CASE REPORT / *CAS CLINIQUE*

Surgery / *Chirurgie*

SURGICAL SYMPHONY: TACKLING LARGE PERIAPICAL CYSTS WITH PRECISION

Paridhi Agrawal[1] | Manoj Chandak[1] | Pooja Agrawa[1] | Nitin Bhola[1] | Rajnikant Kambala[1] | Samiha Khan[1] | Aayushi Pakhale[1] | Jay Bhopatkar[1] | Tejas Suryawanshi[1] | Palak Hirani[1]

Abstract: This case report details the comprehensive treatment of a large radicular cyst in a 48-year-old male with a five-year history of swelling and pus discharge in the upper anterior jaw. Clinical and radiographic examinations, including CBCT, revealed a significant periapical lesion involving multiple teeth. The multidimensional treatment began with meticulous endodontic therapy for teeth 12, 11, 21, and 22, followed by Platelet-rich fibrin (PRF) application to enhance healing. Surgical cystic enucleation was performed under local anesthesia, involving flap elevation and cyst removal, confirmed by biopsy as a radicular cyst. Apicoectomy and retrograde filling with mineral trioxide aggregate (MTA) were executed. A nanocrystalline hydroxyapatite (NCHA) bone graft was placed in the cystic cavity to promote bone regeneration. Six-month follow-up radiographs showed significant bone regeneration, validating the success of this tailored, evidence-based approach, and contributing valuable insights into periapical cyst management.

Keywords: Nanocrystalline hydroxyapatite bone graft, Periapical cyst, Surgical enucleation, Apicoectomy, Platelet-rich fibrin

Corresponding author:
Paridhi Agrawal, e-mail: paridhiag08@gmail.com

Conflicts of interest:
The authors declare no conflicts of interest.

1. Sharad Pawar Dental College and Hospital, Datta Meghe Institute of Higher Education and Research, Wardha, Maharastra, India.
E-mails: paridhiag08@gmail.com ; drmanojchandak@yahoo.com ; Dragrawal47@gmail.com ; drnitinbhola@gmail.com ; rajanikanthmalaviya@gmail.com ; Samiha.khan26@gmail.com ; pakhaleaayu@gmail.com ; jbhopatkar0@gmail.com ; tejassuryawanshi8997@gmail.com ; palakhi1rani13@gmail.com

SYMPHONIE CHIRURGICALE: ABORDER LES GRANDS KYSTES PÉRIAPICAUX AVEC PRÉCISION

Résumé: Ce cas clinique décrit le traitement complet d'un grand kyste radiculaire chez un homme de 48 ans présentant un historique de cinq ans de gonflement et de sécrétion de pus dans la région antérieure supérieure de la mâchoire. Les examens cliniques et radiographiques, y compris la tomographie volumique à faisceau conique (CBCT), ont révélé une lésion périapicale importante impliquant plusieurs dents. Le traitement multidimensionnel a commencé par une thérapie endodontique méticuleuse des dents 12, 11, 21 et 22, suivie de l'application de fibrine riche en plaquettes (PRF) pour améliorer la guérison. L'énucléation chirurgicale du kyste a été réalisée sous anesthésie locale, impliquant l'élévation d'un lambeau et l'ablation du kyste. La biopsie l'a dignostiqué comme un kyste radiculaire. Une chirurgie à retro apicectomie et un remplissage rétrograde avec de l'agrégat de trioxydes minéraux (MTA) ont été effectués. Un greffon osseux en hydroxyapatite nanocristalline (NCHA) a été placé dans la cavité kystique pour promouvoir la régénération osseuse. Les radiographies de suivi à six mois ont montré une régénération osseuse significative, validant le succès de cette approche sur mesure et basée sur des preuves, et apportant des informations précieuses sur la gestion des kystes périapicaux.

Mots clés: Greffon osseux en hydroxyapatite nanocristalline, Kyste périapical, Énucléation chirurgicale, Apicectomie, Fibrine riche en plaquettes

Introduction

In accordance with the stipulated definition, a "cyst" is delineated as a pathological cavity primarily characterized by an epithelial lining, often containing fluid or semifluid material, excluding pus [1]. In a broader classification, cysts can be categorized as either developmental or odontogenic [2]. Radicular cysts fall under the odontogenic classification [3]. Within the spectrum of cystic infections occurring in the mouth, radicular cysts are notably prevalent, constituting approximately 53% of lesions and 63% of lesions with an odontogenic origination [4, 5]. Instances of chronic trauma, caries, or injuries to teeth can incite pulpal irritation, leading to necrosis and chronic apical periodontitis. This, subsequently, triggers cellular proliferation and initiates cystic degeneration. The origin of radicular cysts is attributed to inflammation stemming from the stimulation of epithelial cell rests of Malassez within the periodontal ligament [6]. The progression of a cyst unfolds through three distinct phases: cyst initiation, cyst development, and cyst expansion [7].

The highest occurrence is observed between the third and fifth decades, with a more prevalent occurrence in men compared to women. The maxillary anterior region is most frequently affected, followed by the mandibular premolar region. Radicular cysts typically manifest as asymptomatic and often go unnoticed, being primarily detected incidentally during routine radiographic examinations. Some patients, however, may show symptoms that include cystic edema, tooth movement, and displacement [8]. The primary management of cystic lesions should be nonsurgical means, however, in instances where there is a persistent alteration in peri-radicular tissue that cannot be effectively addressed through nonsurgical means, a surgical approach is commonly favored.

Platelet-rich fibrin (PRF) is linked to the formation of a concentrated film of platelets, creating a fibrin clot that contains both platelets and released cytokines. The important aspect of this process involves measuring the platelet cytokines in the PRF, as these soluble substances play a pivotal role as mediators in inflammation and healing [9]. PRF is a naturally derived component from blood and is linked with immune and platelet concentrates that include all the components of blood, facilitating an accelerated process of wound healing [10]. Rich in various growth factors such as platelet-derived growth factor (PDGF), insulin-like growth factor (IGF), transforming growth factor β1 (TGF β1), and vascular endothelial growth factor (VEGF), among others, PRF exhibits essential characteristics such as cell proliferation, differentiation, migration, and attachment [11].

Using a bone graft after periapical surgery and cyst enucleation facilitates the acceleration of bone regeneration in the afflicted region. The bone graft gradually dissolves and provides the groundwork for the development of new bone. Furthermore, bone grafts can serve as an osteoconductive substance that promotes osteoprogenitor cell migration, stabilizes blood clotting, and expedites bone healing [12]. This case report summarizes the treatment of a substantial radicular cyst utilizing PRF, bone graft, and a retrograde plug of MTA.

Case Presentation

A 48 years old male patient resident of Hinganghat reported to the Department of Conservative Dentistry and Endodontics of Sharad Pawar Dental College and Hospital, Wardha, Maharashtra, India, with a chief complaint of swelling and pus discharge from the upper front region of the jaw for the last 5 years. The patient declared a history of trauma in the same region approximately 15-20 years ago, resulting in mild pain in the upper front region that was alleviated with medication. Upon clinical examination, an Ellis type I fracture was identified with teeth 11, 31, and 32, along with vertical tenderness on percussion positive with teeth 11, 21, and 22. Swelling and pus discharge were observed in the 11 and 21 region, as shown in Figure 1A.

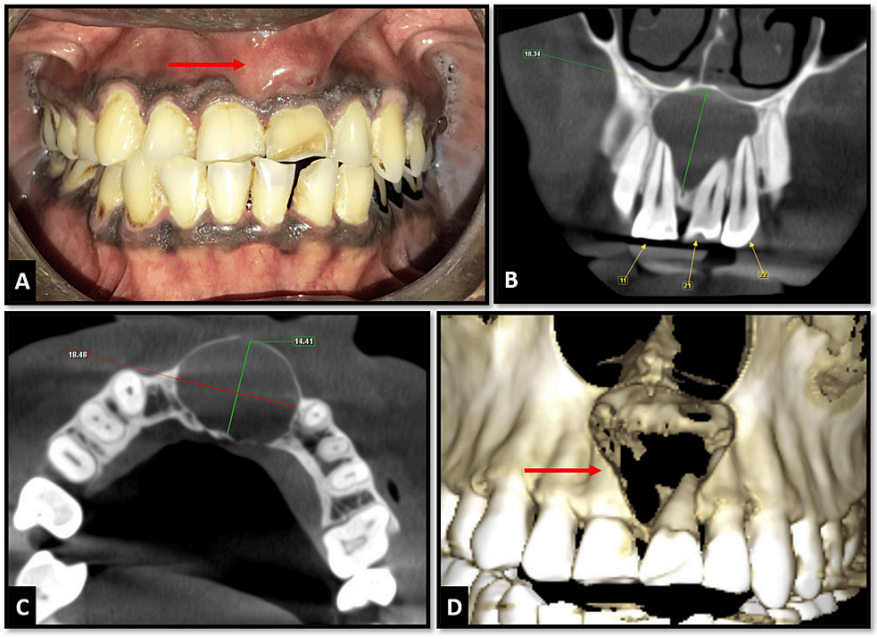

Figure 1. Pre-operative images A- Clinical picture. B- Coronal CBCT view. C- Axial CBCT view. D- Bony view (CBCT- Cone Beam Computed Tomography)

Pulp sensibility testing revealed no response with teeth 12, 11, 21, and 22. Radiographic examination indicated periapical radiolucency associated with teeth 12, 11, and 21, and a CBCT revealed a sizable periapical defect of 18.34 mm x 18.48 mm x 14.41 mm as shown in Figures 1B, 1C, 1D. These comprehensive findings established a conclusive diagnosis of tooth necrosis with a periapical cyst involving 12, 11, 21, and 22. Subsequently, the decision was made to proceed with surgical cystic enucleation, informed consent was acquired from the patient, and the treatment commenced.

Endodontic treatment protocol

The access opening pertaining to teeth 12, 11, 21, and 22 was meticulously carried out using small round and safe-end diamond-coated burs (Mani, Japan). Following this, the working length was established with the aid of an electronic apex locator (J W Morita, Japan), and this measurement was subsequently verified through radiographic assessment. The biomechanical preparation was conducted using hand K-files (Mani, Japan). The master apical file utilized was a #60K-file, and the step-back technique was applied up to a #80K-file. During biomechanical preparation, 5.25% NaOCl (Parcan, Septodont, France) was employed as an irrigant, followed by 17% liquid EDTA (Prime, India), with saline serving as the final irrigant.

Calcium hydroxide Ca(OH)2 (RC Cal, Prime, India) was employed as an intracanal medicament, introduced into the prepared root canal for two dressings with a one-week interval. Considering the scheduled periapical surgery, obturation was carried out using gutta-percha points through the lateral condensation technique, employing a bioceramic-based root canal sealer (CeraSeal, Meta BioMed, Europe), following sealing of access cavity with composite resin (3M ESPE Filtek Z250 Xt, Minnesota, United States) as shown in Figure 2A.

Surgical treatment protocol

Around 10 milliliters of venous blood were withdrawn from the patient during the surgical procedure and carefully divided into two sterile vacutainer tubes (Becton Dickinson, USA), each accommodating 5 ml, without the addition of an anticoagulant. Subsequently, these tubes underwent processing in a tabletop centrifugation machine (Remi Lab World, India), operating continuously at three thousand revolutions per minute for approximately 600 seconds. The resulting product displayed distinct layers: there was a red bottom layer containing red blood cells, followed by the mid layer housing the fibrin clot, and lastly, an upper straw-colored layer comprising cellular plasma. The critical mid layer, known as PRF, encompassing the fibrin clot, was carefully isolated after separating the red blood cells and plasma. It is important to note that the interface layer between cellular plasma and the fibrin clot was handled with particular care during this process, as it contains elevated concentrations of platelets.

The surgical intervention was carried out under local anesthesia, involving the infiltration of 2% local anesthesia containing adrenaline in the anterior region. A full-thickness flap was meticulously elevated to facilitate the enucleation of the cyst (Figure 2B).

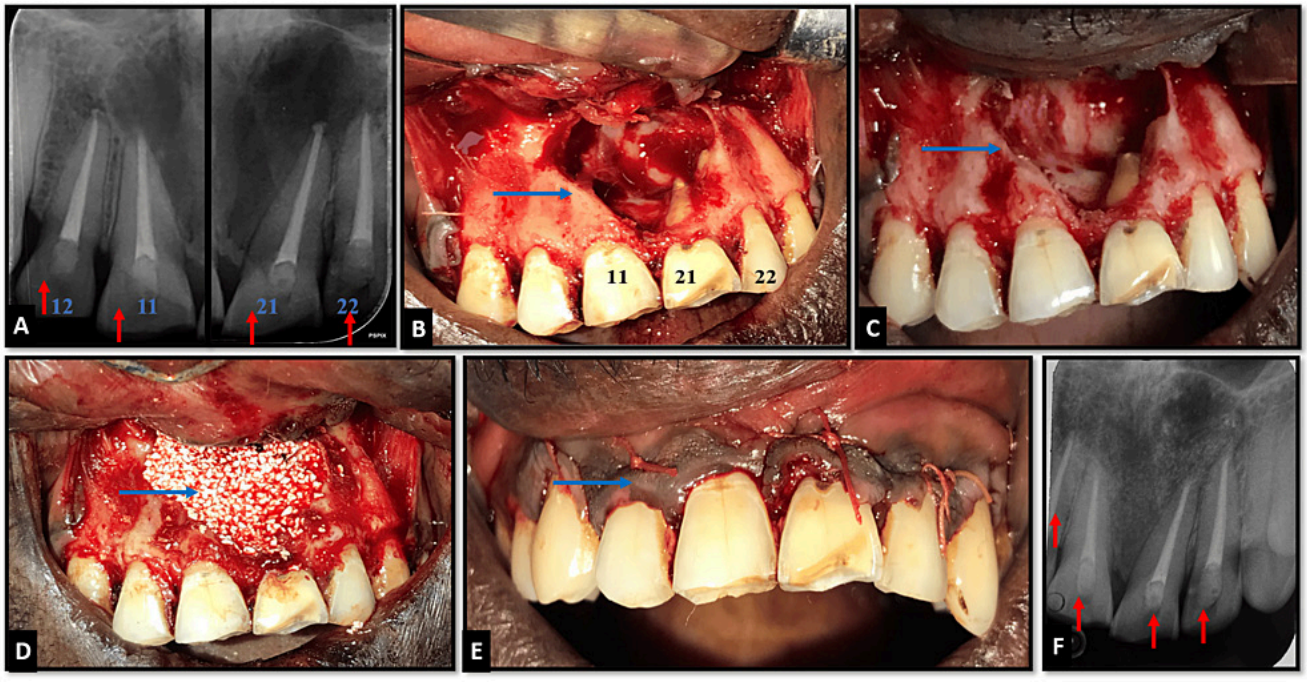

Figure 2. Procedure performed. A- Radiograph after completion of endodontic treatment. B- Clinical image after flap elevation and cyst enucleation. C- Clinical image after apicoectomy. D- Clinical image after placement of PRF and bone graft. E- Clinical image showing repositioned and sutured flap. F- Immediate post-operative radiograph (PRF- platelet-rich fibrin)

A biopsy sample was obtained during the procedure for subsequent pathological examination. Apicoectomy was then performed, followed by root-end preparation using tungsten carbide burs (SS White Burs, USA), and the retrograde filling was achieved using MTA (Angelus, Brazil), as shown in Figure 2C. Additionally, prefabricated PRF and nanocrystalline hydroxyapatite (NCHA) bone graft (particle size 45-50 nm, Sybograf, Eucare Pharmaceuticals, India) was carefully placed within the cystic cavity, and the surgical site was systematically sutured to complete the procedure as shown in Figures 2D, 2E. As shown in Figure 2F, an immediate postoperative radiograph was taken, post-operative instructions were given to the patient, and the patient was recalled for follow-up after 7 days.

The biopsy acquired during the surgical procedure underwent examination, confirming the existence of a radicular cyst, as shown in Figures 3A, 3B.

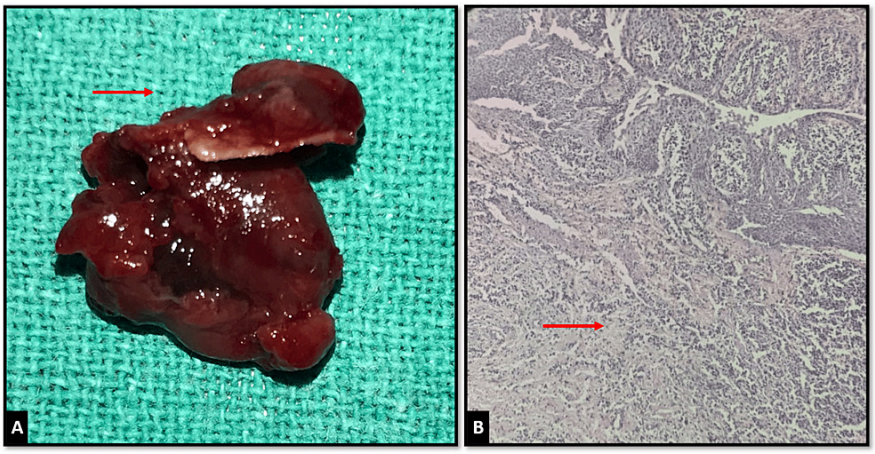

Figure 3. Histopathological diagnosis. A- enucleated cystic lining biopsy specimen. B- Histopathological image

Figure 4. Follow-up radiographs. A- immediate post-operative radiograph. B- 6-months follow-up radiograph

Follow-up examinations

Following this confirmation, the patient underwent follow-up assessments at 3, and 6 months post-surgery. Notably, no symptoms such as discomfort, swelling, or pain were noted throughout the entire review phase. The patient has further been recalled for follow-up at 9 months, and 1 year post-surgery. Regular intraoral examinations, radiographic evaluation, and plaque control were carried out during each follow-up visit, actively contributing to the continuous monitoring and maintenance of the patient's oral health as shown in Figure 4.

Discussion

A steady and ongoing procedure marks the progression of a periapical cyst. Pathological activation of cell rests of malassez initiates the development of cystic fluid, primarily composed of cholesterol, in the vicinity of the apex. Cystic expansion occurs as a consequence of the cystic fluid, and there is a potential for infection [13]. Pathognomonic indicators of cysts include lateral root displacement and tooth mobility. While a conclusive determination of a cyst can only be established through histopathological assessment, the preliminary assessment in this case utilized CBCT criteria. These criteria encompassed features such as lesion localization at the tooth apex, well-defined corticated borders, a radiolucent internal structure, a curved or circular shape, cortical plate perforation in the surrounding bone, and evidence of displacement and root resorption [14]. Treatment decisions rely on multiple factors, encompassing the genesis and degree of the lesion, its proximity to important frameworks, clinical characteristics, comprehensive circumstances, and cooperation from the patient [15]. Based on these considerations, a provisional diagnosis of a cyst was made, leading to the decision to proceed with surgical cystic enucleation.

The management of cysts like these continues to be a topic of debate and contention. When dealing with smaller lesions, many practitioners choose endodontic treatment as a conservative approach. In the current scenario, endodontic treatment was performed over several sessions, incorporating provisional Ca(OH)2 medication.

The utilization of intracanal dressings across several visits plays a vital role in reducing microbial levels, particularly in cases involving chronic periapical lesions. Ca(OH)2 aids in reaching regions inaccessible by instrumentation or irrigation, such as ramifications and dentinal tubules. The hygroscopic properties of Ca(OH)2 have proven to be highly effective clinically in reducing exudate. Studies suggest that a minimum of 14 days is required for optimal antimicrobial activity following the application of Ca(OH)2 medication [16]. However, in cases of larger periapical lesions, relying solely on endodontic treatment may not achieve complete bacterial eradication. Therefore, marsupialization/decompression or even enucleation becomes essential [17].

Surgery becomes imperative if the periapical lesion is indeed a genuine cyst, given its autonomous nature, rendering it less responsive to conventional endodontic treatment. Bioceramic sealer, was selected for its heightened antimicrobial activity against endodontic pathogens, bioactivity, and better sealing ability compared to other sealers. In addition to its healing-promoting properties, PRF has demonstrated efficacy in minimizing post-op hematoma, owing to its excellent sealing capability with fibrin adhesive [18]. The success of PRF utilization is dependent on prompt blood collection and transport to the centrifuge. Without an anticoagulant in the test tubes, the blood tends to coagulate upon contact, necessitating rapid centrifugation to concentrate fibrinogen in the center and top regions of the test tube [19]. Timely manipulation is crucial to obtaining clinically beneficial PRF, as prolonged blood collection and centrifugation durations render the process ineffective. Prolonged durations lead to diffuse polymerization of the acquired fibrin, yielding minimal fibrinogen with inconsistent properties [20].

Using a bone graft after periapical surgery and cyst enucleation accelerates bone regeneration in the affected area. The graft gradually dissolves, creating a foundation for new bone development. Additionally, bone grafts promote osteoprogenitor cell migration, stabilize blood clotting, and expedite bone healing [12]. In this instance, a nanocrystalline hydroxyapatite (NCHA) bone graft was used. According to a study, NCHA is a great scaffold for bone defect regeneration because of its strong cell adhesion, osteoblast viability, and intrinsic osteoconductivity, and the combination of PRF and NCHA showed faster healing potential [21]. MTA is frequently preferred due to its superior sealing, bacteriostatic activity, and effective biocompatibility as a retrograde filling material. MTA has demonstrated clinical and radiographic effectiveness in establishing root-end closure [22, 23].

Thus, the comprehensive management approach in this case, involving endodontic treatment, surgical cystic enucleation, and the strategic use of bio-ceramic sealer, PRF, nanocrystalline hydroxyapatite (NCHA) bone graft, and MTA, was designed to address the intricate nature of periapical cysts. The adherence to CBCT criteria for diagnosis and treatment planning accordingly, substantiate the rationale behind these interventions. The integrated therapeutic modalities proved effective in achieving substantial bone formation, emphasizing the importance of a tailored and evidence-based approach in managing challenging cases. This case provides beneficial knowledge to the currently underway conversation on cyst management and underscores the significance of a holistic strategy for optimal clinical outcomes.

Conclusion

While contemporary periapical cyst management predominantly leans towards nonsurgical methodologies, our case underscores the nuanced reality that the size and extent of the lesion may necessitate surgical intervention for optimal success. The successful outcome in our current case is attributed to the deliberate execution of endodontic therapy, encompassing thorough irrigation, cleaning, shaping, and canal space obturation, followed by a judicious surgical approach. This integrated strategy navigates the challenges posed by large periapical cysts and exemplifies the professional commitment to tailored, multidimensional methodologies for enduring and successful outcomes.

Acknowledgment

None

References

1. Lin L, Chen MY, Ricucci D, Rosenberg PA: Guided tissue regeneration in periapical surgery. J Endod. 2010, 36:618-625. 10.1016/j.joen.2009.12.012
2. Calişkan MK: Prognosis of large cyst-like periapical lesions following nonsurgical root canal treatment: a clinical review. Int Endod J. 2004, 37:408-416. 10.1111/j.1365-2591.2004.00809.x
3. Giannobile WV, Hernandez RA, Finkelman RD, et al.: Comparative effects of platelet-derived growth factor-BB and insulin-like growth factor-I, individually and in combination, on periodontal regeneration in macaca fascicularis. J Periodontal Res. 1996, 31:301-312. 10.1111/j.1600-0765.1996.tb00497.x
4. Choukroun J, Diss A, Simonpieri A, et al.: Platelet-rich fibrin (PRF): a second-generation platelet concentrate. part IV: clinical effects on tissue healing. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2006, 101:0-60. 10.1016/j.tripleo.2005.07.011
5. Aroca S, Keglevich T, Barbieri B, Gera I, Etienne D: Clinical evaluation of a modified coronally advanced flap alone or in combination with a platelet-rich fibrin membrane for the treatment of adjacent multiple gingival recessions: a 6-month study. J Periodontol. 2009, 80:244-252. 10.1902/jop.2009.080253
6. Kaigler D, Cirelli JA, Giannobile WV: Growth factor delivery for oral and periodontal tissue engineering. Expert Opin Drug Deliv. 2006, 3:647-662. 10.1517/17425247.3.5.647
7. Shivashankar VY, Johns DA, Vidyanath S, Kumar MR: Platelet rich fibrin in the revitalization of tooth with necrotic pulp and open apex. J Conserv Dent. 2012, 15:395-398. 10.4103/0972-0707.101926
8. Natkin E, Oswald RJ, Carnes LI: The relationship of lesion size to diagnosis, incidence, and treatment of periapical cysts and granulomas. Oral Surg Oral Med Oral Pathol. 1984, 57:82-94. 10.1016/0030-4220(84)90267-6
9. Ali M, Baughman RA: Maxillary odontogenic keratocyst: a common and serious clinical misdiagnosis. J Am Dent Assoc. 2003, 134:877-883. 10.14219/jada.archive.2003.0286
10. Ribeiro PD Jr, Gonçalves ES, Neto ES, Pacenko MR: Surgical approaches of extensive periapical cyst. considerations about surgical technique. Salusvita. 2004, 23:317-328.
11. Leonardo MR, Silveira FF, Silva LA, Tanomaru Filho M, Utrilla LS: Calcium hydroxide root canal dressing. histopathological evaluation of periapical repair at different time periods. Braz Dent J. 2002, 13:17-22.
12. Agrawal P, Nikhade P, Patel A, Sedani S, Bhopatkar J: Management of discoloured anterior teeth with radicular cyst: a case report. Cureus. 2023, 15:e45536. 10.7759/cureus.45536
13. Tsurumachi T, Saito T: Treatment of large periapical lesions by inserting a drainage tube into the root canal. Endod Dent Traumatol. 1995, 11:41-46. 10.1111/j.1600-9657.1995.tb00678.x
14. Mallya S, Lam E: White and pharoah's oral radiology: principles and interpretation. Elsevier Health Sciences, Amsterdam, Netherland; 2019.
15. Matras H.: Fibrin sealant in maxillofacial surgery. development and indications. a review of the past 12 years. Facial Plast Surg. 1985, 2:297-313. 10.1055/s-0028-1085289
16. Kaur P, Dahiya V: Platelet-rich plasma: a novel bioengineering concept. Trends Biomater Artif Organs. 2011, 25:86-90.
17. Agrawal P, Nikhade P, Patel A, Bhopatkar J, Suryawanshi T: Pioneering periapical healing: the novel synergy of mineral trioxide aggregate and injectable platelet-rich fibrin. Cureus. 2023, 15:e46341. 10.7759/cureus.46341
18. Kim S, Kratchman S: Modern endodontic surgery concepts and practice: a review. J Endod. 2006, 32:601-623. 10.1016/j.joen.2005.12.010
19. Yoshimine Y, Ono M, Akamine A: In vitro comparison of the biocompatibility of mineral trioxide aggregate, 4META/MMA-TBB resin, and intermediate restorative material as root-end-filling materials. J Endod. 2007, 33:1066-1069. 10.1016/j.joen.2007.05.006
20. Bhopatkar J, Ikhar A, Nikhade P, Chandak M, Agrawal P: Emerging paradigms in internal root resorption management: harnessing the power of bioceramics. Cureus. 2023, 15:e45149. 10.7759/cureus.45149
21. Thanikasalam M, Ahamed S, Narayana SS, Bhavani S, Rajaraman G: Evaluation of healing after periapical surgery using platelet-rich fibrin and nanocrystalline hydroxyapatite with collagen in combination with platelet-rich fibrin. Endodontology. 2018, 30:25-31. 10.4103/endo.endo_55_17
22. de Lima Cavalcanti JH, Matos PC, Depes de Gouvêa CV, et al.: In vitro assessment of the functional dynamics of titanium with surface coating of hydroxyapatite nanoparticles. Materials (Basel). 2019, 12:840. 10.3390/ma12050840
23. Agrawal PR, Chandak M, Nikhade PP, Patel AS, Bhopatkar JK: Revolutionizing endodontics: advancements in nickel-titanium instrument surfaces.. J Conserv Dent Endod. 2024, 27:126-33. 10.4103/JCDE.JCDE_248_23