*Int. J. Odontostomat.,*
*18(1)*:100-108, 2024.

# Periradicular and Peri-Implant Lesions Associated with Apical Impact of Osseointegrated Implants in Tooth Roots: Clinical Case Reports

## Lesiones Perirradiculares y Periimplantarias Asociadas con el Impacto Apical de Implantes Osteointegrados en las Raíces de los Dientes: Informes de Casos Clínico

**Veronica de Mello Soares Frauches[1]; Eduarda Calisto de Almeida[2] & Fabiano Luiz Heggendorn[1]**

**FRAUCHES, V. M. S.; CALISTO DE ALMEIDA, E. & HEGGENDORN, F. L.** Periradicular and peri-implant lesions associated with apical impact of osseointegrated implants in tooth roots: clinical case reports. *Int. J. Odontostomat., 18(1)*:100-108, 2024.

**ABSTRACT:** This clinical case report aims to describe the development of periradicular and perimplant cystic lesions resulted from the intimate contact of the apical region of osseointegrated implants of dental roots, and discuss the reasons for failure of the guided bone regeneration procedure associated with platelet rich fibrin and leukocytes, this process was used to the treatment of the first case. Case Reports. Three cases were reported, two cases described the close contact between the tooth roots and the osseointegrated implants and another with a distance of 1.08 mm. All cases realized a radiographic, and they had not periapical lesions before contact with the apical region of the osseointegrated implants on the roots of the teeth. In the case with the largest cystic extension, the procedure was: removal of the osseointegrated implant with apicectomy of the neighboring teeth, excisional biopsy of the lesion, and grafting using the technique of guided bone regeneration associated with L-PRF. All three cases, endodontic treatment was performed on the neighboring teeth within 2 years of survival of the osseointegrated implants in order to reverse the existing lesion. Results. The diagnostic hypothesis of the three cases was periradicular and peri-implant lesion, arising from a contact of the apical region of the osseointegrated implant with the adjacent tooth. The distance of 1.08 mm between the apices did not ensure normality of the periradicular and peri-implant tissues. The intimate contact caused lesions of different extents and root fractures. Conclusion. Premature contact of the osseointegrated implant with the root region of the neighboring tooth may lead to the development of periradicular and peri-implant lesions, suggesting that it is not possible to control this infectious process with endodontic treatment of the injured tooth.

**KEY WORDS: Cystic lesion, L-PRF, root facture, implant failure.**

## INTRODUCTION

The principles of osseointegration brought scientific research to clinical practice. Since then, implant dentistry has been definitively incorporated into the therapeutic arsenal of the dental surgeon, but surgical protocols must be followed to avoid complications and difficulties in prosthetic rehabilitation (Buser *et al*., 2017). Failures in the planning or execution of the technique may lead to cases in which, although osseointegrated, the implant does not present satisfactory restoration conditions due to its inaccurate positioning (Zitzmann *et al*., 2010; de Almeida *et al*., 2022).

In installing dental implants, their positioning must respect distance limits with adjacent teeth to maintain blood supply and preserve periodontal tissues (Zheng *et al*., 2021). Tarnow *et al*. (2000) analyzed the distance between implant and tooth, correlating bone crest formation and type of angulation to adjacent teeth. Hamdoon *et al*. (2021) analyzed 43 inaccurately positioned osseointegrated implants, relating the distance, the severity of the lesion, and the type of angulation to the adjacent teeth. The authors suggested a minimum distance of 2 mm to avoid possible short-

[1] Postgraduate Program in Dentistry, University of Grande Rio (UNIGRANRIO), Rua Prof. José de Souza Herdy, 1160, block C, 2nd floor – August 25th - Duque de Caxias / Rio de Janeiro, Brazil - Zip Code: 25071-202, Brasil.
[2] Faculty of Dentistry, Universidade do Grande Rio (UNIGRANRIO), Rua Prof. José de Souza Herdy, 1.160, block C, 2nd floor - August 25th, Duque de Caxias / Rio de Janeiro, Brazil - Zip Code: 25071-202, Brasil.
This work was supported by Funadesp and Foundation for Research Financial Support in the State of Rio de Janeiro (FAPERJ), Brasil.

Received: 2022-12-23 Accepted: 2023-11-30

and long-term complications, such as loss of the implant and injuries to periodontal tissues. When close to the roots of adjacent teeth, osseointegrated implants can cause post-surgical complications, root resorption, peri-implant bone loss, and periradicular lesions (Naufel *et al*., 2017).

In parallel, surgical trauma can cause endodontic lesions, leading to pulp necrosis of the surrounding teeth. In the presence of large periradicular radiolucencies and periodontal abscesses, conventional endodontic therapy allows the regression of these lesions (Sunitha *et al*., 2008). If primary endodontic lesions persist despite endodontic treatment, secondary periodontal involvement or involvement of surrounding bone structures is suggested. Thus, apicectomy and curettage of the lesion are necessary (Sunitha *et al*., 2008). Frantz *et al*. (2014) reported odontogenic lesions close to dental implants installed immediately after the extraction of infected teeth, considered a great risk for osseointegration failure and permanence of the lesions, even after the removal of the dental elements.

Periapical cysts are pathological cavities covered by epithelial tissue with liquid or semi-solid content. Such lesions may be directly associated with the apical foramen or separated from it by thick connective tissue, presenting a granulation reaction with a predilection to the maxilla anterior region (Nair *et al*., 1996; Andrade Junior *et al*., 2014). The infection within the root canal system causes a granuloma and can evolve into a cyst. According to Regezi *et al*. (2000), such cysts are called root cysts, apical periodontal, apical, and periradicular cysts. In the absence of harmful stimuli to the root, these cysts originate from the epithelial rests of Malassez, which causes the local inflammatory to remain active, asymptomatic, have slow growth, and may reach large proportions. This inflammatory pathological disease is the most common odontogenic cyst, representing 40 % to 85 % of all apical lesions (Mariano *et al*., 2021).

Few reports correlate these cysts with root fractures and osseointegrated implants in the literature. Therefore, this study aims to describe as case reports the development of periradicular and peri-implant cystic lesions resulting from intimate contact of the apical region of osseointegrated implants with dental roots.In addition, our work discusses the reasons for the failure of the guided bone regeneration (GBR) procedure associated with Leukocyte- and Platelet-Rich Fibrin (L-PRF) used to resolve one of the presented cases.

## METHODOLOGY

A cross-sectional study analyzed the contact of the osseointegrated implant with the adjacent dentin root after two years of the implant. Information from the anamnesis and radiographic and tomographic histories of the patients supported analyses and comparisons of the imaging exams with the conditions presented after apical osseointegrated implant impact on the adjacent tooth.

## CASE REPORTS

**CASE 1.** A female leukoderma patient, 31 years old, presented increased volume in the element 11 region, associated with a fistula in the palatal region of the osseointegrated implant located in the same region, with pain and face edema.

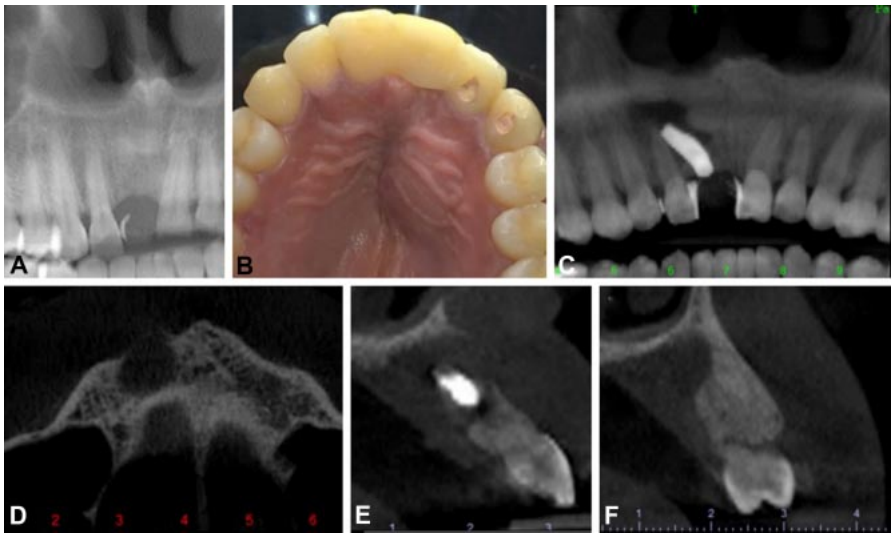


Fig. 1. Initial condition of the peri-implant site. (A) Initial radiograph, two years before implant placement. (B) Gingival abscess condition and (C) computed tomography of the peri-implant contact with the dentinal root. (D) Axial image demonstrating buccal cortical destruction and integrity loss of the nasal floor, and (E) transverse images indicate contact of the apical region of the implant with the apical region of the dental element of tooth 12, (F) extending to the element 13.

In the report, the patient stated that she underwent the installation of the osseointegrated implant approximately two years before, presenting the radiographic history, which demonstrated the integrity of the cortical and medullary tissue without the presence of a pre-existing lesion. The tomographic examination requested for the pre-surgical evaluation revealed the contact of the osseointegrated implant apical region with the apical region of dental element 12, presenting extensive vestibular and palatal cortical loss with involvement of the apical regions of teeth 12 and 13 by the cystic lesion and thinning of the nasal floor cortical lamina of this region (Fig. 1).

**Apicectomy, Excisional Biopsy, and Grafting.** Prior to surgery, dental elements 12 and 13 were treated endodontically as preparation for apicectomy due to local contamination.

After 30 days, the lesion did not change in clinical pattern. It indicated the need for excision surgery associated with removing the osseointegrated implant with the apicectomy of the teeth encompassed by the lesion and the surgery, using the GBR technique associated with grafting particulate and autologous biomaterial of L-PRF.

**Platelet- and leukocyte-rich fibrin (L-PRF).** The PRF preparation followed the protocol developed by Dohan *et al*. (2006). Before surgery, eight sterile 10 ml tubes of venous blood without anticoagulant were centrifuged by 2,700 RPM to divide the blood sample into three layers; the layers consisted of a red blood base, the middle as PRF clot, and acellular plasma as the top. Two tubes underwent centrifugation for three minutes to prepare the PRF-Block, and the remaining six tubes underwent centrifugation for 12 minutes to prepare the membranes of L-PRF. After 12 minutes of centrifugation with sterile forceps, the PRF clot was collected from the six tubes, and subsequently, the red corpuscle was separated from the PRF clot, keeping the buff-colt intact, followed by the formation of the L-PRF membranes through compression in the PRF-BOX.

We added one chopped L-PRF membrane to liquid fibrin in two centrifuged PRF tubes for three minutes. Then, this aggregate was added to one gram of the GenOxOrg Cortical biomaterial (Genius, Baumer, Brazil), a demineralized matrix of bovine bone graft, and then finalized the PRF-Block, a moldable compound for the surgical area (Fig. 2).

**Apicectomy.** After the oblique incisions with relaxing purpose occurred a total flap of the alveolar mucosa, with the total exposure of the cystic lesion area, via vestibular cortical bone and palate between teeth 14 and 21. After exposure of the surgical area, the curettage of the lesion walls, under saline solution irrigation, removed granulation tissue, verifying the presence of a collection of purulent material at the surgical site. The cured material of the lesion was packed in 10 % formalin solution and sent for

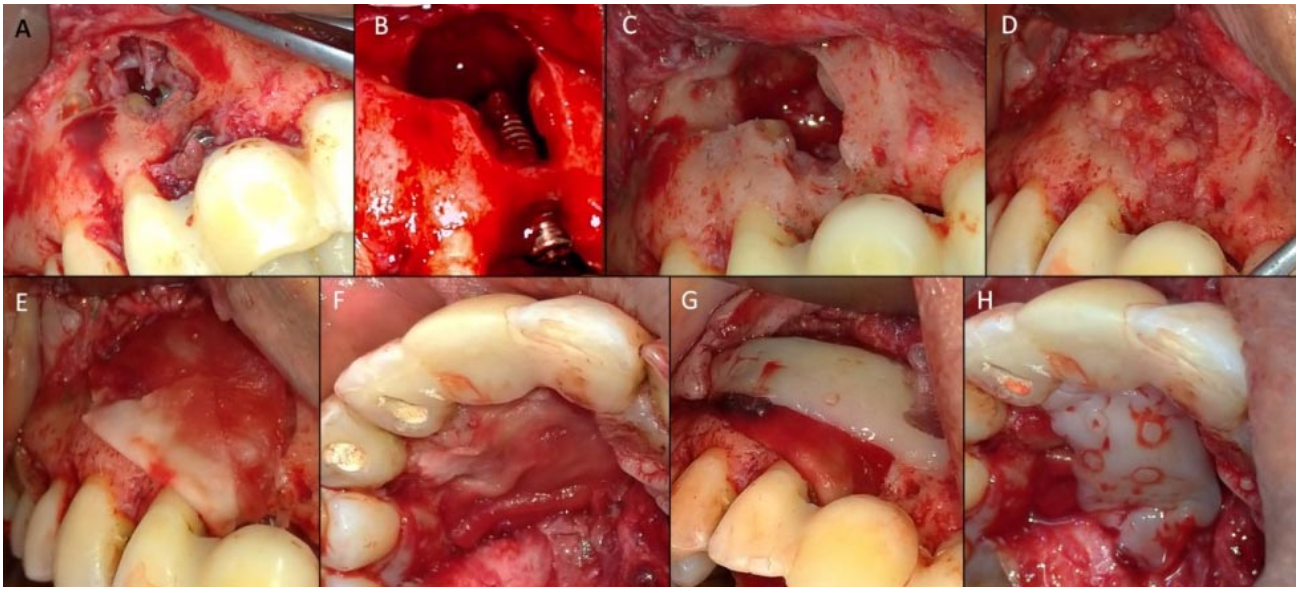


Fig. 2. Surgical Sequence: (A, B) initial lesion condition, with extensive cortical and medullary loss extending to the palatal region. Image C demonstrates the removal of the implant with apicectomy of teeth 12 and 13 at 90º, (D) followed by the PRF-Block grafting (E, F) with coverage of bovine collagen membranes and (G, H) L-PRF membranes.

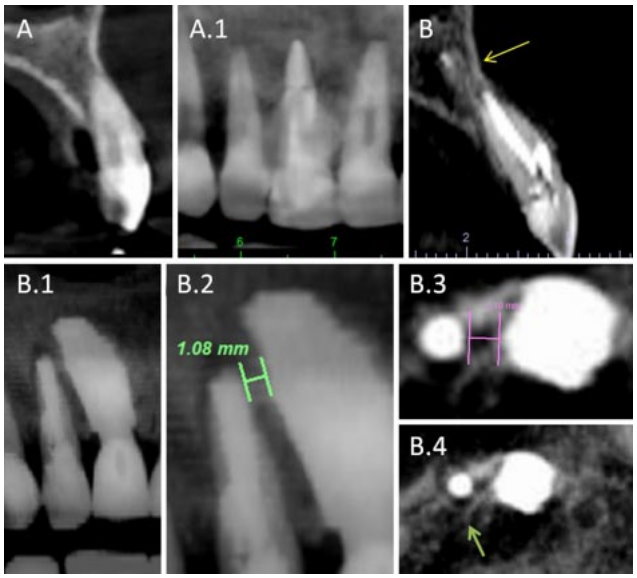


Fig. 3. Case two: (A and A.1) before the implant placement surgery of tooth 11, the periapical region of tooth 12 had no injury. (B) the apical region of implant 11 (yellow arrow) below the apical region of tooth 12. (B.2) a panoramic cut demonstrates the proximity of the apical region of implant 11 with tooth 12, with a distance of 1.08 mm between the regions. (B.3) Axial section demonstrates the proximity relationship, and (B.4, green arrow) the apical lesion on tooth 12.

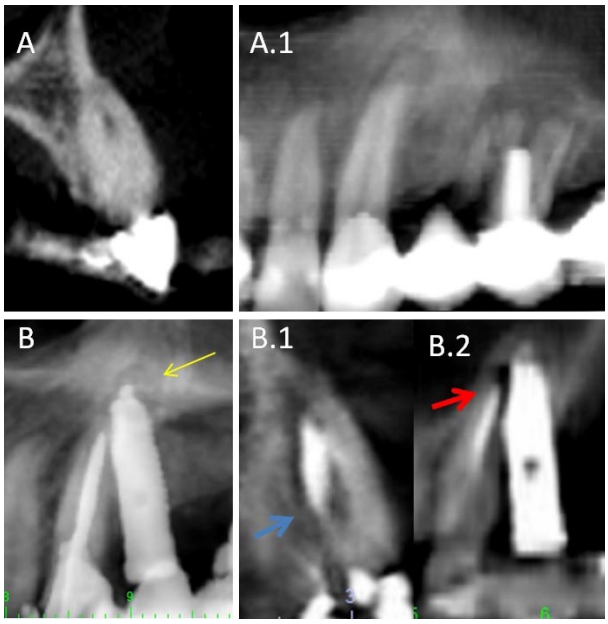


Fig. 4. Case three: (A and A.1) before implant placement surgery of tooth 11, the periapical region of tooth 12 had no injury. (B) The apical region of the implant of tooth 24 (yellow arrow) is in contact with the apical region of tooth 23. (B.1) A cross-sectional image demonstrates the extent of the periapical lesion through the palatal wall of the root of tooth 23, and (B.2) in another panoramic section, the extent of the lesion between the implant contact area and the tooth area in the periapical region.

histopathological analysis at the Oral Pathology Laboratory of the School of Dentistry of the Federal University of Rio de Janeiro, Brazil.

Subsequently, occurred the remotion of the osseointegrated implant of tooth 11 and the apicectomy was performed at 90º of the root apexes of teeth 12 and 13, followed by retro-preparation with a spherical drill, ultrasound cleaning, and retro-obturation with endodontic repair cement (Angelus Ltda).

Then, two L-PRF membranes covered the nasal floor at the bottom of the lesion to avoid extravasation of the grafting material via the nasal cavity. Subsequently, grafting with the PRF-Block occurred, filling the entire surgical cavity and covering the entire grafted area with two bovine collagen membranes (Lumina-Coat, Critéria, Brazil) and three L-PRF membranes. A horizontal mattress suture and several simple sutures completed the surgery (Fig. 2).

## CASE 2

A female patient with no associated systemic disease and denying the use of controlled medication provided the radiographic and tomographic history prior to implant placement in the region of the dental element 11, referring to the planning phase. In this tomographic history, we verified root fracture in dental element 11 and the absence of cystic lesions in elements 11 and 12 (Figs. 3A and 3A.1).

After two years of implant placement, the patient sought care, reporting pain in touching the periapical region of the elements 12 and the osseointegrated implant 11. We identified the presence of a periapical lesion in tooth 12 associated with the apical region of the dental implant 11 in the tomographic examination, which presented an apical angle invading the periradicular region of the dental element 12 (Figs. 3B and 3B.1). In addition, the endodontic treatment in tooth 12 is visualized, and the patient reported that this procedure proposed the elimination the periradicular lesion identified during this period.

From the tomographic examination, the distances between the apical region of the dental element 12 and the osseointegrated implant 11 were measured, revealing a distance of 1.08 mm in the panoramic section (Fig. 3B.2) and a distance of 1.10 mm in the axial section (Fig. 3B.3) with a circumscribed and well delimited radiopaque halo in the apical region of tooth 11 (Fig. 3B.4).

## CASE 3

The third case refers to a female patient with no systemic disease. In 2019, the patient underwent the installation of an osseointegrated implant in element 24. The preoperative radiographic and tomographic history for installing the osseointegrated implant revealed a periapical lesion in this element and periradicular normality in tooth 23 (Figs. 4A and 4A.1).

After two years, the patient returned for an evaluation of the implant. In the tomographic examination, we observed the intimate apical contact of the osseointegrated implant 24 with the periapical region of tooth 23 on the distal face of the apical portion, associated with a periradicular and peri-implant lesion in this area (Fig. 4). In addition, we visualize the presence of endodontic treatment in tooth 12, and the patient reported that she underwent this procedure to eliminate the periradicular lesion identified during this period.

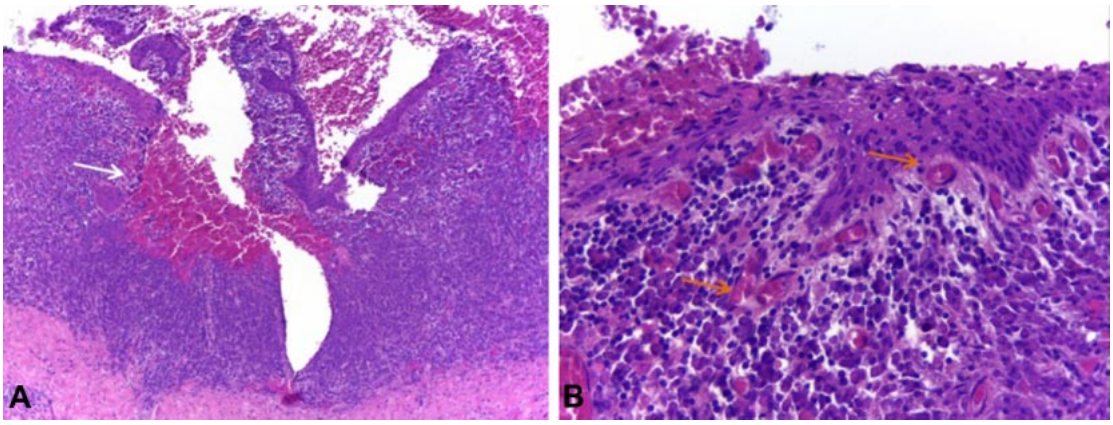


Fig. 5. Histological sections HE stained. Areas of dystrophic calcification (A, white arrow), Rushton corpuscles (B, orange arrows), and chronic inflammatory infiltrate (A and B), characteristics of a periapical cyst.

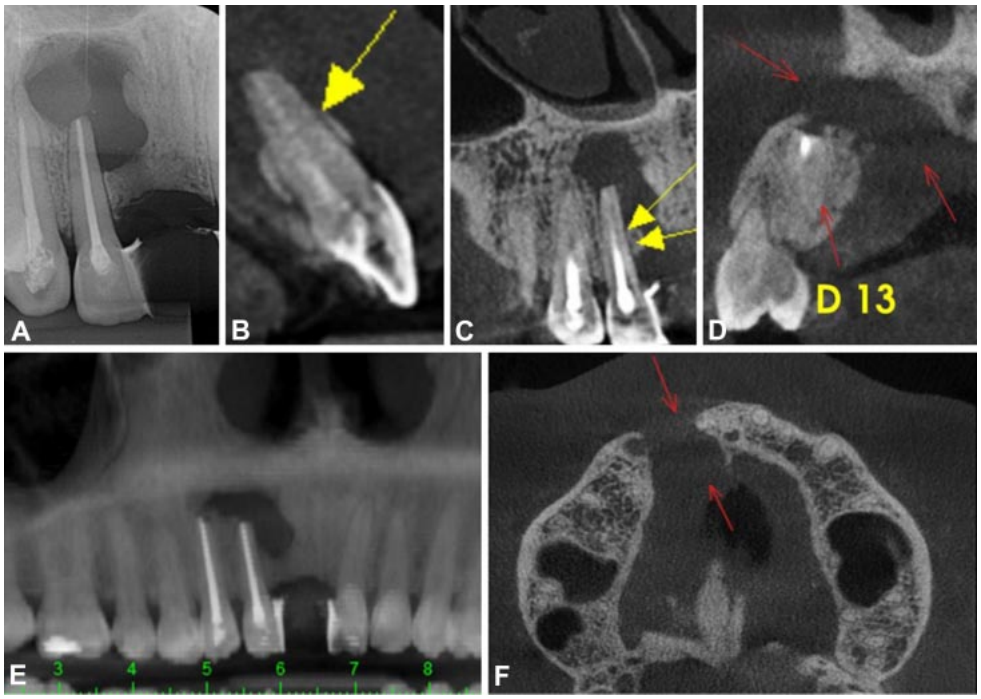


Fig. 6. Postoperative control. (A) Periapical radiography two months postoperative. While the tomography at ten months postoperatively revealed an image suggestive of a root fracture or crack in the buccal-mesial face of the root, (B) in the sagittal and (C) coronal sections. (D) Tooth 13 showed a reduction in the height of the bone defect in the sagittal section. (E) A tomographic image of the panoramic section demonstrates reduction of the lesion, and (F) axial section demonstrates the permanence of the vestibular and palatal cortical loss.

## RESULTS

In Case 1, which presented the greatest extent of periradicular and peri-implant lesions, the histopathological analysis of the cured material was compatible with a periapical cyst, with the presence of chronic inflammatory infiltrate.

On the other hand, the two-month postoperative radiographic revealed the permanence of the bone defect, while the clinical control demonstrated the absence of the infectious process with the normality of the gingival tissue. However, the tomographic examination after ten months of surgery revealed the presence of an area suggestive of fracture or crack at the root of the dental element 12. The location of this fracture or crack line on the mesial face of the root in the middle third was compatible with the contact area of the apex of the osseointegrated implant with the dental root before surgery for its removal (Fig. 6).

A fracture or crack line in the region of dental element 12 suggested a direct correlation with GBR failure, which may perpetuate a local inflammatory process leading to local repair and no bone regeneration. However, some conditions of bone gain can still be visualized, such as in the periradicular region of tooth 13, which showed a reduction in the height of the bone defect and gain in nasal floor thickness and closure of the communication areas of the lesion with the nasal cavity. The analysis after GBR suggested bone gain in the peripheral margins of the lesion, restricting bone loss in medullary and cortical areas on the throne of the roots of teeth 12 and 13.

The patient is being followed up, awaiting high-resolution tomography to show the root fracture. Once the root fracture or fissure is verified, a second GBR associated with the extraction of this element will be planned. In cases of extensive lesions, where bone regeneration is expected, tomographic control will assist in determining the time of a second approach to GBR. The absence of an active infectious process enabled this positioning.

The diagnostic hypothesis of the three cases presented is periradicular and peri-implant injury, resulting from contact of the apical region of the osseointegrated implant with the adjacent tooth. Even in Case Two, which presented a distance of 1.08 mm and 1.10 mm between the apexes, the development of periradicular and peri-implant lesions is suggested. Intimate contact caused lesions of different extensions and may cause root fractures, as in case three and one, respectively.

In addition, we must highlight the short period of development of the periradicular lesion, with a reported time of less than two years for the disclosure of the periradicular lesion. During this period, in the cases reported, patients underwent endodontic treatments to control periradicular lesions that did not result in the regression of the lesions.

## DISCUSSION

During surgical planning, analyzing the prosthetic space and ideal location is essential, so the installation of osseointegrated implants is successful, and it also reduces and avoids complications during surgery, such as excessive angulation in bone milling, that causes irreversible damage to adjacent teeth. Correct planning may require prior orthodontic correction to increase the space between adjacent teeth or correct the root inclination, so these regions leave the expected milling area. Rubinstein *et al*. (2019) performed orthodontic treatment by increasing the space between adjacent teeth for subsequent installation of the osseointegrated implant.

In addition, the distance between the osseointegrated implants and the dental elements is an important factor in the aesthetic result during the prosthetic phase. According to Chackartchi *et al*. (2019), proper implant positioning, carefully considering the appropriate mesiodistal and buccolingual dimensions, and implant angulation can prevent interdental soft tissue loss and the development of soft tissue recessions. The intraosseous positioning of the implant and the conditions around the peri-implant apexes should be favorable since the biological width forms a barrier against bacteria, influences the remodeling of the soft and hard tissue around the implant, and has implications for the clinical aspects of dental implantation (Zheng *et al*., 2021). Therefore, called the comfort zone, the mesiodistal distance should be between 1.0 mm and 1.5 mm (Buser *et al*., 2004). Jivraj & Chee (2006) reported the need for a minimum distance between the tooth and the 1.5 mm osseointegrated implant, preventing the maintenance of the bone crest and interdental papilla at lower distances, which can lead to harmful consequences in osseointegration, aesthetics, and function.

This lack of planning and technical errors can cause aesthetic and functional losses that are

challenging to reverse (Buser *et al*., 2004; Jivraj & Chee, 2006). In case one, even with the removal of the implant unsatisfactorily installed associated with GBR and L-PRF, with all the osteogenic properties ideal for bone regeneration of large and small defects, the postoperative results were unsatisfactory. In this context, the insufficient bone formation occurred due to the permanence of the periradicular lesion of the adjacent teeth, possibly caused by the root fracture or crack identified later in the dental element 12, even after apicectomy and severe curettage of the bone region.

Only after removing the osseointegrated implant, the fracture line of the dental element 12 was identified. The site of occurrence of this fracture line suggested that the pressure of the apical region of the osseointegrated implant during implant placement caused it. The maintenance of the dental element 12 with the fracture line suggested the maintenance of the inflammatory process leading to the repair of the surgical site of the grafting. Thus, even with good surgical planning, the treatment of complications of inadequately performed surgeries does not always obtain an ideal result, allowing the reinstallation of the implant in a short period and reversal of the cystic lesion (Tian *et al*., 2019).

An urgent approach is necessary to minimize the damage from the contact of the osseointegrated implants with the dental roots. Tooth loss is related to a process of bone resorption that can significantly affect the volume of the alveolar bone. In addition, if in the presence of a large bone cyst, the enucleation treatment associated with tooth extraction can considerably increase the size of the defect, leading to incomplete healing due to the size of the cystic cavity, loss of periosteum and bone walls (Mauceri *et al*., 2021). The clinical cases presented required an average of two years of survival of the osseointegrated implants to generate lesions with considerably harmful sizes to the supporting bone structure. Hamdoon *et al*. (2021) described the consequences of impaction of osseointegrated implants in adjacent roots in 43 patients by identifying mobility, injury and root resorption, and sensitivity in injured teeth. The osseointegration of the implants failed, leading to the mobility of the implants installed in some cases.

The GBR technique can promote bone growth in tissue defects adjacent to dental implants. This technique uses a barrier, absorbable or non-absorbable membrane, to cover the defect region, preventing possible infection and growth of fibrous tissue before new bone regeneration (Pereira *et al*., 2012). However, the GBR used in Case One suggested a process of substantial loss of the grafting material, promoting the repair of the lesion and not regeneration. This fact may be associated with the permanence of the cracked root or fracture impacted by the osseointegrated implant, perpetuating the periradicular inflammatory process in this dental element.

Numerous techniques are cited in the treatment of periapical cysts, mainly due to the possibility of recurrence or permanence of the lesion (Shah *et al*., 2014). The recurrence rate may be related to the pathological nature, as well as the size of the cyst associated with dental roots (Lee *et al*., 2019). Therefore, based on such prerogatives, the failure in GBR of the extensive periradicular and peri-implant lesion of case one suggests that it is associated with the extensive size of this lesion and the presence of the root crack line in the affected tooth. The fistulous process in the palatal region was eliminated even without volume gain, demonstrating tissue improvement.

The literature has few reports of the association of cystic, peri-implant, and periradicular lesions. The reports cite the treatment of root cysts in isolation through surgical removal, which is usually successful when the bone walls surround the endodontic lesion. However, when root bone loss is surgically discovered, the chance of a positive result is greatly reduced (Britain *et al*., 2005). Due to the involvement of the root region, apicectomy is necessary, associated with the treatment or retreatment of the related dental elements in cases of large or recurrent cystic lesions (Brown, 1995).

The removal of malpositioned implants is not always indicated due to the great surgical trauma and possible bone loss, requiring grafts to correct the defects resulting from this removal. However, if surgery is indicated, minimally invasive procedures should be considered to avoid the impossibility of replacement and rehabilitation with osseointegrated implants (Solderer *et al*., 2019). Therefore, ideal planning is extremely important, considering the clinical history of the patient and directing the procedures to be performed.

## CONCLUSION

The premature contact of the osseointegrated implant with the root region of the adjacent tooth may lead to the development of periradicular and peri-implant lesions, suggesting that it is impossible to control this infectious process with endodontic treatment in the injured tooth.

The two-year survival analysis of osseointegrated implants in three cases with root contact suggested the formation of periradicular lesions and peri-implants of different sizes. The malpositioned implants may also cause a fracture or cracked root of the affected tooth due to the impact of the osseointegrated implant on this structure.

Further studies are necessary on this subject for the development of protocol treatments and to define the minimum distance that ensures the normality of the periradicular tissues with the osseointegrated implant.

**FRAUCHES, V. M. S.; CALISTO DE ALMEIDA, E. & HEGGENDORN, F. L.** Lesiones perirradiculares y periimplantarias asociadas con el impacto apical de implantes osteointegrados en las raíces de los dientes: informes de casos clínico. *Int. J. Odontostomat., 18(1)*:100-108, 2024.

**RESUMEN:** Este reporte de caso clínico tuvo como objetivo describir el desarrollo de lesiones quísticas perirradiculares y periimplantarias resultantes del contacto íntimo de la región apical de implantes osteointegrados de raíces dentales, y además discutir las razones del fracaso del procedimiento de regeneración ósea guiada asociado a fibrina rica en plaquetas y leucocitos. Este proceso se utilizó para el tratamiento del primer caso. Se reportaron tres casos, en dos casos se describieron el estrecho contacto entre las raíces de los dientes y los implantes osteointegrados y en el otro se determinó una distancia de 1,08 mm. En los tres casos se realizó una radiografía y se determinó que no existían lesiones periapicales, antes del contacto con la región apical de los implantes osteointegrados, en las raíces de los dientes. En el caso de mayor extensión quística, el procedimiento fue: extracción del implante osteointegrado con apicectomía de los dientes vecinos, biopsia excisional de la lesión e injerto mediante la técnica de regeneración ósea guiada asociada a L-PRF. En los tres casos, el tratamiento de endodoncia se realizó en los dientes vecinos dentro de los 2 años de supervivencia de los implantes osteointegrados para revertir la lesión existente. La hipótesis diagnóstica de los tres casos fue lesión perirradicular y periimplantaria, originada por un contacto de la región apical del implante osteointegrado con el diente adyacente. La distancia de 1,08 mm entre los ápices no aseguraba la normalidad de los tejidos perirradiculares y periimplantarios. El contacto íntimo provocó lesiones de diferente extensión y fracturas radiculares. El contacto prematuro del implante osteointegrado con la región radicular del diente vecino puede conducir al desarrollo de lesiones perirradiculares y periimplantarias, lo que sugiere que no es posible controlar este proceso infeccioso con tratamiento endodóntico del diente lesionado.

**PALABRAS CLAVE: lesión quística, L-PRF, fractura radicular, fracaso del implante.**

## REFERENCES

Andrade Junior, C. V.; Antunes, H. S.; Carvalhal, J. C. A.; Neto, N. D. & Uzeda, M. Radicular cysts may heal after endodontic treatment? *Rev. Bras. Odontol., 71(1)*:99-102, 2014.

Britain, S. K.; Arx, T. V.; Schenk, R. K.; Buser, D.; Nummikoski, P. & Cochran, D. L. The use of guided tissue regeneration principles in endodontic surgery for induced chronic periodontic-endodontic lesions: a clinical, radiographic, and histologic evaluation. *J. Periodontol., 76(3)*:450-60, 2005.

Brown, D. C. Advances in endodontic surgery: Part 1. *Dent. Update, 22(7)*:298-302, 1995.

Buser, D.; Martin, W. & Belser, U. C. Optimizing esthetics for implant restorations in the anterior maxilla. Anatomic and surgical considerations. *Int. J. Oral Maxillofac. Implants, 19 Suppl.*:43-61, 2004.

Buser, D.; Sennerby, L. & De Bruyn, H. Modern implant dentistry based on osseointegration: 50 years of progress, current trends and open questions. *Periodontol. 2000, 73(1)*:7-21, 2017.

Chackartchi, T.; Romanos, G. E. & Sculean, A. Soft tissue-related complications and management around dental implants. *Periodontol. 2000, 81(1)*:124-38, 2019.

de Almeida, E. C.; Dias, K. D. S. R.; De Oliveira, M. F. M.; Valetim, E. R. N. A. & Heggendorn, F. L. Prosthetic solution for whistling in fixed prostheses on implants: a case report. *Res. Soc. Dev., 11(9)*:e50311932025, 2022.

Dohan, D. M.; Choukroun, J.; Diss, A.; Dohan, S. L.; Dohan, A. J. J.; Mouhyi, J. & Gogly, B. Platelet-rich fibrin (PRF): a second-generation platelet concentrate. Part I: technological concepts and evolution. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 101(3)*:e37-44, 2006.

Frantz, B. J.; Caton, J. G.; Bonacci, F. J.; Germiniani, A.; Arseneau, R. & Kahn, M. A. Peri-implant cystic lesion with unusual cellular changes: A case report. *Clin. Adv. Periodontics, 4(4)*:240-5, 2014.

Hamdoon, Z.; Talaat, W.; Aziz, A.; Sattar, A. A.; Kheder, W. & Jerjes, W. The consequences and outcomes associated with dental implants encroaching on adjacent teeth. *Clin. Implant Dent. Relat. Res., 23(6)*:851-6, 2021.

Jivraj, S. & Chee, W. Treatment planning of implants in posterior quadrants. *Br. Dent. J., 201(1)*:13-23, 2006.

Lee, H.; Lee, S. J. & Seo, B. M. Investigation of postoperative complications of intrabony cystic lesions in the oral and maxillofacial region. *J. Oral Maxillofac. Surg., 77(9)*:1823-31, 2019.

Mariano, E. C.; Rangel, L. F. G. O.; Barbosa, C. C. N. & Barbosa, O. L. C. Cisto periapical tratado endodontico e cirurgicamente: relato de caso. *Braz. J. Surg. Clin. Res., 33(2)*:30-3, 2021.

Mauceri, R.; Murgia, D.; Cicero, O.; Paterno, L.; Fiorillo, L.; De Caro, V. & Campisi, G. Leucocyte- and platelet-rich fibrin block: its use for the treatment of a large cyst with implant-based rehabilitation. *Medicina (Kaunas), 57(2)*:180, 2021.

Nair, P. N. R.; Pajarola, G. & Schroeder, H. E. Types and incidence of human periapical lesions obtained with extracted teeth. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod., 81(1)*:93-102, 1996.

Naufel, A. O.; Aguiar, M. C. F.; Madeira, F. M. & Abreu, L. G. Treg and Th17 cells in inflammatory periapical disease: a systematic review. *Braz. Oral Res., 18(31)*:e103, 2017.

Pereira, N. S.; Souza, L. R. B.; Soares, L. C.; Santos, I. M. S. P. & Araújo, K. S. Regeneração óssea guiada utilizando membrana reabsorvível fixada com etilcianoacrilato. *Rev. Bras. Odontol., 69(1)*:39-42, 2012.

Regezi, J. A.; Sciubba, J. J. & Jordan, R. C. K. *Patologia Oral: Correlações Clínico Patológicas.* 3rd ed. Rio de Janeiro, Guanabara Koogan, 2000. pp.260-2.

Rubinstein, S.; Levin, B. P.; Fulreader, A.; Barack, D. & Fujiki, T. Prosthetic and surgical management of atypical space when teeth are missing. *Compend. Contin. Educ. Dent., 40(6)*:358-66, 2019.

Shah, N.; Logani, A. & Kumar, V. A minimally invasive surgical approach for large cyst-like periapical lesions: a case series. *Gen. Dent., 62(1)*:1-5, 2014.

Solderer, A.; Al-Jazrawi, A.; Sahrmann, P.; Jung, R.; Attin, T. & Schmidlin, P. R. Removal of failed dental implants revisited: Questions and answers. *Clin. Exp. Dent. Res., 5(6)*:712-24, 2019.

Sunitha, R. V.; Emmadi, P.; Namasivayam, A.; Thyegarajan, R. & Rajaraman, V. The periodontal - endodontic continuum: A review. *J. Conserv. Dent., 11(2)*:54-62, 2008.

Tarnow, D. P.; Cho, S. C. & Wallace, S. S. The effect of inter-implant distance on the height of inter-implant bone crest. *J. Periodontol., 71(4)*:546-9, 2000.

Tian, F. C.; Bergeron, B. E.; Kalathingal, S.; Morris, M.; Wang, X. Y.; Niu, L. N. & Tay, F. R. Management of large radicular lesions using decompression: a case series and review of the literature. *J. Endod., 45(5)*:651-9, 2019.

Zheng, Z.; Ao, X.; Xie, P.; Jiang, F. & Chen, W. The biological width around implant. *J. Prosthodont. Res., 65(1)*:11-8, 2021.

Zitzmann, N. U.; Krastl, G.; Hecker, H.; Walter, C.; Waltimo, T. & Weiger, R. Strategic considerations in treatment planning: deciding when to treat, extract, or replace a questionable tooth. *J. Prosthet. Dent., 104(2)*:80-91, 2010.

Corresponding author:
Fabiano Luiz Heggendorn
Postgraduate Program in Dentistry
University of Grande Rio (UNIGRANRIO)
Rua Prof. José de Souza Herdy, 1160, block C, 2nd floor
August 25th - Duque de Caxias
Rio de Janeiro
BRAZIL

E-mail: fabianohegg@gmail.com

| | ORCID:http://orcid.org/ |
|---|---|
| Veronica de Mello Soares Frauches | 0000-0001-9017-2604 |
| Eduarda Calisto de Almeida | 0000-0001-9568-1707 |
| Fabiano Luiz Heggendorn | 0000-0002-2687-0165 |