jaws are affected in less than 15% of cases, with a maxilla-to-mandible ratio of 2:1 (5). Pathological fractures happen frequently, especially in the femur. Pain is typical in subjects with PD from

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muscle, skeletal, or neurological origin (6). The primary lesion is a localized area of raised bone resorption and hypertrophy of an immature new bone. The result is bone expansion with structural weakness. This disease exhibits a unique epidemiology characterized by its geographical distribution (7). While its etiology remains unknown, there are two prevailing hypotheses: one based on viral involvement and the other on genetic factors (8,9). Chronic infection with paramyxoviruses is the most relevant etiology for PD (10, 11). Gene mutations have also been associated with the development of PD, especially genes mediating cytokine signaling (7).

Juvenile Paget's disease (JPD) has a robust genetic predisposition. JPD affects all the bones and causes progressive deformities, growth retardation, short stature, and facial deformities like maxillary expansion and progressive macrocephaly. Due to the bone expansion, structures like the auditory and optic nerves are affected. The morbidity and mortality of JPD is high. In case of no treatment, a significant number of patients can be led to wheelchairs before the age of 15. The first-choice treatment for JPD is oral bisphosphonates. Early therapy reduces bone turnover and controls the development of deformities (7).

MATERIALS AND METHODS

This study utilized PubMed research conducted on May 2, 2023, using the MeSH term "Paget's disease and Oral Manifestations." All original papers reporting randomized controlled clinical trials and observational studies (including cohort and case-control studies, cross-sectional investigations, case series, and single case reports) describing the correlation between Paget's syndrome and manifestations in the maxillofacial region were included. Proceedings, letters, editorials, theses, abstracts, and studies written in languages other than English were excluded. PubMed was searched without limitations on the year of publication, from the earliest available date up to May 2023. Titles and abstracts of research papers were examined, and papers that did not meet the inclusion criteria were excluded. If the abstract did not provide sufficient information for evaluation, the full text of the paper was considered. Subsequently, the full texts of the remaining articles were reviewed to assess their relevance and suitability for qualitative synthesis.

RESULTS

A total of 32 articles were identified, and only 7 met the inclusion criteria (12-18). The initial search yielded 32 results. The titles and abstracts derived from the survey were independently screened by two authors (RAA, FL). Removing duplicates and after screening the titles, seven abstracts were then analyzed; full-text articles were obtained for all agreed titles, and discrepancies were resolved by discussion. Finally, seven studies were included in the present review. We summarized and schematized the seven studies in Table I.

Table I. *Main data extracted from the seven included papers.*

Type of Study	Authors (ref.)	Year	Number of Patients	Description of the Study	Findings
Case report	Seehra et al. (13)	2009	1 patient	A 20-year follow-up is reported of a patient who was diagnosed with Paget's disease following the investigation of her initial oral complaint. Following surgical extraction of two teeth in her maxilla, the sockets have failed to heal, despite numerous attempted interventions.	Highlights both the cranio-maxillofacial and oral manifestations of Paget's disease of bone, its effects on surgical exodontia and the possible effects of bisphosphonate therapy. Prevention and conservation of the patient's remaining teeth are paramount as the extraction complications are significant.
Case report	Campolongo et al. (18)	2018	1 patient	The study highlights how it possible by a general dentist recognised Paget's disease, observing, rapid bone resorption trought dental malposition and blatant prognatism	Clinicians should consider PDB in differential diagnosis for an elderly patient undergoing unexplained alteration in face

					profile and occlusion.
Case Report	Thomas et al.(16)	1994	1 patient	The study describes the case of a 59-year-old woman with already established paget's disease. It analyzes all oral manifestation.	Evidence just a case of prognathism.
Case Report	Gage et al. (15)	1965	1 patient	The study describes clinical situation of a 77 years old female.	Bilateral enlargement of the maxilla.
Case Report	M. Marks et al. (12)	1980	1 patient	Intra-oral clinical investigation of oral manifestation in 40 years old man.	Prognathism with III Class malocclusion. Diastemas between all anterior teeth. Pulpal calcification and generalized hypercementosis. Extra-oral radiographs show classic cotton wool aspect in parietal and frontal bones.
Case Report	Cook et al. (17)	1957	3 patients	Research of clinical and radiographic findings in 3 cases of conclamate Paget's desease.	Enlargement of alveolar process. With bone changes. The maxilla and Mandible may be affected.
Observational study	Sofaer et al. (14)	1984	360 patients	The results of a postal questionnaire completed by 360 patients with Paget's disease of the bone suggest that dentists are aware of the possible consequences of dental extractions in patients but yet patients still suffer more difficulties at extraction and more post-extraction complications than normal.	Paget's disease patients in general are indeed more likely than normal to suffer from difficulty at extraction and from post-extraction complications. The greater frequency of heavy or prolonged bleeding following extractions in the younger compared to the older age range for Paget's patients is consistent with initial vascularity and progressive sclerosis of the supporting bone

Marks et al. (12) recommended periodic examinations for edentulous patients. They emphasized the importance of paying attention to edentulous patients, as ridge widening can cause denture fracture and pressure on supporting tissues, leading to ulceration or necrosis. Marks proposed extraction strategies, as did the study by Seehra et al. (13), which examined patients with an established diagnosis of PD obtained from clinical (examination and biochemistry) and radiological evaluation. Clinical chemistry analysis reveals an elevated serum alkaline phosphatase level (normal range 40-129u/L) and urine hydroxyproline level (normal range 6-22 mg/day/m2), reflecting increased bone turnover. A distinctive histologic feature of pagetoid bone is the "mosaic" appearance. Examining the skeleton with radionuclide bone scintigraphy can lead to a definitive diagnosis. The study highlights the challenges of performing oral surgical procedures in patients with PD, as previously mentioned in the study by Sofaer JA et al. (14). The study also reported a connection between osteonecrosis of the jaws and bisphosphonate therapy, as described in the literature. The most commonly used bisphosphonates are pamidronate and zoledronate, administered intravenously, and alendronate, administered orally.

Most cases of osteonecrosis of the jaws are associated with intravenous therapy. Seehra et al. (13) emphasized that the origin of osteonecrosis in these patients is unknown and could be attributed to both the disease and the use of bisphosphonates. However, given the higher prevalence of pathology in the maxilla, it could be a discriminating factor. What is certain is that bisphosphonates worsen a condition already prone to post-surgical complications. Surgical extractions are recommended if a tooth requires extraction due to the risk of hypercementosis of the roots and ankylosis.

Dentists should also be mindful of the improved possibility of bleeding from the socket if a tooth is removed during the early stages of PD and should administer pre- and post-operative antibiotics to reduce the risk of localized osteitis and osteomyelitis development. The recommendations regarding bisphosphonate therapy are the same as for patients undergoing chemotherapy or radiotherapy. This includes a comprehensive dental assessment to identify and treat dental caries, periodontal disease, and teeth removal with a poor prognosis before commencing treatment. If a tooth requires removal, antibiotic coverage should be provided, and extraction should be performed at least one month before starting bisphosphonates. The patient's dentition should be closely monitored during therapy (15). As with all medically compromised patients, implementing excellent oral hygiene practices should minimize the need for surgical treatment.

Other studies examined one of the most common aspects of PD: involvement of the skull, which is a frequent occurrence. Growth of the outer table during the appositional phase results in an increasing size typically observed as a 'cotton wool' appearance on radiographs. Clinically, deformities can also affect the jaws, especially the maxilla. This deformation can lead to alveolar deformity and tooth loosening. Enlargement of the jaws may cause pain and altered sensation because of irritations of the periosteum or nerve compression (15-17). Campolongo et al. followed a case in which they observed gradual mandibular deformation. Other manifestations that may occur in these patients, as reported in the literature, include the involvement of salivary glands with calculi (18).

DISCUSSION

PD is a complex disorder. Current evidence suggests that genetic factors are crucial in susceptibility (10), but it is not the only cause. Numerous studies have found a possible association between paramyxovirus exposure and the disease. Indeed, Viral infections have been considered a potential environmental trigger in many multifactorial genetic disorders (19-21). Today, the role that the paramyxoviruses may play in this disease is still unclear, and the chance that earlier exposure to a viral infection early in life might play a part in PD cannot be totally excluded (10,11).

The literature study highlights the most common aspects among patients with PD, including jaw and dental alveoli deformation with possible loss of dental elements, pulp calcification, and the rare occurrence of mandible fractures.

Analyzing an older review by Smith et al. (22) reported the most common oral manifestations of the condition: teeth may become unusually solid during ankylosis or, during the osteolytic stages of the disease, teeth may migrate, and root resorption may lead to tooth mobility. The study also noted pulpal calcifications that may compromise endodontic treatments. Dental extractions pose a risk of osteonecrosis.

One of the most significant considerations relates to dental extractions, where complications may be exacerbated by using bisphosphonates, especially intravenous ones. Therefore, dentists should adhere to precise protocols and, whenever possible, evaluate the patient's general health status before initiating bisphosphonate therapy once the disease is identified.

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Case Report

DENTAL IMPLANT INSERTION AND GUIDED BONE REGENERATION FOR RESTORING LOWER LATERAL INCISOR AGENESIS

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ABSTRACT

The anterior mandible, being a highly esthetic region, presents unique challenges for implant placement and dental restoration. Dental implants have become a cornerstone of modern dentistry, offering a reliable and long-term solution for tooth replacement. However, successful implantation relies not just on the osseointegration of the implant itself, but also on the health and stability of the surrounding soft tissues. This is where bone regeneration and grafted mucosa play a crucial role. Bone loss in the anterior mandible is particularly relevant not only from functional (i.e., chewing, speech) but also from an aesthetic and psychological point of view. Bone loss in the anterior mandible can pose significant challenges for dental treatments, particularly when placing dental implants. Dental implants require a stable and adequate amount of bone for successful integration. When bone loss occurs, it may necessitate additional procedures such as bone grafting or Guided Bone Regeneration (GBR) to augment the bone volume and create a suitable foundation for implant placement. This paper has described a case of replacing lower lateral teeth agenesis in the anterior mandible, focusing on the crucial steps involved in the characteristics of bone regeneration to restore alveolar width. The GBR ensured a good quality of bone around the anterior fixtures and the teeth's roots.

KEYWORDS: *dental implants, keratinized mucosa, peri-implant health, esthetics, implant stability, surgical techniques, maintenance, oral hygiene*

INTRODUCTION

The anterior mandible plays a crucial role in both oral function and facial aesthetics. Missing teeth in this region can lead to significant challenges, including impaired speech, difficulty chewing, and a compromised smile. Dental implants offer a predictable and long-term solution for replacing missing teeth in the anterior mandible.

Implants function similarly to natural teeth, allowing patients to eat and speak normally. Unlike dentures, fixtures are stable and don't slip or cause discomfort during these activities. Implants provide a natural-looking replacement for missing teeth. They can be precisely positioned and shaped to match surrounding teeth, creating a cosmetically pleasing smile.

Dental fixtures have become a cornerstone of modern dentistry, offering a reliable and long-term solution for tooth replacement. However, successful implantation relies not just on the osseointegration of the implant itself, but also on the health and stability of the surrounding hard and soft tissues. This is where guided bone regeneration (GBR) and eventually grafted mucosa play a crucial role (1).

Peri-implant tissues comprise a complex ecosystem of gums and bone that provide support and protection to the implant. A critical component within this ecosystem is the keratinized gingiva (KG). Adequate width of KG around

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implants is essential for several reasons (2). KG acts as a barrier against bacterial invasion, facilitating proper oral hygiene practices, like brushing. Insufficient width can lead to plaque accumulation, thereby increasing the risk of peri-implantitis, a condition that can result in bone loss and implant failure (3). A healthy band of KG contributes to a natural-looking gumline around the implant crown, improving the overall aesthetics of the implant restoration. Adequate KG provides a cushion for the implant, minimizing discomfort or sensitivity during brushing or flossing.

In some cases, the natural amount of KG around a planned implant site may be insufficient. This can occur due to anatomical factors, previous tooth loss, or gum recession. To address this deficiency, dentists can employ grafted mucosa techniques.

Grafting procedures involve taking a small piece of healthy tissue from another location in the mouth, typically the palate, and transplanting it to the implant site. The grafted tissue then heals and integrates with the surrounding tissues, creating a band of functional and aesthetically pleasing KG (4).

There are various types of grafting procedures used for peri-implant soft tissue augmentation, each with its own advantages and considerations. Common techniques include free gingival graft and connective tissue graft. Free gingival graft is considered the "gold standard" for increasing KG. A thin layer of tissue is harvested from the palate and placed over the implant site. Connective tissue graft utilizes subepithelial connective tissue from the palate to increase the volume of the soft tissue without adding additional KG (5).

The choice of grafting technique depends on the patient's specific needs and the available tissue at the donor site. Studies have shown that grafted KG procedures are highly effective in achieving optimal peri-implant health. By increasing the width of KG, grafting can reduce plaque accumulation and the risk of peri-implantitis, improve implant stability and long-term success, enhance the aesthetics of the implant restoration, and minimize discomfort associated with implant cleaning (6, 7). Grafted KG plays a vital role in optimizing the health and longevity of dental fixtures. By addressing deficiencies in KG, grafting procedures can contribute to successful implantation outcomes, improved patient satisfaction, and a beautiful, functional smile.

Bone loss in the anterior mandible refers to the reduction of bone volume in the front part of the lower jaw. This phenomenon is particularly relevant not only from functional (i.e., chewing, speech) but also from an aesthetic and psychological point of view. Several factors contribute to bone loss in the anterior mandible. One of the primary causes is tooth loss, particularly when it results from trauma, decay, or periodontal disease. When a tooth is lost, the surrounding bone that once supported it can start to resorb or shrink over time. This process is accelerated in the absence of a tooth root, which normally provides stimulation to the jawbone. In cases of prolonged tooth loss or edentulism, the reduced mechanical loading on the jawbone can lead to further bone atrophy. Additionally, factors such as age, hormonal changes, and systemic conditions may also affect bone density in the mandible. Bone loss in the anterior mandible can pose significant challenges for dental treatments, particularly when placing dental implants. Dental implants require a stable and adequate amount of bone for successful integration. When bone loss occurs, it may necessitate additional procedures, such as bone grafting or Guided Bone Regeneration (GBR), to augment bone volume and create a suitable foundation for implant placement (8-20).

GBR is a surgical procedure designed to enhance the growth of bone in areas where it is deficient. During the GBR procedure, a barrier membrane is placed over the deficient bone area to prevent soft tissue ingrowth and allow space for bone regeneration. This membrane acts as a guide, protecting the site from unwanted cells while creating a secluded environment that encourages the growth of new bone. The barrier can be made of various materials, such as resorbable or non-resorbable membranes, and is selected based on the patient's specific needs and the procedure. The primary goal of GBR is to stimulate the body's natural healing processes, facilitating the formation of new bone that is both structurally and functionally similar to the surrounding native bone. This technique is crucial in cases where there is insufficient bone volume due to factors like trauma, periodontal disease, or tooth loss. GBR is often performed in conjunction with bone grafting procedures, where additional bone material may be introduced to further support regeneration. The success of GBR relies on several factors, including the choice of membrane, the patient's overall health, and adherence to postoperative care protocols.

Overall, GBR is a valuable and commonly used approach in oral surgery, enabling clinicians to restore or augment bone volume, thereby improving outcomes in procedures such as dental implant placement. Here, a case of GBR and implant placement is reported, along with a discussion of the relevant literature. In this paper, we describe a case of implant-prosthetic rehabilitation of teeth agenesis in the anterior mandible, with GBR, which ensured a good quality of bone around anterior implants and teeth’s roots.

Case report

A 27-year-old female patient was referred to the dental clinic complaining of poor aesthetics of the Maryland prostheses replacing the teeth 32 and 42 (Fig. 1). In agreement with the patient, it was decided to replace the Maryland bridge with an implant-prosthetic rehabilitation. The patient underwent a cone-beam computed tomography scan and orthopantomography. She claimed neither systemic diseases nor a history of bruxism. The horizontal and vertical prosthetic spaces of the edentulous area were sufficient for implant prosthetics with an anatomical design. However, the bone volume was insufficient in width for complete implantation. Based on the patient's condition, we arranged a one-step surgical procedure of fixture insertion and GBR by means of heterologous bone chips and resorbable membrane.

Before surgery, the patient was informed about the operative risk and complications, and written consent was obtained from the patient for publication of this case report and accompanying images.

Fig. 1. *Frontal view of Maryland bridge to replace missing teeth 32 and 42.*

Under local infiltration anesthesia with articaine, a linear incision was made on the alveolar ridge crest of 32 and 42. The mucosa and periosteum were detached exposing the alveolar bone, and small holes were drilled in the alveolar bone to create retention (Fig. 2) to provide bleeding to guarantee bone graft integration.

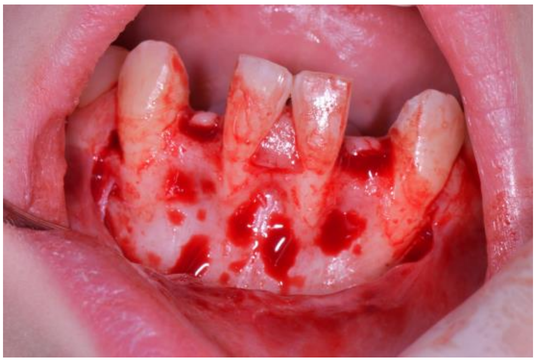

Fig. 2. *Frontal view of surgical field. The alveolar crest is thin, and the tooth roots are partially exposed.*

Implant socket preparation was performed step by step under permanent cooling with 0.9% saline, and two bone-level implants were placed with a final insertion torque of 20 N/cm (Fig. 3).

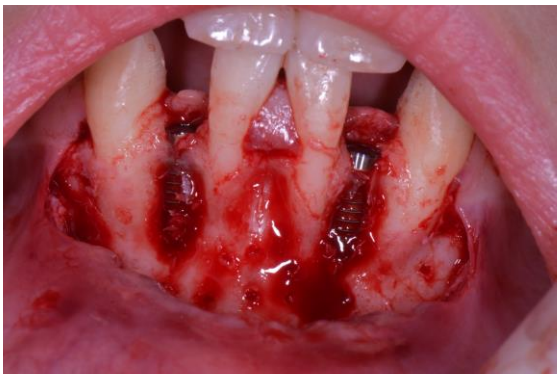

Fig. 3. *Dental fixtures inserted to replace the roots of teeth 32 and 42. Implants are out of the bone in the vestibulum.*

Thereafter, heterologous bone chips were placed on the vestibular side of the alveolar bone crest to cover implants and dental roots. Additionally, a resorbable membrane was used to stabilize the bone graft, which was then fixed in place with titanium pins (Fig. 4). At the end of the GBR surgical procedure the mucosa was sutured (Fig. 5).

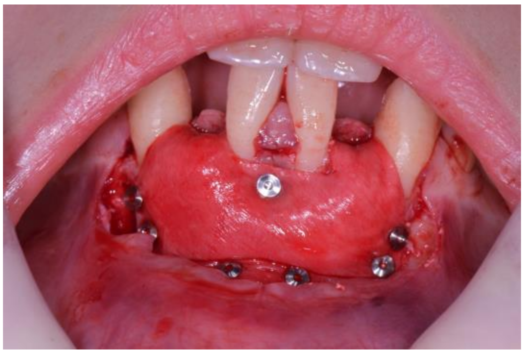

Fig. 4. *The resorbable membrane is secured with pins to stabilize heterologous bone chips.*

Fig. 5. *Sutured mucosa.*

Six months after GBR, the case was finalized with a prosthetic rehabilitation with screw-retained crowns (Fig. 6 and 7). According to radiographic examinations and probe measurements, osseointegration was satisfactory, and the keratinized tissue volume was sufficient for the manufacture of the next-stage prosthesis.

The patient was satisfied with both the healing process and the final outcome, achieving a natural-looking and harmonious smile.

Fig. 6, 7. *Frontal and occlusal view of prosthetic rehabilitation with screw-retained crowns.*

DISCUSSION

The anterior mandible plays a crucial role in facial esthetics and dental function. The loss of a tooth or multiple teeth in this region can significantly impact a patient's self-confidence and oral health. Dental fixtures have revolutionized the field of restorative dentistry, providing a reliable and aesthetically pleasing solution for replacing missing teeth. However, the anterior mandible presents unique challenges due to its thin alveolar bone, proximity to vital structures, and demanding esthetic requirements. Understanding the anatomy of the anterior mandible is essential for successful implant placement. Sometimes, to improve the aesthetics and long-term success of the implants, it is necessary to perform a GBR in one stage to restore an adequate alveolar ridge volume.

In addition, it is of paramount importance to evaluate the quantity and quality of KG around teeth and implants. KG is firmly attached to the underlying bone and is composed of keratinized epithelium, connective tissue, and underlying peri-implant bone. It is thicker and more resistant to mechanical and microbial challenges compared to non-KG. The presence of KG enhances the stability and function of dental fixtures, providing a protective barrier against external irritants. KG plays a vital role in maintaining peri-implant health by reducing inflammation and preventing bacterial migration into the peri-implant sulcus. It helps to minimize the risk of peri-implant diseases, such as peri-implant mucositis and peri-implantitis (21). The presence of KG contributes to the esthetic outcomes of dental implant restorations. It provides a natural-looking gingival contour, harmonizing with the adjacent natural teeth and soft tissues. Adequate KG ensures a seamless transition between the implant and the surrounding gingiva, resulting in a more pleasing smile. KG enhances the stability of dental implants by providing a firm and resistant tissue attachment. It helps to distribute occlusal forces evenly, reducing the risk of implant mobility and bone loss.

Proper maintenance and oral hygiene practices are crucial in preserving the health of KG and ensuring long-term implant success. Regular professional cleanings, plaque control, and patient education are essential components of implant maintenance protocols. KG plays a pivotal role in ensuring peri-implant health, stability, and esthetics. Clinicians should prioritize the preservation or augmentation of KG during implant treatment planning and surgical procedures (22, 23). Future research should focus on investigating the optimal width and height of KG required for long-term implant success. A 10-year prospective comparative study reported that fixtures not surrounded by KG showed a smaller survival rate, as they were more prone to plaque accumulation and soft-tissue recession (24).

Treatment of anterior bone atrophy of the mandible is a challenging problem since that area is particularly relevant not only from functional (i.e., chewing, speech) but also from aesthetic and psychological points of view. Alveolar bone reduction in the aesthetic zone of the mandible is connected with keratinized gingival reduction, which is an additional problem for implant long-term survival.

Some reports described the use of bone blocks for ridge reconstruction (8-12). Steigmann and Coll. (8) reported that a bovine-bone mineral block was used to treat a severe horizontal and vertical anterior ridge deficiency. Such a block can be shaped to conform to the defect, thereby avoiding the need for harvesting autogenous bone or fixing the block with screws. After a 6-month integration period, an implant was placed. Six months later, the implant was restored with a single crown. The case has been followed for 3 years.

Moon and Coll. (9) assess the efficacy of the piezoelectric sandwich osteotomy for vertical augmentation in the atrophic segment of the anterior mandible through clinical and histologic studies. Interpositional mineral allograft materials were inserted in the space between the basal bone and the segmented bone with favorable results. Felice and Coll. (10) reported a case treated with inlay augmentation procedure with resorbable bone plates and fixation screws, showing that the effectiveness of resorbable plates during the graft healing process is similar to that of titanium plates. Chaushu and Coll. (11) evaluated the application of allograft cancellous bone blocks for the augmentation of the anterior atrophic mandible, demonstrating that cancellous bone block allografts for the reconstruction of partial edentulism in the anterior mandible are a promising material. Mangano and Coll. (12) documented the clinical, radiographic, and histologic outcome of a custom-made computer-aided-design/computer-aided-manufacturing (CAD/CAM) scaffold used for the alveolar ridge augmentation of a severely atrophic anterior mandible. A custom-made scaffold was milled from a synthetic micro-macro-porous biphasic calcium phosphate block. The scaffold closely matched the shape of the defect, which helped reduce the time required for surgery and contributed to good healing. One year later, the newly formed and well-integrated bone was clinically available, and two implants were placed. The histologic samples retrieved from the implant sites revealed compact mature bone undergoing remodeling, marrow spaces, and newly formed trabecular bone surrounded by residual particles.

Other surgical procedures were also used (13-17). Cohen and Coll. (13) reported the outcome of four cases with localized vertical osseous deficits in the anterior mandible, treated by using a technique that utilized the bony defect's margins through a vestibular approach to wedge inlay grafts without additional fixation or distraction hardware, thus overcoming the surgical difficulties and achieving a favorable outcome.

Uehara and Coll. (14) retrospectively evaluated the success rate of staged localized alveolar ridge augmentation using titanium micromesh. To verify their hypothesis, the authors treated twenty-three alveolar ridges using titanium micromesh and were retrospectively assessed. This limited study suggested that the predictability of augmented bone volume in staged alveolar ridge augmentation using titanium micromesh was insufficient to ensure an ideal and planned implant placement. The success was influenced by the distance of the augmentation site and the infection of the graft material, which were associated with moderate to severe vertical ridge resorption and/or mechanical and functional loading on the surgical site.

Chan and Coll. (15) reported the outcomes of interpositional osteotomy with mineralized allograft in the treatment of alveolar vertical defects in preparation for implant placement. Thirteen defects were treated with osteotomy segments ranging in length from two to five missing teeth. The segments were positioned 5-7 mm coronally, with the gap space filled with allograft and then fixated with titanium hardware. Vertical bone augmentation was analyzed by superimposing pre- and post-surgical cone beam computed tomography images and stratified based on the length and number of missing teeth in each edentulous segment. Mampilly and Coll. (16) reported six patients treated with a stainless steel vertical alveolar distraction device to augment the atrophic anterior mandibular ridge. Parthiban and Coll. (17) reported a case treated with a contemporary application of platelet-rich fibrin membrane, ridge split technique, and simultaneous implant placement.

Other authors focused on soft tissue procedures (18, 19). Adams and Coll. (18) utilized a pre-prosthetic mucosal flap combined with a re-positional periosteal flap concomitant with an alveoloplasty and placement of endosteal implants as a single-stage procedure in the anterior mandible. This approach (i.e., a lip switch vestibuloplasty combined with placement of two implants) provides a valued alternative for dental rehabilitation in patients with poor masticatory efficiency using a conventional denture. Urban and Coll. (19) described a novel surgical approach for releasing the lingual flap, which can help clinicians achieve primary closure without incurring intraoperative complications.

In our case, the quantity of KG was adequate; however, there was a need for implant insertion and GBR in a single stage. The surgical procedure has several key points, among them the freedom of soft tissue to completely cover the graft at the end of the procedure. Achieving natural-looking and harmonious restorations is crucial in the anterior mandible, given the various restorative options available, including single crowns, implant-supported bridges, and implant-supported removable prostheses. The importance of proper implant-abutment selection, emergence profile, and management of both hard and soft tissues is emphasized to achieve optimal aesthetic results. Furthermore, the role of patient-related factors, such as oral hygiene, smoking habits, and systemic diseases, must also be considered.

CONCLUSIONS

While the efficacy of GBR is well-established, ongoing research continues to explore ways to improve the techniques and materials used. This includes investigating the potential of alternative membranes and heterologous bone, as well as the development of minimally invasive grafting procedures. Additionally, ongoing research aims to better understand the long-term effects of grafting on peri-implant health and patient outcomes.

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Case reports

LOCALIZED BONE REGENERATION WITH PORCINE BONE: 18-YEAR FOLLOW-UP

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ABSTRACT

The presence of localised bone defects in the alveolar processes can prevent the use of implants, due to insufficient bone volume for osseointegration. Localised bone resorption can also prevent a good aesthetic result due to poor soft tissue support. Autologous bone grafting is considered the gold standard, but it has disadvantages for the patient, such as a donor site and the risk of morbidity. The use of alloplastic, allogenic, or xenogenic grafts has therefore become a very attractive alternative. A recent study conducted on the maxilla of rabbits has shown that porcine bone grafting exhibits strong osteoconductive properties and, over time, is remodelled and replaced with new bone. The aim of this study is to describe a technique designed to reconstruct a bone volume suitable for implant placement and, therefore, capable of supporting soft tissues in order to achieve an adequate aesthetic result with an 18-year follow-up of prosthetic loading. Bone augmentation was also evaluated from a histological point of view at the time of dental implant placement.

KEYWORDS: *dental implants, bone regeneration, xenogeneic grafts, porcine bone*

INTRODUCTION

Adequate bone volume is a fundamental prerequisite for successful implant placement, ensuring functional, aesthetic, and prosthetic rehabilitation. Clinical and histological studies in both animals and humans have demonstrated that spontaneous healing of post-extraction sockets initiates a physiological process resulting in bone remodeling and resorption, which is more pronounced on the buccal side than on the palatal or lingual aspects (1-3).

In 1996, Buser et al. (4) introduced the concept of Guided Bone Regeneration (GBR) to address the loss of alveolar bone. The aim of GBR is to promote new bone formation in ridge defects, either prior to or simultaneously with implant placement. GBR relies on creating a favorable environment that supports the natural regeneration of bone tissue (5-7). Critical factors in establishing this environment include stabilization of the blood clot, prevention of acute inflammation due to bacterial infection, and the creation and maintenance of a space filled with the clot (8-9).

Both resorbable and non-resorbable barrier membranes have been successfully employed in bone regeneration for many years. Their primary function is to exclude soft tissue cells from the mucosa, thereby allowing osteogenic cells from surrounding tissues to repopulate the defect. However, most membranes alone are insufficient to maintain a stable

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space conducive to bone formation. While autologous bone grafts, in block or particulate form, remain the gold standard for ridge augmentation (10-11), alternative grafting materials, including xenografts (12-13), alloplastic grafts (14-15), and allografts (16), have been extensively studied. The use of alternative materials is driven by the desire to eliminate the need for a second surgical site, thereby reducing procedural invasiveness and postoperative morbidity. A recent study on rabbit maxillae confirmed that porcine-derived bone grafts exhibit strong osteoconductive properties and are gradually resorbed and replaced by new bone over time (17).

The aim of this study is to report on the clinical, radiographic, and histological outcomes observed following the use of porcine bone granules (Osteobiol Gen-Os, Tecnoss, Italy), mixed with collagen gel and covered with a thin cortical lamina, six months after the regenerative procedure. Long-term clinical and radiographic outcomes are also assessed after 18 years of prosthetic loading (18).

MATERIALS AND METHODS

In February 2007, two patients were recruited who had a horizontal and, in part, vertical bone defect in the upper first premolar. Since both bone defects were quite extensive, it was decided to carry out the regeneration procedure in two stages: bone regeneration, followed by a six-month waiting period, and then implant insertion with a healing period of at least four months before reopening and abutment placement. The area to be regenerated was filled with a mixture of collagen gel (OsteoBiol Gel 0, Tecnoss, Italy) mixed with collagenated bone of porcine origin (OsteoBiol Gen-Os, Tecnoss, Italy). This particular mixture has allowed for better control of the grafting, thanks to the greater malleability of the product obtained and its particular adhesiveness.

The main purpose of the proposed protocol was to maintain adequate space for new bone regeneration, which was achieved by using a support screw beneath a cortical bone plate (OsteoBiol Soft Cortical Lamina, Tecnoss, Italy). The latter was stabilised on the vestibular side with two mini osteosynthesis screws (length 5 mm, diameter 1.2 mm; Graftek fixation screws, Roen), while on the palatal side, it was positioned below the mucoperiosteal flap.

After six months, at the end of the healing period, a bimodal surface implant with positive tolerance geometry and a taper of approximately 1° (Neoss Italia) was inserted (19). After implant placement, at the time of reopening and before positioning the final abutment, the ISQ (implant stability quotient, Osstell Mentor) value was measured, i.e., the resonance frequency value, which is related to the stiffness of the bone-titanium interface.

The implant site was prepared using a Trephine drill (Maillefer) with an internal diameter of 2 mm and an external diameter of 3 mm. The drill, containing the extracted bone, was immersed in a 4% buffered formaldehyde solution and sent to the Department of Biomaterials at the Institute of Surgical Sciences (Sahlgrenska Academy, Gothenburg University, Sweden) for histological evaluation. The samples were then dehydrated with successive steps in different alcohol gradients and subsequently embedded in photopolymerisable resin. Sections of approximately 10-15 µm were cut using a saw and a grinder, stained with toluidine blue, and observed under a microscope.

First case

A 56-year-old female patient with edentulism in zone 1.4 presents with both vertical and horizontal bone defects. Consequently, it is decided to perform bone defect reconstruction using GBR prior to implant placement (Fig. 1).

Under local anaesthesia (2% lidocaine with 1:80,000 epinephrine), a full-thickness vestibular flap is designed in order to expose the bone defect completely. After carefully cleaning the bone surface of any periosteal residue, the vestibular cortical bone of the recipient site was perforated with a ball bur to induce bleeding and promote the incorporation and vascularisation of the graft material (Fig. 2).

Fig. 1. *Pre-operative radiograph.*

Fig. 2. *Intraoperative view of the bone defect.*

A support screw is inserted on the occlusal side of the recipient site in order to create a tenting effect and thus prevent the barrier membrane from collapsing. The site is then filled with OsteoBiol Gen-Os mixed with collagen gel (OsteoBiol Gel 0) to make the product denser and stickier, thereby facilitating its positioning (Fig. 3).

A thin cortical lamina (OsteoBiol Lamina Soft) is moulded over the graft material and stabilised to the bone using two fixation screws on the vestibular side apically to the defect itself, while on the palatal side, the lamina is adapted to the bone surface below the mucoperiosteal flap (Fig. 4).

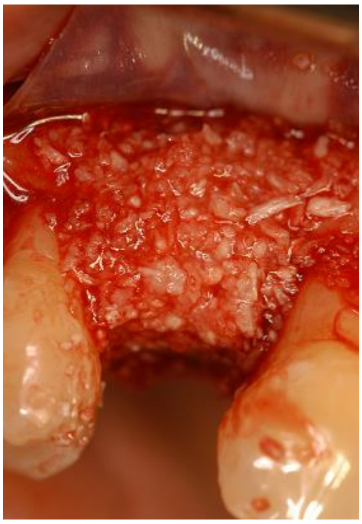

Fig. 3. *Defect filled with Osteobiol graft material.*

Fig. 4. *Placement of membrane with fixation screws.*

Before suturing, a fenestration of the periosteum is performed at the base of the vestibular flap in order to achieve a tension-free adaptation of the wound margins. The wound is closed with horizontal mattress sutures and separate stitches. The patient was called back weekly for follow-up visits.

At the end of the third week, partial exposure of the osteosynthesis screw head was noted, which was nevertheless maintained. The patient was advised to apply chlorhexidine gel daily. After six months, at the surgical follow-up, no residual lamina or biomaterial granules were detected, but rather compact and well-vascularised new bone formation. The partial exposure of the upper head of the fixation screw indicates that there has been minimal vertical resorption of the graft material (Fig. 5).

The increase in crest height was quantifiable as 5 mm horizontally and 4 mm vertically. Once the screw was removed, a small portion of the regenerated bone was taken for histological examination using a 3 mm external diameter drill bit (Fig. 6).

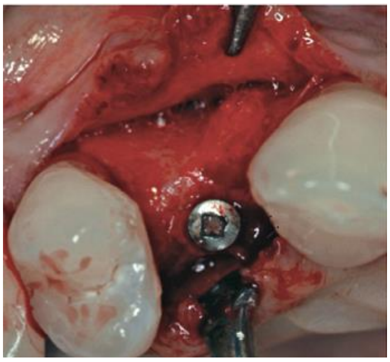

Fig. 5. *Bone regeneration observed at surgical re-entry, six months postoperatively.*

Fig. 6. *Histological result from the implant insertion site: Biopsy performed at 5 months shows mature bone. Bone substitute particles (*) are barely distinguishable from newly formed bone. (Scale bar = 200 µm).*

Subsequently, the preparation of the implant socket was completed, and a 13 mm long, 4 mm diameter implant (Neoss Ltd, Harrogate, UK) was inserted, achieving good primary stability (ISQ 71). A 3 mm high transgingival healing cap made of PEEK (polyetheretherketone) is immediately inserted to manage the soft tissues and avoid further surgery.

After a five-month healing period, implant stability was reassessed (ISQ 78); the X-ray examination showed that the implant was well integrated into the basal bone. Subsequently, the implant was restored with a gold-ceramic crown (Fig. 7, 8).

Fig. 7. *Clinical view at prosthetic delivery.*

Fig. 8. *Radiograph at the time of prosthetic delivery.*

Second case

A 38-year-old female patient presented to our clinic with traumatic avulsion of tooth 2.4 (Fig. 9). The residual area showed a severe horizontal and vertical defect and, in particular, a loss of attachment of approximately 7 mm, mesially to tooth 2.5. As per protocol, the area was anaesthetised and skeletonised and, after drilling holes in the bone to be grafted, a regeneration screw (Memphix, Straumann) was placed, with a smooth part of 5 mm outside the bone (Fig. 10). A soft cortical lamina (OsteoBiol Lamina, Tecnoss) was moulded and fixed with two mini screws (5 mm long and 1.2 mm in diameter, Graftek fixation screws, Roen) vestibularly to the defect. After the cortical lamina had been properly adjusted, the defect was filled with a mixture of collagen and bone (OsteoBiol Gen-Os, Tecnoss) and then covered with the cortical lamina (Fig. 11).

Fig. 9. *Pre-operative radiograph.*

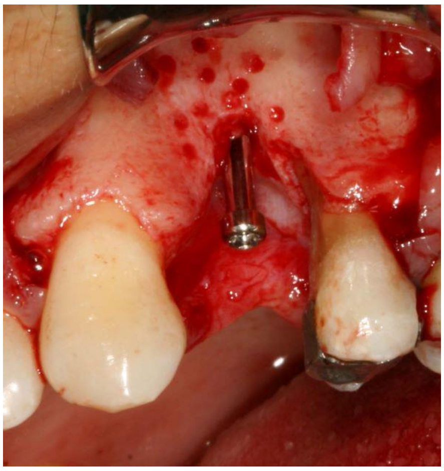

Fig. 10. *Placement of a tenting screw to facilitate space maintenance during regeneration.*

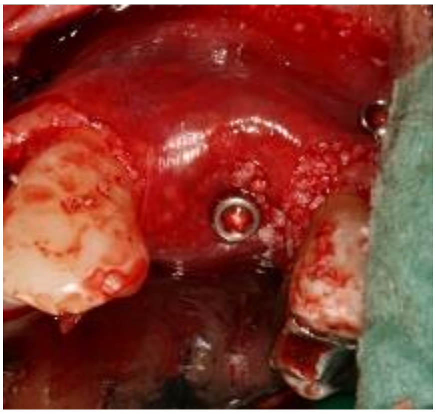

Fig. 11. *Cortical bone lamina fixed to the buccal side, covering the graft.*

The release of the flap with a periosteal incision and the use of mattress sutures allowed the flap to be closed and the graft to be covered throughout the healing period. After a seven-month waiting period, with no symptoms or signs of inflammation or infection, the flap was reopened, the screws were removed, and the implant site was prepared with a Trephine drill.

For histological evaluations, bone sampling is performed. The site was refined using a 3.2 mm diameter drill. A Neoss implant (length 13 mm and diameter 4 mm) was inserted, achieving excellent primary stability (ISQ 77). Bone measurements showed an increase of 5 mm vertically and 4 mm horizontally; in addition, mesially to the second premolar, a localised attachment gain was noted (Fig. 12).

After five months, the site was reopened, a zirconium abutment and a temporary crown were immediately placed, and an increase in resonance frequency values (ISQ 81) was measured. After four months, a permanent zirconium and ceramic crown was cemented. The final intraoral X-ray confirms the increase in bone growth (Fig. 13, 14).

Histological examination of the bone biopsy from the site shows well-incorporated bone substitute particles and dense bone (Fig. 15).

Fig. 12. *Surgical re-entry at 7 months: a horizontal and vertical bone gain of 5 mm is noted, along with improved attachment mesial to tooth 25.*

Fig. 13. *Clinical view of the zirconia crown one-year post-grafting.*

Fig. 14. *Radiograph 18 months after grafting.*

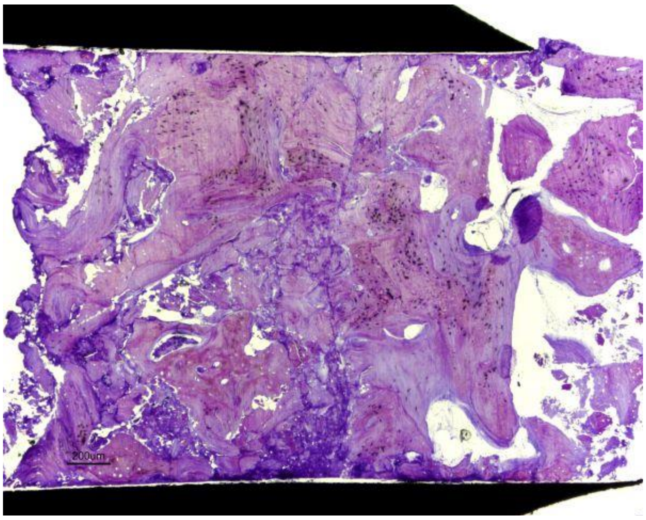

Fig. 15. *Histological result: presence of dense mature bone with visible bone substitute particles (*). (Scale bar = 200 µm).*

DISCUSSION

The original aim of the study was to evaluate the clinical, radiological and histological results obtained six months after regenerative surgery using a mixture of collagen gel (OsteoBiol Gel 0, Tecnoss) combined with collagenated bone of porcine origin (OsteoBiol Gen-Os, Tecnoss) as a filling material in combination with a cortical bone lamella (OsteoBiol Lamina Corticale Soft, Tecnoss). In both cases, there was an increase in bone ridges, both vertically and horizontally, of approximately 4-5 mm and an increase in the volume of local soft tissue, which allowed the implants to be inserted in an appropriate position, satisfying both functional and aesthetic criteria. There were no complications, except in one of the two cases, where, after approximately three weeks, partial exposure of the head of the osteosynthesis screw occurred. However, this did not cause any inflammatory or infectious reaction and did not affect bone healing. These data demonstrate the optimal biocompatibility of the materials used.

A comparison of the ISQ values at the time of implant placement and at the time of abutment placement after ten months showed a significant increase in both cases (first case: from 71 to 78; second case: from 77 to 81), indicating that a clear process of bone remodelling had taken place, leading to greater densification and maturation of the new bone tissue.

The results of histological examinations performed six months after GBR showed the presence of mature bone. Furthermore, the porcine bone particles were well incorporated and difficult to distinguish from native bone. In some areas, remodelling was observed with partial resorption of the particles and the formation of new bone. Particles without bone contact could occasionally be seen in the deepest areas of the two biopsies.

Similar data were also reported by Nannmark and Sennerby (17) in an animal model. The authors evaluated bone tissue responses to PCPB, with or without collagen gel, covered with a collagen membrane (OsteoBiol Evolution, Tecnoss). Histological examinations performed at eight weeks showed active resorption of the materials, the presence of mature bone and revascularisation of the mineralised part and soft tissue, and finally that the collagen membrane was undergoing active degradation.

After 18 years of prosthetic loading, during which the two patients examined did not experience any complications, radiological examination showed that the crestal bone levels remained unchanged. (Fig. 16, 17).

Fig. 16. *Radiographic follow-up of Case One at 18 years of prosthetic loading.*

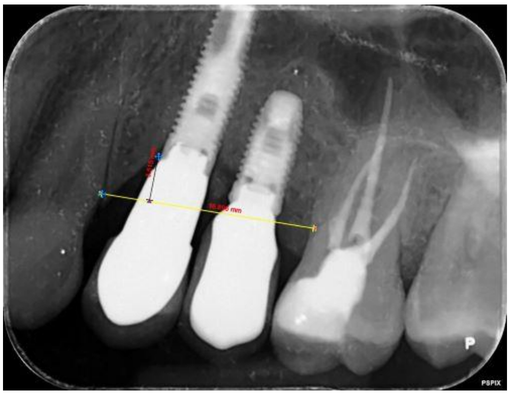

Fig. 17. *Radiographic follow-up of Case Two at 18 years, showing excellent stability of the bone tissues. Over time, a post-extraction implant was placed at site 25 with maxillary sinus lift via a crestal approach using the "Rialto" technique.*

CONCLUSIONS

This study has provided clinical, histological, and radiological evidence in humans of the regenerative potential of the combination of the three materials used (OsteoBiol Gel 0, OsteoBiol Gen-Os, OsteoBiol Soft Cortical Lamina, Tecnoss) after 18 years of functional loading.

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Review

A COMPREHENSIVE NARRATIVE REVIEW OF TEMPOROMANDIBULAR JOINT CONDYLAR FRACTURES: ETIOLOGY, CLASSIFICATION, DIAGNOSIS, AND CONTEMPORARY MANAGEMENT STRATEGIES

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ABSTRACT

This narrative review aims to provide a comprehensive overview of temporomandibular joint (TMJ) condylar fractures, focusing on their etiology, classification, diagnostic approaches, and contemporary management strategies. The narrative synthesis encompasses current literature, emerging trends, and challenges in the field to guide clinicians and researchers in understanding the complexities associated with TMJ condylar fractures. A systematic search of databases, including PubMed, Scopus, and Lilacs, was conducted to identify pertinent articles published from inception to the present. The selected studies were screened for their contribution to the understanding of TMJ condylar fractures, and critical findings were synthesized to create a narrative overview. The etiology of TMJ condylar fractures involves a diverse range of traumatic incidents, including motor vehicle accidents, falls, and interpersonal violence. Comprehensive classification systems have been developed to categorize these fractures based on anatomical location, displacement, and associated injuries. Diagnostic modalities, such as clinical examination, radiography, and advanced imaging techniques, play pivotal roles in accurate assessment. The review outlines contemporary management strategies, including conservative approaches, open reduction and internal fixation (ORIF), and emerging technologies like 3D printing for personalized treatment plans. Additionally, the narrative explores the importance of rehabilitation and long-term follow- up in achieving optimal outcomes. This narrative review provides a holistic perspective on TMJ condylar fractures, encompassing their etiology, classification, diagnosis, and contemporary management strategies. Clinicians and researchers can use this comprehensive overview to enhance their understanding of these fractures, facilitating improved patient care and guiding future research endeavors in this evolving field.

KEYWORDS: *temporomandibular disorders, temporomandibular joint, TMD, TMJ, condylar fractures*

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INTRODUCTION

The temporomandibular joint (TMJ) is a pivotal and intricate component of the craniofacial anatomy, facilitating essential functions such as mastication, speech, and facial expression. Among the myriad challenges afflicting this crucial joint, condylar fractures stand out as a complex and multifaceted issue, demanding a nuanced understanding of effective management. As a typical sequel to traumatic injuries, these fractures not only pose immediate concerns for patients but can also have far-reaching implications on the long-term function and aesthetics of the craniofacial region (1, 2).

This narrative review embarks on a comprehensive exploration of temporomandibular joint condylar fractures, delving into the intricacies of their etiology, classification, clinical presentation, and contemporary management strategies. By synthesizing current research, clinical experiences, and evolving treatment paradigms, this review aims to provide a holistic perspective on the challenges posed by condylar fractures and the dynamic landscape of therapeutic interventions.

Throughout the narrative, we will navigate the historical evolution of understanding TMJ condylar fractures, addressing the shifting paradigms in their diagnosis and treatment (3). We will explore the impact of advancements in imaging modalities, surgical techniques, and the integration of emerging technologies in reshaping the landscape of patient care. Additionally, our journey will unravel the intricate interplay between anatomical considerations, biomechanics, and patient-specific factors that influence the diverse clinical presentations and outcomes associated with TMJ condylar fractures (4).

As we embark on this exploration, it is our endeavor to provide a comprehensive overview of the current state of knowledge and stimulate dialogue and reflection within the medical and dental communities (5-7). By fostering a deeper understanding of temporomandibular joint condylar fractures, we aim to contribute to the ongoing refinement of clinical approaches, ultimately enhancing the quality of care provided to individuals grappling with this intricate facet of craniofacial trauma (5).

In pursuing this comprehensive review, we will scrutinize the various classifications of TMJ condylar fractures, acknowledging the importance of precision in characterizing these injuries for optimal treatment planning. From simple fractures amenable to conservative measures to complex fractures requiring surgical intervention, each subclassification poses unique challenges and considerations that demand the clinician's attention. We will delve into the intricacies of diagnostic modalities, emphasizing the role of advanced imaging techniques, such as cone-beam computed tomography (CBCT) and magnetic resonance imaging (MRI), in enhancing our ability to assess the extent of the injury (8) precisely. An essential facet of this exploration involves an in-depth analysis of the clinical manifestations associated with TMJ condylar fractures. Beyond the immediate pain and dysfunction, we will scrutinize the impact on occlusion, mandibular mobility, and the potential development of temporomandibular joint disorders (TMDs). Understanding the spectrum of presentations is paramount for tailoring individualized treatment plans that address the acute and long-term consequences of these fractures (8).

As we progress, the review will scrutinize the dynamic landscape of therapeutic interventions, encompassing conservative measures, such as intermaxillary fixation and physical therapy, as well as surgical approaches ranging from open reduction and internal fixation (ORIF) to emerging minimally invasive techniques. The evolving role of tissue engineering and regenerative medicine in promoting functional recovery and mitigating long-term sequelae will also be explored, highlighting the potential for cutting-edge innovations to redefine the treatment paradigm for TMJ condylar fractures (9).

In traversing the historical, diagnostic, and therapeutic dimensions of temporomandibular joint condylar fractures, this narrative review aspires to consolidate existing knowledge and stimulate further research and collaboration. By fostering a comprehensive understanding of these fractures, we endeavor to empower clinicians, researchers, and educators to contribute to the evolution of best practices, ultimately improving the quality of care and outcomes for individuals navigating the intricate challenges of TMJ condylar fractures (10).

This review thoroughly explores condylar fractures in the temporomandibular joint (TMJ). It concentrates on elucidating their origins, classification, diagnostic methods, and modern approaches to management. The synthesis of this narrative incorporates up-to-date literature, emerging patterns, and the challenges encountered in the realm, aiming to assist clinicians and researchers in comprehending the intricate aspects associated with TMJ condylar fractures.

MATERIALS AND METHODS

Search strategy

A comprehensive literature search was conducted to identify relevant articles about temporomandibular joint (TMJ) condylar fractures. The following electronic databases were searched: PubMed/MEDLINE, Scopus, and Lilacs. The search strategy included keywords such as "temporomandibular joint," "condylar fractures," "mandibular fractures," and related terms. Boolean operators (AND, OR) were used to refine the search and ensure inclusivity (Table I).

Table I. *Search strategy.*

PubMed *Search: temporomandibular joint AND condylar fractures AND mandibular fractures*
Scopus *TITLE-ABS-KEY (temporomandibular joint AND condylar fractures AND mandibular fractures)*
Lilacs *ALL=(temporomandibular joint)) AND ALL=(condylar fractures) AND ALL= (mandibular fractures)*

Inclusion and exclusion criteria

Articles were included if they met the following criteria:

- Published in English.
- Primary focus on temporomandibular joint condylar fractures.
- Included diagnosis, classification, treatment modalities, outcomes, and information on complications.

The exclusion criteria were as follows:

- Non-English language articles.
- Irrelevant to temporomandibular joint condylar fractures.
- Duplicate publications.

Study selection

Two independent reviewers screened the titles and abstracts of identified articles to assess their relevance. Full texts of potentially relevant articles were then examined to determine eligibility based on the inclusion and exclusion criteria. Any discrepancies between the reviewers were resolved through discussion and, if necessary, consultation with a third reviewer.

Data extraction

Data were extracted from eligible articles using a standardized form. Key information included study design, sample size, patient demographics, fracture classifications, diagnostic methods, treatment approaches, and outcomes. Emphasis was placed on recent and high-impact studies and those providing novel insights or perspectives.

Data synthesis and analysis

Due to the narrative nature of this review, a formal meta-analysis was not conducted. Instead, findings from the included studies were synthesized and presented thematically. Emphasis was placed on identifying trends, controversies, and gaps in the existing literature related to diagnosing and managing temporomandibular joint condylar fractures. Fig. 1 explains the results of this narrative review.

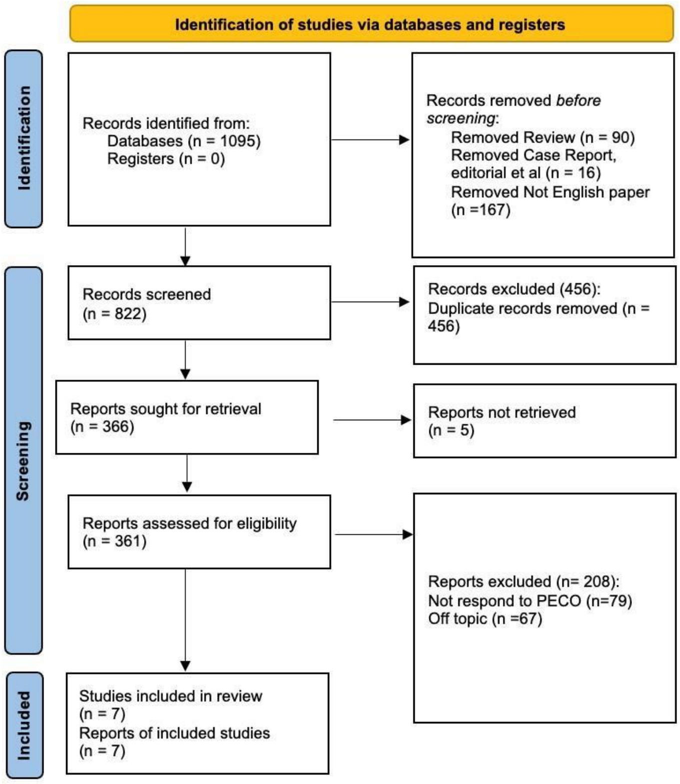

Fig. 1. *Prisma flowchart.*

RESULTS

Classification of TMJ condylar fractures

TMJ condylar fractures are commonly classified based on the extent and location of the fracture. The traditional classification divides condylar fractures into subgroups such as intracapsular and extracapsular fractures. However, more recent classifications consider the specific anatomical location and severity of the fracture, providing a more nuanced understanding that aids in treatment planning (11-13).

Diagnostic modalities

Accurate diagnosis is crucial for appropriate management. Imaging modalities, including conventional radiography, computed tomography (CT), and magnetic resonance imaging (MRI), play pivotal roles in assessing the extent and displacement of condylar fractures. Recent advancements in three-dimensional imaging have further enhanced the precision of diagnosis, allowing for better preoperative planning (14).

Treatment modalities

The management of TMJ condylar fractures has evolved significantly over the years. While conservative approaches such as closed reduction and intermaxillary fixation were once prevalent, surgical interventions have gained prominence, particularly in cases of displaced or complex fractures. Open reduction and internal fixation (ORIF) techniques, including mini plates and screws, have demonstrated favorable outcomes, promoting early functional recovery and reducing the risk of long-term complications (10, 15, 16).

Outcomes and complications

Studies assessing the outcomes of different treatment modalities have reported varying success rates. While surgical interventions generally result in satisfactory functional and aesthetic outcomes, complications such as infection, malocclusion, and hardware-related issues are not uncommon. Long-term follow-up studies are crucial to understanding the durability of the interventions and the potential for late-onset complications.

DISCUSSION

The temporomandibular joint (TMJ) is a complex and crucial hinge that connects the jawbone to the skull, facilitating essential functions such as chewing, speaking, and facial expressions. While it plays a pivotal role in daily activities, the TMJ is susceptible to a range of injuries, with condylar fractures emerging as a noteworthy concern. Temporomandibular joint condylar fractures present a multifaceted clinical challenge that demands a nuanced understanding of their causes, symptoms, diagnosis, and treatment modalities.

The term "condylar fracture" refers to a break in the condylar region of the mandible, the lower jawbone's rounded, knob-like prominence that articulates with the skull's temporal bone. These fractures can result from a variety of traumatic events, including automobile accidents, falls, or sports-related injuries. Furthermore, the condylar region is particularly vulnerable due to its anatomical characteristics and biomechanical functions. It is crucial to delve into the intricacies of TMJ anatomy and its role in oral health (17).

To comprehend temporomandibular joint condylar fractures comprehensively, it is imperative to explore the underlying anatomy of the TMJ. The temporomandibular joint comprises several components, with the condyle being a vital element. Situated at the lower end of the mandible, the condyle interacts with the temporal bone's glenoid fossa to facilitate smooth jaw movement. Ligaments, muscles, and a disc within the joint further contribute to its intricate functioning. This biomechanical complexity makes the TMJ susceptible to a range of injuries, particularly in the condylar region, where fractures can disrupt the delicate balance of the joint (18).

The causes of temporomandibular joint condylar fractures are diverse, often stemming from traumatic incidents that exert significant force on the jaw. Motor vehicle accidents falls from heights, and sports-related injuries are common scenarios that can lead to condylar fractures (11). Understanding the mechanisms behind these fractures is essential for prevention and effective management. Furthermore, certain medical conditions, such as osteoporosis, may weaken the bone structure, increasing the susceptibility to fractures even with minor trauma. Exploring the interplay of external forces and internal vulnerabilities provides a comprehensive perspective on the etiology of temporomandibular joint condylar fractures.

Recognizing the symptoms associated with condylar fractures is crucial for timely diagnosis and intervention. Patients with these fractures often experience pain, swelling, and restricted jaw movement. As the condyle is integral to the joint's articulation, fractures can lead to abnormalities in jaw function, affecting everyday activities like chewing and speaking. Additionally, patients may report clicking or popping sounds in the joint, further underscoring the need for a detailed examination. Understanding these symptoms and their variations is pivotal for healthcare professionals to accurately diagnose temporomandibular joint condylar fractures and formulate tailored treatment plans (19).

Diagnosing temporomandibular joint condylar fractures involves a combination of clinical evaluation, imaging studies, and advanced diagnostic tools. Clinical assessment includes a thorough examination of the patient's medical history, a physical examination of the jaw, and an evaluation of symptoms. Imaging studies, such as X-rays and computed tomography (CT) scans, play a crucial role in visualizing the extent and nature of the fracture. These diagnostic modalities enable healthcare providers to make informed decisions regarding the most appropriate course of treatment.

Treatment options for temporomandibular joint condylar fractures are diverse, ranging from conservative approaches to surgical interventions. Treatment choice depends on various factors, including the severity of the fracture, the patient's overall health, and individualized considerations. Conservative management may involve immobilizing the jaw through orthodontic appliances or intermaxillary fixation, allowing the fracture to heal without surgical intervention. Surgical options, on the other hand, may include open reduction and internal fixation (ORIF), where the fractured segments are repositioned and stabilized using screws, plates, or other hardware.

In conclusion, temporomandibular joint condylar fractures represent a significant clinical entity that requires a comprehensive understanding of their anatomy, causes, symptoms, diagnosis, and treatment options (20). As the delicate balance of the TMJ is disrupted by these fractures, healthcare professionals must navigate the intricate interplay of external forces and internal vulnerabilities to provide optimal care. This article aims to delve into the depths of temporomandibular joint condylar fractures, offering a valuable resource for healthcare practitioners and individuals seeking insights into this complex facet of oral health (21). Through thoroughly exploring the subject, we aim to shed light on the nuances of these fractures and contribute to a greater awareness of their impact on individuals' lives and the broader field of maxillofacial medicine.

Temporomandibular joint (TMJ) condylar fractures are complex injuries that require careful management to prevent long-term complications (17). The treatment options for mandibular condyle fractures have been the subject of extensive research and a systematic review and meta-analysis, highlighting temporomandibular joint prosthesis as a viable treatment option for mandibular condyle fractures. This emphasizes the importance of considering joint prostheses as a potential intervention in managing such fractures. Furthermore, the influence of impacted mandibular third molars on mandibular angle and condyle fractures has been investigated. Their findings revealed a significant association between impacted third molars and condyle fractures, shedding light on a potential risk factor that should be considered in assessing and managing these fractures. The surgical management of condylar head fractures has been a topic of controversy. This controversy underscores the need for further research to establish consensus and best practices in the surgical treatment of condylar head fractures to minimize post-traumatic TMJ ankylosis. In the context of pediatric patients, the implications of combined symphyseal-condylar fractures on TMJ function, facial growth, and long-term dental development were emphasized. This underscores the importance of tailored approaches for pediatric patients with combined fractures to mitigate potential long-term consequences. We conducted a retrospective chart review on pediatric patients with mandibular condylar fractures, providing valuable insights into treating these fractures in pediatric populations (15, 22, 23). Understanding the specific considerations for pediatric condylar fractures is crucial for optimizing treatment outcomes in this patient group. In addition, the clinical significance of condyle-fossa relationships in the temporomandibular joint has been controversial (12, 14, 20, 24, 25). This highlights the need for further research to elucidate the clinical implications of condyle-fossa relationships in the context of temporomandibular joint dysfunction. In summary, managing temporomandibular joint condylar fractures is a multifaceted area that requires a comprehensive understanding of risk factors, treatment options, and long-term implications. The existing literature provides valuable insights into various aspects of these fractures, emphasizing the need for further research to optimize treatment strategies and improve patient outcomes.

Managing temporomandibular joint (TMJ) condylar fractures is critical to oral and maxillofacial surgery. The treatment options for these fractures have been the subject of extensive research. We conducted a systematic review and meta-analysis, highlighting temporomandibular joint prosthesis as a viable treatment option for mandibular condyle fractures (15). This emphasizes the importance of considering joint prostheses as a potential intervention in managing such fractures. Furthermore, the influence of impacted mandibular third molars on mandibular angle and condyle fractures was investigated. Their findings revealed a significant association between impacted third molars and condyle fractures, shedding light on a potential risk factor that should be considered in assessing and managing these fractures and, in the context of pediatric patients, emphasizing the implications of combined symphyseal-condylar fractures on TMJ function, facial growth, and long-term dental development. This underscores the importance of tailored approaches for pediatric patients with combined fractures to mitigate potential long-term consequences. In summary, the existing literature provides valuable insights into various aspects of TMJ condylar fractures, emphasizing the need for further research to optimize treatment strategies and improve patient outcomes, especially in pediatric populations.

CONCLUSIONS

In conclusion, this narrative review has delved into the intricate and multifaceted realm of temporomandibular joint (TMJ) condylar fractures. By comprehensively exploring the current literature, we have gained insights into the various classifications, diagnostic modalities, and treatment approaches for this complex pathology. The diverse nature of condylar fractures, ranging from conservative management to surgical interventions, underscores the importance of a tailored approach based on individual patient characteristics.

As we navigate the nuanced landscape of TMJ condylar fractures, it becomes evident that the optimal management strategy requires a delicate balance between preserving joint function and achieving anatomical restoration. The advancements in imaging techniques and surgical technologies have enhanced our ability to accurately diagnose and treat these fractures, fostering improved outcomes and minimizing complications.

Nevertheless, challenges persist in patient-specific factors, such as age, comorbidities, and associated injuries, which necessitate a nuanced and personalized treatment plan. Collaborative efforts among oral and maxillofacial surgeons, orthodontists, and other allied healthcare professionals must ensure a holistic and patient-centered approach.

In the ever-evolving landscape of craniofacial trauma, continued research, and technological innovations will undoubtedly shape the future of TMJ condylar fracture management. By staying abreast of emerging evidence and embracing a multidisciplinary perspective, clinicians can aspire to optimize patient outcomes and quality of life in this intricate and challenging clinical scenario.

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