v. 4, n. 91, 2024

International Journal of Health Science

PARENDODONTIC SURGERY USING PRF GRAFT AND FREEZE-DRIED BOVINE BONE IN *dens invaginatus*: CASE REPORT

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Acceptance date: 14/10/2024

"Joy is in the struggle, in the attempt, in the suffering involved and not in the victory itself. "

Mahatma Gandhi

Abstract: *Dens Invanginatus*, also known as *dens in dens,* is characterized as an anomaly that occurs during the development of tooth enamel. The best known causes are genetic or environmental factors, and 2D and 3D radiographic examinations are recommended for its diagnosis and treatment plan. With parendodontic surgery, it is possible to remove necrotic and infected remains that have lodged in the apical portion of the tooth. The aim of this study was to report a clinical case of endodontic surgery on a *dens invaginatus*, using a PRF graft and freeze-dried bovine bone. The use of PRF graft in this surgery is justified by its biological properties, generating deposition of growth factors, carrying out cell migration, proliferation and differentiation, its gelatinous characteristic allows better handling and adaptation of the material in the region. The external and internal anatomical complexity of the *dens invaginatus* makes its structure fragile. In order to make the best choice in the treatment plan, it is essential to assess the condition of the pulp and its root development. In order to better assess the healing of the periapical lesion after apicectomy, follow-up was indicated for one year after surgery using 3D technology, volumetric computed tomography.

Keywords: *Dens invaginatus*, parendodontic surgery, retroobturation, bone graft, computed tomography.

INTRODUCTION

Dens invaginatus, also known as *dens in dens,* is characterized as an anomaly occurring at the moment of tooth enamel development, the bell phase, where epithelial cells normally begin their formation. In the coronal region, before the process of tooth mineralization, tubercles are formed which make up this curious anatomy. These cases are most commonly found in upper lateral and central incisors and permanent teeth, affecting approximately 0.3 to 10% of the population. The best-known causes are genetic or environmental factors, usually caused by infections or trauma at the time of tooth formation and development. This anomaly can be considered very difficult to detect through routine clinical examinations, but with the help of complementary radiographic examinations and volumetric computed tomography, it is possible to visualize the complex anatomy of this tooth in a three-dimensional way.

The main difference between the types of *dens in dens* is their origin. Type I is considered to be an invagination that does not reach the root, only the coronary portion. Type II, on the other hand, the anatomical alteration reaches the root region, communicating with the dental pulp like a blind sack, where there is no communication with adjacent tissues. Type III has access in the apical region through the dentin, entering into intimacy with the periodontal ligament without reaching the pulp chamber. The form of treatment will depend on different factors, such as anatomy and whether or not the tooth has pulp or periapical disease.

Due to its structure full of tubercles, making it more fragile and causing damage to the pulp and its remnants, in order to choose the best treatment plan it is necessary to assess the conditions in which the pulp and its root development are present, The treatment options for this case range from the most

conservative to composite resin restorations as a way of protecting the tubercles, but when contact with the dental pulp occurs, it is necessary to opt for more invasive treatments such as pulpotomy, pulpectomy, apical surgery or even more extreme methods such as extraction of the tooth.

Endodontic surgery or apicectomy aims to remove necrotic and infected tissue remnants by removing the most apical portion of the element.

This procedure is carried out when all conventional endodontic alternatives have been exhausted and bacteria and toxins from the root canal systems cannot be effectively eliminated to ensure successful treatment, resulting in persistent periapical lesions. Apicectomy consists of removing the apical third and making a 3 mm apical retropreparation to incorporate the retrograde filling material. The aim of this study was to report a clinical case of endodontic surgery of a *dens invaginatus*, using PRF graft and freeze-dried bovine bone.

LITERATURE REVIEW

DeNicolo *et al* in 2015 combined PRP with Bio-Oss and analyzed whether this combination had better results in bone regeneration. The regions where the Bio-Oss graft was placed had better repair and healing, but the use of PRP after 8 weeks did not show significant improvement. Its gelatinous characteristics and autologous origin allowed for positive results, with easier handling and adaptation of the material to the region.

Angerame *et al* in 2015 evaluated the benefits of PRF in endodontic surgery by analyzing the speed of healing and postoperative discomfort. Patients who had persistent periapical radiolucency, the presence of a fistula and symptoms after endodontic retreatment were selected for the study. Approximately 2 to 3 months after treatment, the region showed bone stimulation and a reduction in post-operative discomfort when the PRF gel was applied. However, it is essential that further studies are carried out to confirm the results.

Kobayashi *et al* in 2016, compared platelet-rich plasma (PRP), fibrin-rich plasma (PRF) and a modernized protocol for PRF, advanced PRF (A-PRF) by evaluating the release of growth factor over time. For this study, 18 blood samples from 6 donors were collected and incubated to evaluate the growth factor using the ELISA scale. The authors concluded that PRP obtained higher rates in the short term, unlike PRF and A-PRF which had a gradual release up to a period of 10 days after incubation. The formation of advanced PRF allowed growth factor stimulation to be greater over time when compared to ordinary PRF.

Schloss *et al* in 2017, through this study were able to compare the healing rate after endodontic microsurgery treatment using two-dimensional radiographs (periapical radiography) and three-dimensional radiographs (cone beam computed tomography), 44 patients were recruited and 51 teeth were selected to be evaluated using the Molven (2D) and PENN (3D) criteria. After comparing the pre- and post-operative periods, it was clear that the volume of the lesions had been significantly reduced. Using the Molven criteria, 40 teeth showed complete healing, 7 incomplete and 4 uncertain, but when using the PENN criteria, 33 showed complete healing, 14 limited healing, 1 uncertain healing and 3 unsatisfactory. The use of 3D technology showed satisfactory results, obtaining greater precision in the dimensions of the lesions and healing of the region when compared to 2D periapical radiography.

In 2017, Zhu *et al*. discussed the methods used to arrive at a diagnosis, the treatment options and the correct way to manage

clinical cases in teeth with *dens invaginatus* (DI) characteristics. Two-dimensional scans were widely used to diagnose this type of anatomy, but this radiographic method has its limitations when it comes to analyzing the internal anatomy of canal systems in detail. With the emergence of three-dimensional technology for endodontic treatment, the treatment plan and diagnosis has become more effective. Cone beam computed tomography allows better quality assessments to be carried out, enabling the patient to be exposed to relatively low radiation. In order to draw up a treatment plan for a *dens invaginatus*, care must be taken to assess the condition of the dental pulp.

Pinto *et al* in 2017 described regenerative endodontic treatment using leukocytes and fibrin-rich plasma (L-PRF) in an immature tooth that had asymptomatic apical periodontitis and an extensive periapical lesion in a *dens invaginatus*. A 22-year-old female patient was referred to the University of Los Andes Dental Clinic in Chile for endodontic treatment of tooth 22, which was discolored and had a deep groove on the palatal side. This type of graft allows for better cell adhesion and migration, leading to better cell growth, proliferation and differentiation factors, but more clinical analysis is needed to ensure that this type of graft is effective.

Standardized protocols for its use. This study obtained good results showing that this is a viable clinical protocol.

Sharma *et al* in 2018, evaluated the use of fibrin-rich plasma (PRF) and Biodentine combining apicification and non-surgical treatment in teeth with open apices and large periapical and cystic lesions involving the same tooth element. This study describes three cases, two female patients, aged 39 and 45, and a 15-year-old boy. Firstly, intracanal aspiration, digital decompression and apexification were carried out to close the root apex using PRF and Biodentine. The authors were able to conclude that when apicification was carried out using PRF and Biodentine, when complemented with decompression of the lesion, it proved to have a high success rate. Those who had these pathological characteristics were able to return to their state of health without the need for endodontic surgery, as the materials used led to good periapical healing quickly and improved radiolucency over a period of 3 months in periapical lesions.

Pandey *et al* in 2018 described the retreatment process of a tooth element that had failed endodontic treatment and showed extensive periapical lesion, open apex and root fracture. MTA is a cement composed of tricalcium silicate, which has come to be used in complex endodontic procedures due to its ability to induce biological mechanisms, allowing the necessary repair of the area to take place. This cement was used for orthograde and retrograde fillings and for sealing root fractures. Follow-up was carried out over a period of one year, noting the progression of healing by means of radiographs and the absence of signs and symptoms. Currently, the treatment of exodontia and rehabilitation with a dental implant is the method of choice for most patients, and after 1 year showed positive results in healing when MTA was used in soft tissues.

Shah *et al* in 2019 discussed the concept of injectable PRF and its use when activating bone grafts. The conventional protocol for making this type of graft is to couple the blood collected from the patient in a centrifuge at 2,700 rpm rotation for 12 minutes without adding anticoagulant, through this process formed 3 layers, the first composed of red blood cells, the second called the intermediate layer formed by fibrin clot rich in platelets and the upper layer is filled with plasma poor in platelets. The authors were able to define that PRF (fibrin-rich plasma) has been gaining

International Journal of Health Science ISSN 2764-0159 DOI https://doi.org/10.22533/at.ed.1594912414104

acceptance in regenerative dentistry over time. However, this material can only be used in the form of a gel or membrane, and is not indicated for injection.

Sureshbabu *et al* in 2019 described the use of concentrated growth factors (CGF), a new group of autologous platelets, as a material for bone regeneration after endodontic surgery. Two female patients aged 32 and 35 were selected, in both patients tooth 11 had an open apex and teeth 11 and 12 were diagnosed with apical periodontitis, teeth 31 and 41 were previously endodontically treated and had a chronic apical abscess. These teeth underwent surgical treatment, with retrograde filling and grafting with CGF fibrin block and membrane. The use of growth factors in concentrated form can be considered a good option for membranes and bone grafts when large periapical lesions are found, with the aim of increasing the speed of healing and bone regeneration. For procedures such as revascularization and lesions of endoperative origin, CGF can be used, the only limitation currently being the low levels of evidence.

In 2020, Karan *et al* carried out a study whose main objective was to compare the use of MTA (mineral trioxide aggregate) and PRF (fibrin-rich plasma) cement in the healing of the periapical region after endodontic surgery using volumetric computed tomography. They noted that the adaptation of MTA in this type of surgery is essential for a better prognosis. However, the use of the PRF graft did not generate any major changes in the surgical outcome.

Dhamija *et al* in 2020 evaluated the role of PRP (platelet-rich plasma) in the healing of periapical lesions using 2D and 3D radiographic examinations, periapical radiography and three-dimensional cone beam radiography, respectively. The criteria used were patients who had failed conventional endodontic treatment and large persistent periapical lesions whose loss of cortical bone was located on the buccal and lingual surfaces, analyzed on CBCT images. PRP grafting is most indicated when the periosteum is absent on one or both sides, vestibular and lingual, facilitating cell migration, proliferation and differentiation for better tissue regeneration after 12 months were able to obtain significant healing results using three-dimensional imaging (volumetric computed tomography).

Liu *et al* in 2020 analyzed the impact of the use of regenerative techniques and materials in endodontic surgery. Patients were selected and divided into three groups: the first was made up of participants who had persistent periapical lesions, the second was the intervention group who underwent endodontic surgery using regenerative methods or materials and the third was the control group selected to perform endodontic surgery without any technique or use of regenerative material. Through this study, the authors were able to understand that regenerative techniques generate better healing. When the collagen membrane was combined with hydroxyapatite, it had a direct effect on the repair of medium and large periapical lesions, showing a significant improvement in healing.

Meschi *et al* in 2020 evaluated bone healing 1 year after endodontic surgery using L-PRF (leukocytes and fibrin-rich plasma) and Bio-Gide® used as a membrane. This study is an RCT with a 2x2 open factorial design, the patients were randomly divided into 2 groups: control and test. Follow-up was carried out using ultrasound, periapical radiography and cone beam computed tomography. The authors noted that there was no evidence of the effect of L-PRF on echographic measurements when evaluating periapical radiography and cone beam computed tomography. There are better results with the use of Bio-Gide.

Chen *et al* in 2020 analyzed the treatment options for *dens invaginatus* (DI), assessing the condition of the pulp and the maturation of the teeth. When the professional detects the presence of a DI early on, it allows more conservative treatments to be carried out. Its anatomy, full of tubercles, can make its structure fragile, leading to tooth fracture and pulp exposure. Treatment options will depend on the damage caused to its anatomical structure. The tubercle can be protected by composite resin restoration, pulpotomy, pulpectomy, apical surgery and extraction in cases related to orthodontic treatment. Therefore, it can be concluded that *dens invaginatus* and pulp necrosis have shown positive results in the last two decades when it comes to regenerative endodontics, apicification treatment and apical sealing using bioceramic cement can be used in endodontics in teeth with this anatomical condition, and the use of stem cells for treatment is being considered in the future.

Sutter *et al* in 2020 analyzed the results of previous studies on teeth undergoing apical surgery after a 1-year follow-up. The 81 patients selected were treated between 2010 and 2017 and during this period 235 teeth underwent surgery with retrograde filling and follow-up examinations for 1 year at the University of Zurich after the procedure. Patients who had no clinical complaints and good healing, as assessed radiographically, were classified as having successful treatment. As a result, 91.4% of patients had satisfactory clinical and radiographic healing. The regions that were treated had positive results, the anterior teeth had a better prognosis when compared to the premolar and molar teeth, probably the ease of access to the surgical site was an important factor in the success of the procedure, so that the apicectomy has more satisfactory results guided techniques can be used, the use of prefabricated guides and 3D prints, facilitate the process of osteotomy and root resection.

Viganò *et al* in 2020, evaluated the efficiency of bone tissue regeneration in endodontically treated teeth with a periapical lesion of 1.5mm in diameter, using a new preparation of platelet-rich plasma, using a pure platelet concentrate. According to recent articles, the authors were able to conclude that the use of PRP in lesion healing obtained favorable results, but in studies where PRP was used in apical surgery there was no significant difference in bone quality. Good curettage of the cavity, instrumentation and sealing with MTA cement helped with bone quality and the speed of repair.

In 2021 Alkadi *et al*, analyzed the prevalence and characteristics found in maxillary anterior teeth with *dens invaginatus*. A survey of 505 patients from the archives of the Faculty of Dentistry at King Saud University in Saudi Arabia was carried out from January 2017 to June 2019, based on cone-beam volumetric computed tomography imaging, which showed that the prevalence of DI was 7.3% of the population and 1.6% in maxillary anterior teeth. The authors concluded that the lateral incisors were the most affected and that there was a greater anatomical alteration in the coronal region, which was not related to this anomaly in the teeth on the opposite side. In order to the use of volumetric cone-beam computed tomography is indispensable for proper diagnosis and treatment.

Miralles *et al.* in 2021 carried out an analysis based on scientific literature on the application of biomaterials and their capacity for tissue regeneration in endodontic microsurgery. The criteria for choosing the 30 articles selected were: publications up to December 2020 found in high-impact journals (International Endodontic Journal, Journal of Endodontic and Australian Endodontic Journal). They were able to conclude that magnification, lighting and the use of microinstruments allowed the success rate in microsurgery to

be 91.5% in 5 years and 93.3% in 10 years, when compared to conventional endodontic surgery. The use of bone grafts and membranes in endodontic surgery is not essential for healing the periapical lesion, but only leads to better healing of the surrounding tissue. After the retropreparation, it is necessary to adapt the cement with the aim of generating better periapical healing in the region. To this end, MTA cement has cementogenic properties that allow the repair to be of better quality.

Siqueira *et al* in 2022 discussed the endodontic implications, treatment recommendations based on the anatomy *of dens invaginatus* and the new technologies used to treat it. This tooth has a very complex anatomy and is more prone to pulp and periradicular diseases. It is therefore essential for professionals to know the best therapeutic strategies for successful treatment.

PROPOSAL

The aim of this study was to report a clinical case of endodontic surgery of a *dens invaginatus*, using PRF graft and freeze-dried bovine bone.

CASE PRESENTATION

A 41-year-old male patient came to the endodontics specialization clinic at the University of São Paulo, reporting as his main complaint pain located in the region of tooth 12.

In the intraoral examination, the horizontal, vertical and thermal percussion tests were performed, obtaining negative results, but the apical palpation test generated slight discomfort.

At first, a radiographic examination (Figure 1) was requested in order to complement the initial report and the patient's clinical examinations were carried out. The periapical radiograph showed that the tooth had already undergone endodontic treatment and had been handled twice by other professionals. The same examination revealed a periapical lesion and a very peculiar internal anatomy characteristic of a *Dens Invaginatus*. Based on this image, the team decided to request a 3D cone-beam volumetric computed tomography scan (Figure 3) which, according to the European Society of Endodontology, is a type of scan that provides a better pre- and post-operative assessment, facilitating diagnosis and treatment planning.

The mesial root showed a lesion and the distal root showed a trepanation in the apical third with leakage of a filling material (Figure 4). As all conventional treatment methods had already been exhausted, we opted for parendodontic surgery, the last alternative for restoring the health of the tooth.

Figure 1: In this image we can see the presence of a circumscribed periapical lesion in the region of element 12, in the mesial root and in the distal root there is leakage of filling material involving the apical third of the canal.

Figure 2: Initial panoramic radiograph.

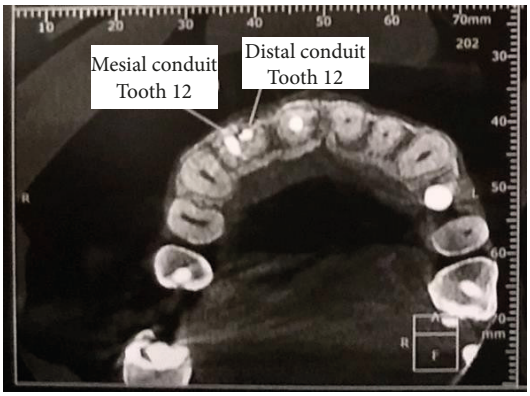

Figure 3: Axial volumetric computed tomography image showing the presence of two conduits in tooth 12.

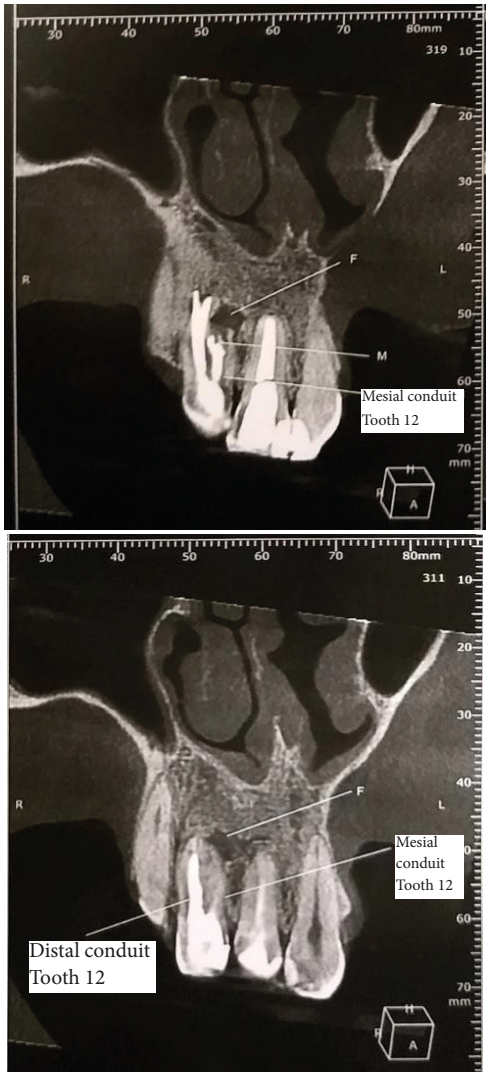

Figure 4: Coronal volumetric computed tomography image showing the periapical lesion in the mesial root and the perforation with leakage of filling material in the distal root.

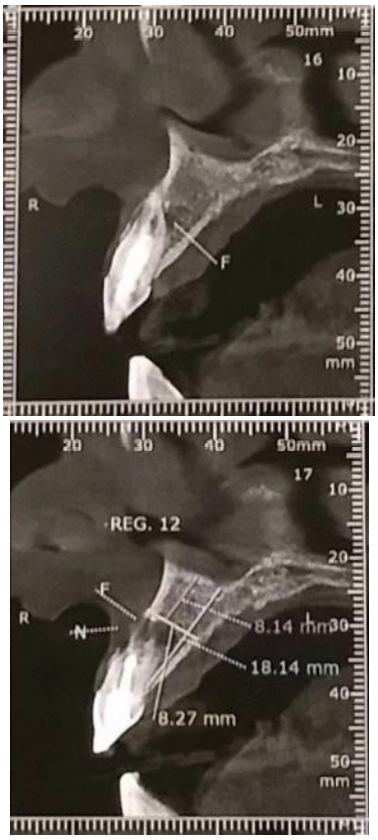

Figure 5- Sagittal volumetric computed tomography image showing the periapical lesion.

The treatment plan for this case was parendodontic surgery with PRF grafting and retrofilling using bioceramic cement, with this a pre-operative consultation was scheduled, in which laboratory tests were requested, the post-operative recommendations with diet tips and the medications that would be taken after the procedure.

Figure 6- Biomedical technician collecting blood from the patient to prepare the PRF graft.

On the date of the surgery, the patient underwent antibiotic prophylaxis one hour before the start of the surgery (one capsule of amoxicillin 875mg and one tablet of dexamethasone 4mg), the patient signed the consent and authorization forms and blood was taken for the preparation of the PRF graft and the membrane (Figure 6). Once the patient was in the dental chair, we carried out the extra-oral antisepsis procedure using 2% chlorhexidine and intra-oral antisepsis by rinsing the mouth for 1 minute with a 0.12% chlorhexidine solution.

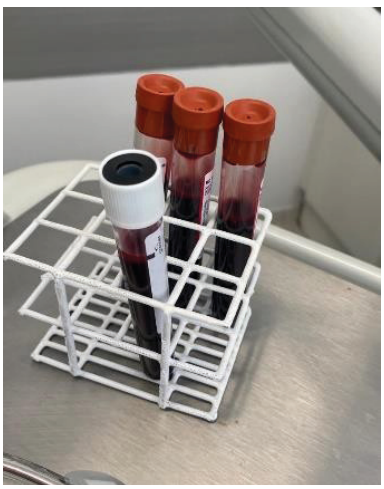

Figure7-Tubes after blood collection

Figure 8- Surgical table equipped with all previously sterile instruments

We began the procedure by anesthetizing the region, first placing lidocaine gel 2% for 3 minutes under the mucosa, we began the anesthesia using the infiltrative technique reaching the anterior and middle superior alveolar nerve with 2 glass tubes of articaine with epinephrine (Figure 9), with the region anesthetized we began the incision with a number 11 scalpel blade, A relaxing incision was made in the distal part of tooth 14 and in the papilla of teeth 14, 13, 12, 11 and 21 (Figure 10) so that the gingiva could be carefully detached without tearing the tissue. With the aid of a Molt detacher, we divulsed the periosteum, making it easier and more precise to reach the surgical site.

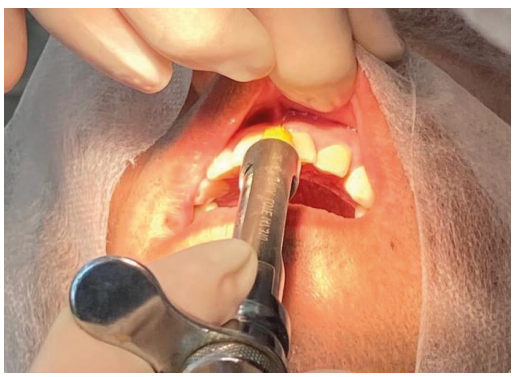

Figure 9- Infiltrative anesthesia on the anterior superior alveolar nerve

Figure 10- Papilla incision using blade no. 1

Using a 1016 and 1016Hl drill at high speed and sterile 0.9% saline solution (Figure 11), we irrigated the area so that there would be no overheating of the surgical site. We began the osteotomy with the aim of removing the first layer of bone covering the roots of tooth 12, and once we had access to the lesion, we carried out the enucleation with the aid of the lucas curette nº85 and periodontal curettes, and with a bone file we were able to regularize the ridge (Figure 12).

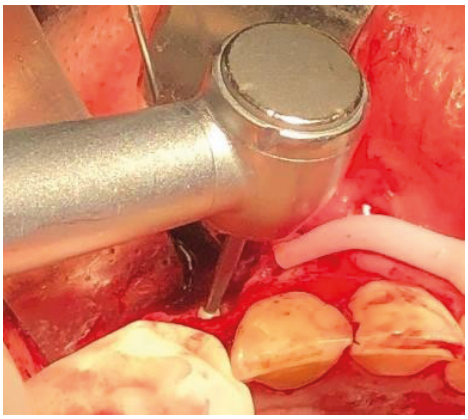

Figure 11- Ostectomy using high rotation and passive irrigation with sterile saline 0.9%

Figure 12- Enucleation of the lesion.

We performed a 2 mm apicectomy of the mesial and distal roots, using high rotation drills (4072, 3195 and 3071) and hydration with sterile saline solution (Figure 13).

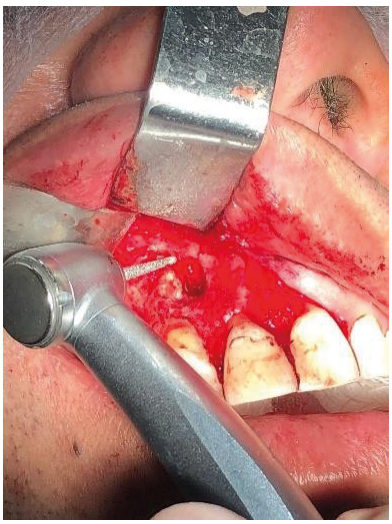

Figure 13- 2mm apicoectomy using high rotation.

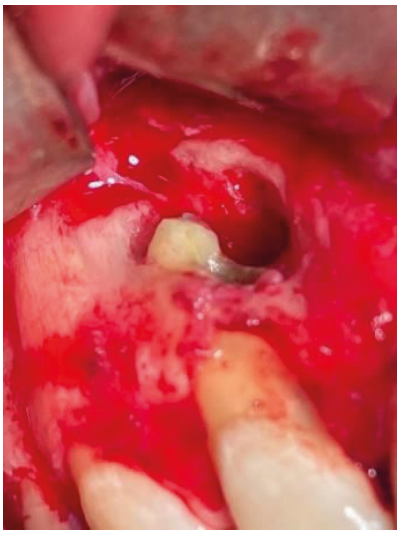

Figure 14- After apicectomy.

The helse P1 ultrasound tip was used for the retropreparation and the gutta percha was removed 3 mm deep.

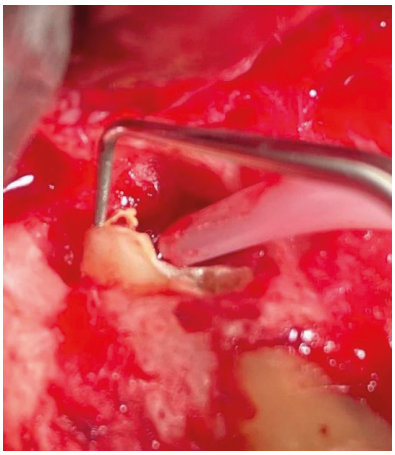

Figure 15- Retropreparation using ultrasound tip, this image shows the gutta-percha cone coming out of the canal.

After the retropreparation, we began photodynamic therapy (PDT), which aims to improve decontamination by reducing the microbial load in the area. In order for the laser to be effective, a photosensitive dye must be applied and held for 5 minutes, after which it must be subjected to light at 9J so that it acts directly on the bacteria.

Figure 16- PDT

With the PDT complete, we could start retro-coating with bio c repair manipulated on a sterile glass plate and flexible spatula 24.

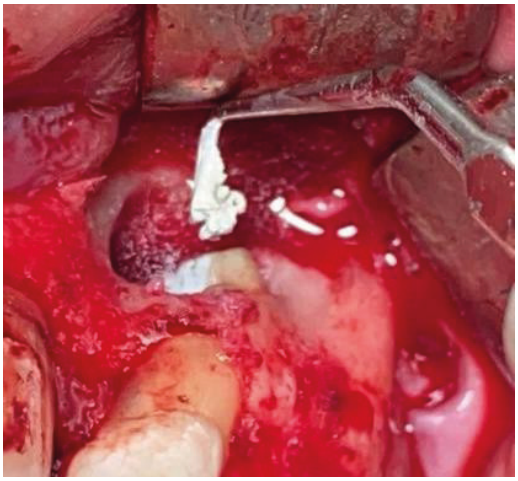

Figure 17- Backfilling with Bio c repair cement.

The edge of the root region and the surgical site were then smoothed with a bone file and the PRF graft was placed. After collecting the patient's blood, the tubes with red lids, which contained the PRF graft, were taken to the hospital.

the silica adjuvant was coupled in a centrifuge at 2,000 rpm for 10 minutes for the membrane to be formed, then the white cap tube was coupled to the centrifuge without adjuvant at a rotation of 2,000 rpm for another 10 minutes, so the L-PRF was formed, the intermediate part was removed, where the PRF is, this mass was mixed with the freeze-dried bovine bone and accommodated in the surgical store.

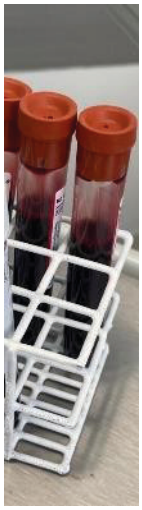

Figure 18- tube containing silica for membrane formation

Figure 19- After centrifugation, the formation of L-PRF can be seen.

Figure 20- In this image we can see the PRF, mixed with the freeze-dried bone of bovine origin and the two autogenous membranes (taken from blood, after centrifugation).

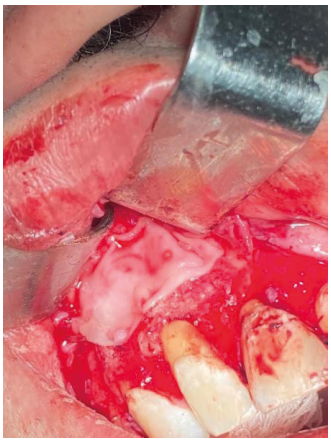

Figure 21- Atapetamento da membrana.

Using a needle holder and surgical tweezers, we were able to suture and join the ridge using a 4.0 silk needle with the interpapillary suture, involving the palate. To this end, we supplemented anesthesia in the palatal region.

Figure 22- Periapical radiograph immediately after surgery.

Figure 23- Periapical radiograph 1 month after surgery.

Figure 24- Intraoral examination 1 month after surgery.

DISCUSSION

Parendodontic surgery is recommended when the patient has clinical and radiographic signs and symptoms of endodontic origin. It can be an excellent alternative when it comes to persistent lesions, inaccuracy after conventional endodontic treatments, conduits that are obliterated by instruments, the impossibility of removing prosthetic parts, perforations that make repair impossible and leakage of obturator material. In order for surgical treatment to be successful and apical healing to be good, it is important to analyze bone regeneration after the procedure. Various authors have analyzed the correct step-by-step procedure for this type of treatment to have the best prognosis. According to Angerame *et al* in 2015, endodontic surgeries performed with PRF grafts have better healing, this is a biomaterial that has great osteogenic properties, being effective for 1 week after surgery (Karan *et al* in 2020). This type of graft does not need anticoagulant agents or gelling components added to the container, so when the patient's blood is removed, the tube must be quickly attached to the centrifuge so that the fibrinogen transformation process can begin. During the centrifugation process, the fibrinogen settles at the top of the tube, thus slowly according to Shah *et al* in 2019, this region contains polymerized fibrin, platelets,

white blood cells and glycosaminoglycans (heparin, hyaluronic acid), while red blood cells are concentrated at the bottom of the tube. The use of the PRF graft in apical surgery is justified mainly by its biological properties, generating the deposition of growth factors (Sureshbabu *et al* in 2019, Pinto *et al* in 2017) performing cell migration, proliferation and differentiation, being favorable for good healing of the bone region, remodeling and angiogenesis in medium and large periapical lesions (Liu *et al* in 2020), however Meschi *et al* in 2020, carried out a study that showed that after 1 year the L-PRF showed no improvement in healing, which corroborates the study by Karan *et al* who in the same year, reached similar results, reporting that the use of the PRF graft did not generate major changes in the surgical outcome.

Dhamija *et al* in 2020 reported that PRF grafting is most indicated when the periosteum is absent on one or both sides of the tooth, vestibular and lingual, so that after 12 months, using volumetric computed tomography, the professional can see significant healing results.

Several authors (Sureshbabu, *et al* in 2019, Sharma *et al* in 2018, Angerame *et al* in 2015, Karan *et al* in 2020, Shah *et al* in 2019) have reported rotational speeds of between 2,500 and 3,000 RPM varying between 10-15 minutes, but according to Kobayashi, *et al* in 2016 lower speeds allow platelet cells and white cells (monocytes and macrophages) to increase in volume.

The gelatinous characteristic and autologous origin of L-PRF showed positive results, facilitating the handling and adaptation of the material, according to DeNicolo *et al* in 2015, but this type of graft did not show significant results in just 8 weeks, however when coupled with the Bio-Oss graft they obtained better repair and healing in the same period.

According to Alkadi *et al* in 2021, the lateral incisors were the teeth most commonly found with *dens invaginatus*, and the coronal region of these teeth showed greater anatomical alterations, although this was not the case with the teeth on the side. Siqueira *et al* in 2022 found that teeth with ID are more prone to pulp and periradicular disease.

Three-dimensional technology in endodontics has enabled professionals to draw up treatment plans and make more effective diagnoses. In *dens invaginatus*, caution is essential when assessing and planning treatment. Zhu *et al* (2017) and Schloss *et al* in the same year carried out a study using 3D technology in favor of endodontics, understanding that these means allow better precision when assessing the dimensions of lesions and the healing of the region when compared to 2D periapical radiography.

After the apicification process, backfilling with a biocompatible material in the apical third is necessary, and is one of the fundamental parts of successful treatment. According to Miralles *et al* in 2021, the material chosen must provide specific characteristics, such as good canal sealing, prevent the proliferation of bacteria in the surrounding periradicular tissues (bactericidal or bacteriostatic), favorable dimensional stability, not be resorbable and be biocompatible with the tissue. In the 1990s, bioceramic cements were introduced, raising the bar for surgical procedures in endodontics. In addition to having all the characteristics needed for a good retroobturator material mentioned above, it also allows cell proliferation and mineralization, as well as having good antibacterial capacity against E. *faecalis*, due to its pH. Karan *et al* in 2020 showed that the adaptation of MTA in parendodontic surgery is fundamental for the treatment to have a better prognosis.

CONCLUSION

The anatomical complexity, both external and internal, of the *dens invaginatus* makes its structure fragile. In order to make the best choice of treatment plan, it is essential to assess the condition of the pulp and its root development, which can range from a more conservative treatment such as restorations to apical surgery.

Parendodontic surgery is considered the last treatment option after all conventional endodontic alternatives have been exhausted.

The grafting method using fibrin-rich plasma is a technique widely used in endodontic surgery for better healing and bone regeneration. For a better assessment of the healing of the periapical lesion, a volumetric computed tomography scan is recommended.

ACKNOWLEDGMENTS

First of all, I would like to thank my family, who have always been by my side, supporting me and giving me the strength to keep fighting throughout this stage of my life, making me feel sure of all my choices and my future.

Many thanks to my husband, Guilherme Neres, who shared this moment with me, was patient when I had to leave and helped me in the most difficult moments, giving me tips and moral support for the development of much of my university work.

I would also like to thank my friends and classmates for all the work we did together during the course and for all their support on a daily basis.

I would like to thank my advisor Karina Salzano for giving up her time to help and guide me through this work, clearing up my doubts and giving me all the support I needed.

Finally, thank you very much to everyone I met during this journey!

REFERENCES

Alkadi M., Almohareb R., Mansour S., *et al.* Assessment of dens invaginatus and its characteristics in maxillary anterior teeth using cone-beam computed tomography. **Scientifc Reports**. V.11, 2021.

Angerame D, Biasi MD, Kastrioti I, et al. Application of platelet-rich fibrin in endodontic surgery: a pilot study. **Giornale Italiano di Endodonzia**. V.29, p.51- 57,2015.

Chen J.W., Huang G.T.J., Bakland L.K. Dens evaginatus Current treatment options. **JADA.** V. 5, n.151, p. 358-367, 2020.

DeNicolo PJ, Guyton MK, Cuenin MF, et al. Histologic Evaluation of Osseous Regeneration Following Combination Therapy With Platelet-Rich Plasma and BioOss in a Rat Calvarial Critical-Size Defect Mode. **Journal of Oral Implantology**. V.41, n.5, p. 543-549, 2015.

Dhamija R, Tewari S, Sangwan P, et alImpact of Platelet-rich Plasma in the Healing of Through-andthrough Periapical Lesions Using 2-dimensional and 3- dimensional Evaluation: A Randomized Controlled Trial. **Journal of Endodontics**. v.46, n.9, p.1167-1184, 2020.

Karan NB, Aricioglu B. Assessment of bone healing after mineral trioxide aggregate and platelet-rich fibrin application in periapical lesions using cone-beam computed tomographic imaging. **Clin Oral Invest**. V.24, p.1065-1072, 2020.

Kobayashi E., Flückiger L., Kobayashi MF., *et al.* Comparative release of growth factors from PRP, PRF, and advanced-PRF. **Clin Oral Invest**. V.20, p.2353- 2360,2016.

Liu T.J, Zhou J.N, Guo LH. Impact of different regenerative techniques and materials on the healing outcome of endodontic surgery: a systematic review and meta-analysis. **International Endodontic Journal.** V. 54, p. 536–555, 2021.

Meschi N, Vanhoenacker A, Strijbos O, et al. Multi-modular bone healing assessment in a randomized controlled clinical trial of root-end surgery with the use of leukocyteand platelet-rich fibrin and an occlusive membrane. **Clin Oral Invest**. V.24, p.4439-4453,2020.

Miralles PM, Barranco RI, Balsera DC, *et al*. Biomaterials in periapical regeneration after microsurgical endodontics: A narrative review. **J Clin Exp Dent.** V.13, n. 9, p. 35-40, 2021.

Pandey P, Nandkeoliar T, Bains R, *et al*. Use of mineral trioxide aggregate for retreatment of a tooth with large periapical lesion, wide-open apices and vertical root fracture. **BMJ Case Rep.** p. 1-5, 2018.

Pinto N., Harnish A., Cabrera C., *et al*. An Innovative Regenerative Endodontic Procedure Using Leukocyte and Platelet-rich Fibrin Associated with Apical Surgery: A Case Report. **Journal of Endodontics**. v. 43, n. 11, p- 1828-1834, 2017.

Schloss T., Sonntag D., Kobli M.R., *et al*. A Comparison of 2- and 3- dimensional Healing Assessment after Endodontic Surgery Using Cone-beam Computed Tomographic Volumes or Periapical Radiographs**. Journal of endodontics.** v. 43, p. 1072-1079, 2017.

Shah R, Gowda TM, Thomas R, *et al*. Ativação biológica de enxertos ósseos por injeção de fibrina rica em plaquetas. The Journal of Prosthetic Dentistry. 2019;121:3

Sharma S, Sharma V, Passi D, *et al*. Large Periapical or Cystic Lesions in Association with Roots Having Open Apices Managed Nonsurgically Using 1-step Apexification Based on Platelet-rich Fibrin Matrix and Biodentine Apical Barrier: A Case Series. **Journal of Endodontics**. v.44, n.1, p.179-185, 2018.

Siqueira J.F., Rôças I.N., Hermández S.R., *et al*. Dens Invaginatus: Clinical Implications and Antimicrobial Endodontic Treatment Considerations. **Journal of Endodontics**. v. 48, n.2, p- 161-170, 2022.

Sureshbabu, NM, Selvarasu K, Kumar J, *et al*. Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases. **Case Reports in Dentistry.** n.6, p. 1-6, 2019

Sutter E., Valdec S., Bichsel D., *et al*. Success rate 1 year after apical surgery: a retrospective analysis. **Oral and Maxillofacial Surgery.** V.24, p. 45-49, 2020.

Viganò R., Disconzi M., Bertini E., *et al.* Bio-Plasma® with Pure Growth Factors (BioPlasma®) Used for the Treatment of a Persistent Great Periapical Lesion of an Endodontically Treated Tooth: A New Therapeutic Option. **Case Reports in Dentistry.** p.1-6,2020.

Zhu J., Wang X., Fang Y., *et al*. An update on the diagnosis and treatment of dens invaginatus. **Australian Dental Association.** v.62, p- 261-275, 2017.