Case Report

DOI: 10.7860/JCDR/2026/82816.23342

Dentistry Section

Combining Mineral Trioxide Aggregate, Titanium-prepared Platelet-rich Fibrin and Hydroxyapatite Bone Graft in Apicoectomy as a Regenerative Strategy in Endodontic Surgery: A Case Report

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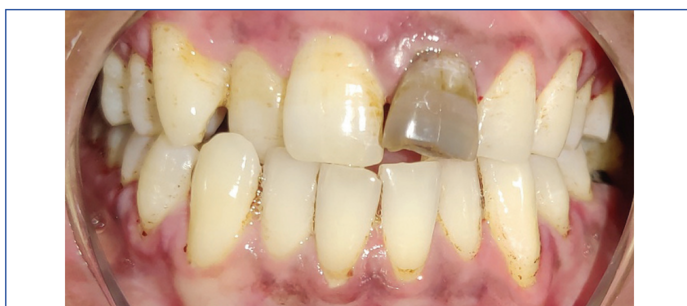
ABSTRACT

An apicoectomy is a microsurgical endodontic procedure performed to manage persistent periapical pathologies in teeth that have previously undergone root canal therapy. The technique involves a precise osteotomy to gain access to the periapical region, excision of the pathological tissue, resection of the apical portion of the root, and retrograde preparation and filling of the root-end cavity. Advances in regenerative endodontic surgery have focused on combining bioactive materials with autologous platelet concentrates and bone grafts to promote predictable healing. Mineral Trioxide Aggregate (MTA) offers excellent sealing ability and biocompatibility, while Titanium-prepared Platelet-rich Fibrin (T-PRF) and Hydroxyapatite (HA) bone grafts support tissue regeneration. In the present report, a 35-year-old male patient presented with discolouration of the left maxillary central incisor. A microsurgical apicoectomy was performed using MTA for retrograde filling, a T-PRF membrane, and an HA bone graft. The outcome demonstrated uneventful healing with radiographic evidence of bone regeneration at three months.

Keywords: Autologous platelet concentrates, Bioactive materials, Periapical, Root canal therapy, Tooth preservation

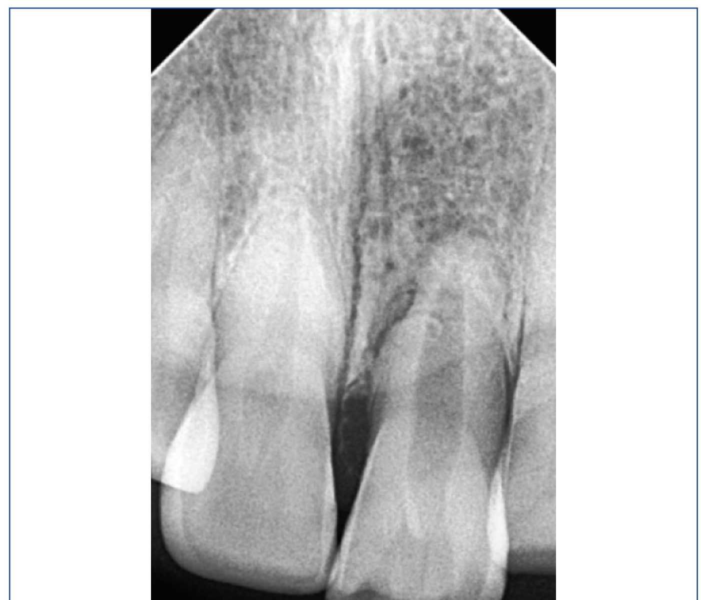
CASE REPORT

A 35-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with the chief complaint of intermittent pain and swelling in the upper front region, accompanied by discolouration of the upper left front tooth. The patient had a history of dental trauma approximately one year earlier, for which no immediate dental care was sought. Over the past 6-8 months, the patient observed gradual darkening of tooth #21, along with episodes of tenderness and localised swelling. Clinical examination revealed discolouration of the tooth, and the electric pulp test showed no response on the upper left front tooth, indicating pulpal necrosis. Grade II mobility was noted, with slight tenderness on palpation and percussion. No sinus tract or fistula was evident [Table/Fig-1].



[Table/Fig-1]: Tooth #21 discoloured with pulp necrosis

An Intraoral Periapical (IOPA) radiograph and Cone Beam Computed Tomography (CBCT) revealed a radiolucency involving the apex of tooth #21, approximately 3 mm in diameter [Table/Fig-2,3]. Evidence of trauma-related internal and external root resorption was observed [Table/Fig-4]. Based on the clinical findings, the diagnosis was pulpal necrosis with a periapical granuloma associated with trauma-induced inflammatory external and internal root resorption.

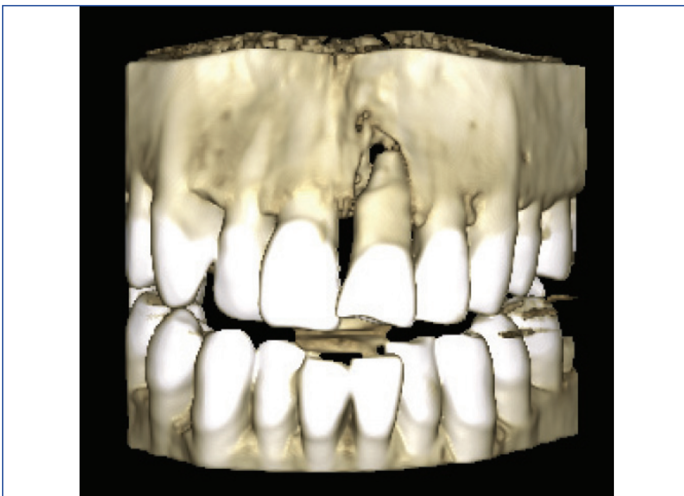


[Table/Fig-2]: IOPA showing a well-circumscribed periapical radiolucency involving the apex of tooth #21

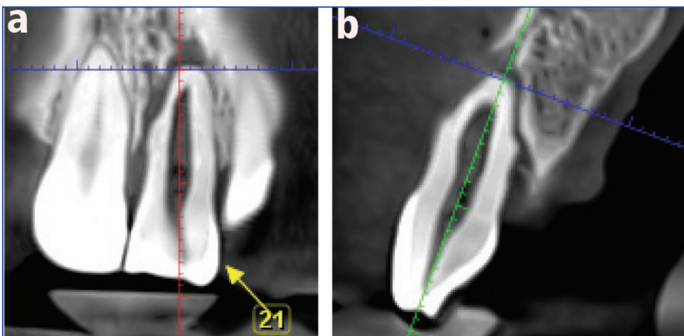
Treatment Plan

The comprehensive treatment plan involved a multidisciplinary approach to manage the periapical pathology associated with tooth #21. Initially, orthograde endodontic therapy was performed, including thorough cleaning and shaping of the root canal system, followed by obturation using MTA to ensure a hermetic seal. The coronal portion of the access cavity was subsequently restored with composite resin to provide structural integrity and prevent microleakage.

Given the persistent periapical lesion, a microsurgical apicoectomy was undertaken, involving resection of 3 mm of the apical root tip



[Table/Fig-3]: Three-dimensional reconstruction CBCT showing periapical lesion and loss of bone with front left incisor.



[Table/Fig-4]: a) Coronal view and; b) Saggital view: Trauma induced inflammatory external and internal root resorption.

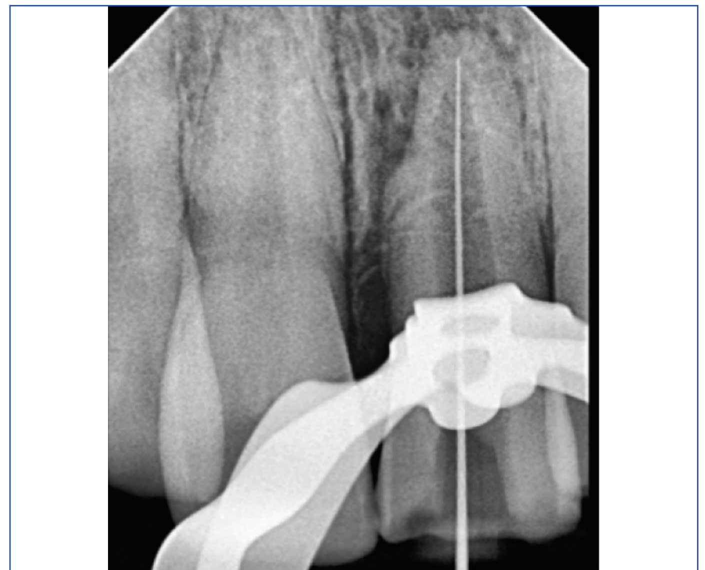
and meticulous curettage of the periapical granulation tissue. To promote regenerative healing, a HA bone graft was placed within the osseous defect to support osteoconduction. This was followed by the application of a T-PRF membrane to enhance healing through the sustained release of growth factors and to stabilise the graft material within the surgical site.

The treatment plan was explained to the patient and informed consent was obtained. Root canal therapy was initiated for tooth #21, which presented with inflammatory root resorption [Table/Fig-5]. Given the presence of a wide apical foramen, MTA was chosen as the obturation material to establish an apical barrier and achieve an effective apical seal. Following meticulous cleaning and shaping of the root canal system, complete obturation of the canal was performed with MTA using the incremental technique and a Micro-Apical Placement (MAP) system. The material was gently compacted to ensure proper adaptation. After confirming adequate placement of MTA in the canal up to the orifice, the remaining coronal portion was filled with composite resin to restore structural integrity and prevent coronal microleakage [Table/Fig-6].

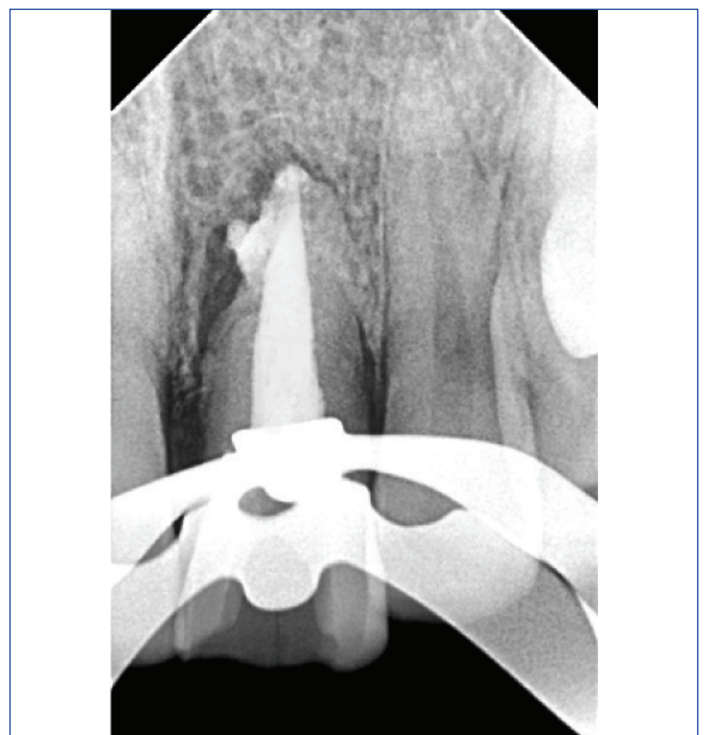
Local anaesthesia with 2% lignocaine containing epinephrine was administered, and an incision was placed on the labial aspect to elevate a full-thickness mucoperiosteal flap in the anterior maxillary region [Table/Fig-7].

An osteotomy was performed using a round bur under copious irrigation to expose the root apex of tooth #21 [Table/Fig-8]. Approximately 3 mm of the root tip was resected at a 0-10° bevel. The periapical granulation tissue was thoroughly curetted. The previously placed MTA appeared intact, and no retrograde filling was required.

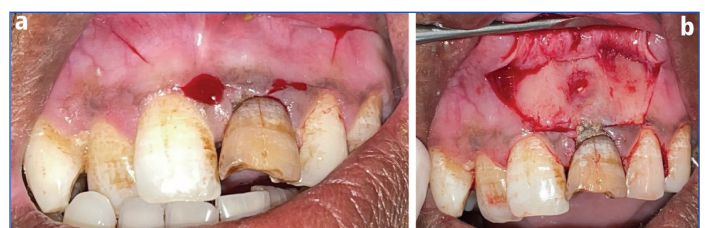
After thorough irrigation of the surgical site and achieving haemostasis, an alloplastic HA-based bone graft material [Osbone®, a synthetic HA material manufactured by Curasan AG, Kleinostheim, Germany] was placed into the osseous defect to promote bone regeneration [Table/Fig-9].



[Table/Fig-5]: Working length determination.



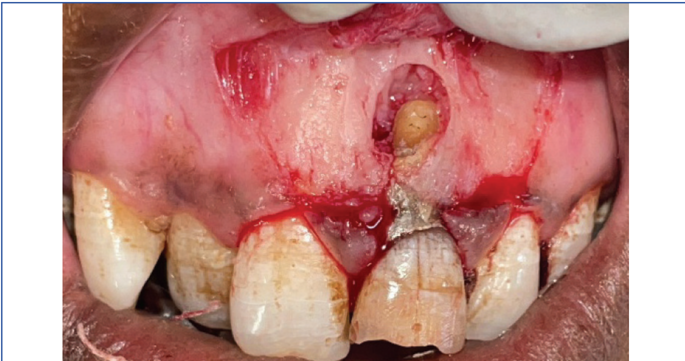
[Table/Fig-6]: Periapical radiograph following MTA placement.

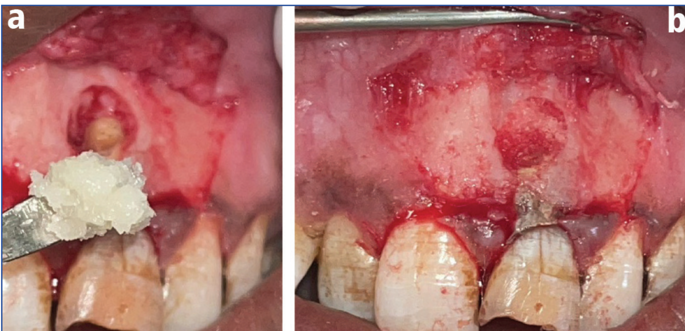


[Table/Fig-7]: (a) Incision placed on the labial aspect of the tooth; (b) Raised Full-thickness mucoperiosteal flap.

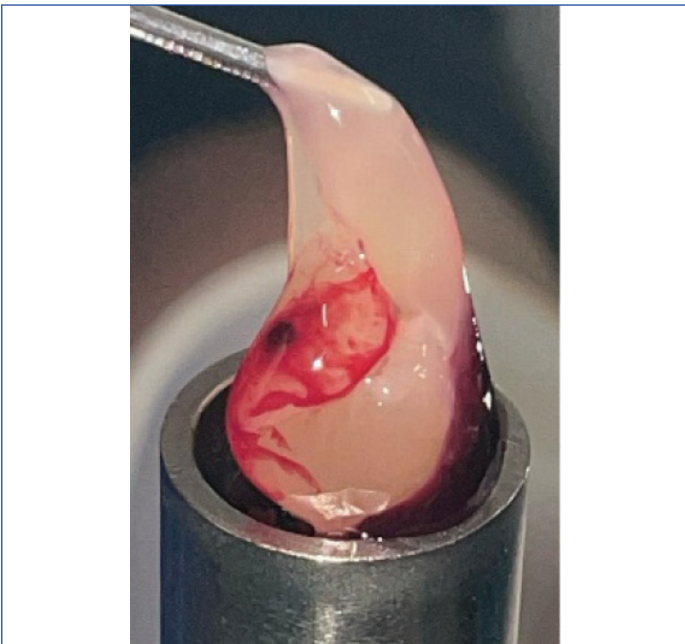
For preparation of the T-PRF membrane, 10 mL of venous blood was drawn from the patient into sterile titanium tubes without anticoagulant and centrifuged at 3000 rpm for 10 minutes [Table/Fig-10]. The fibrin clot obtained was separated, gently compressed into a membrane, and placed over the HA graft to stabilise it and enhance healing (Tunali M et al., 2015) [1].

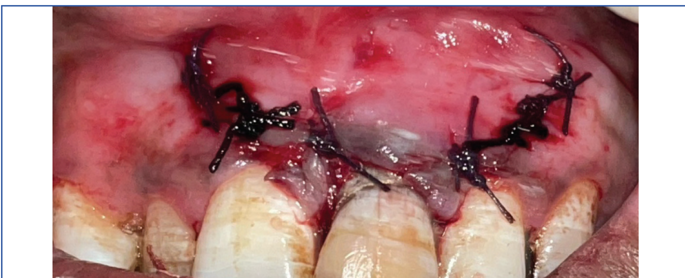
The flap was repositioned and closed using 3-0 silk sutures [Table/Fig-11]. Postoperatively, the patient was prescribed Amoxicillin 500 mg three times daily for 5 days, along with a combination of Ibuprofen 400 mg and Paracetamol 325 mg every 8 hours for 3 days. The patient was advised to apply cold compresses for the first


[Table/Fig-8]: Osteotomy performed.



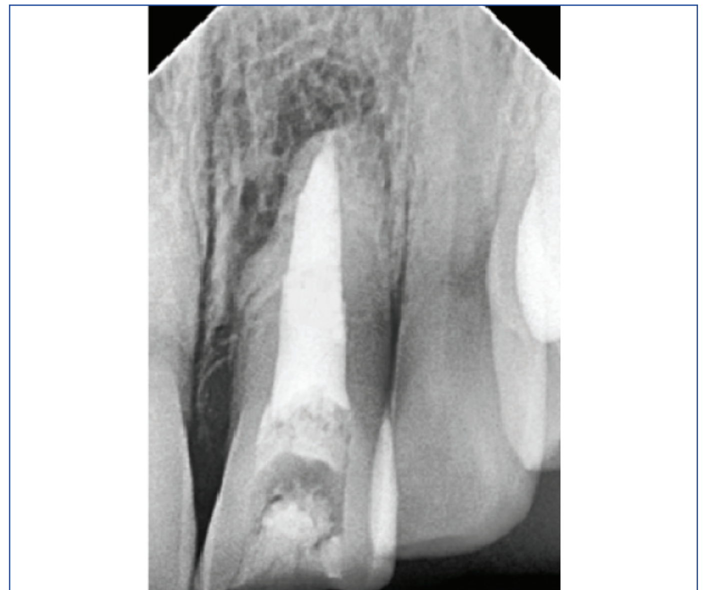
[Table/Fig-9]: (a) Alloplastic/HA-based bone material; (b): Alloplastic/HA-based bone material placement

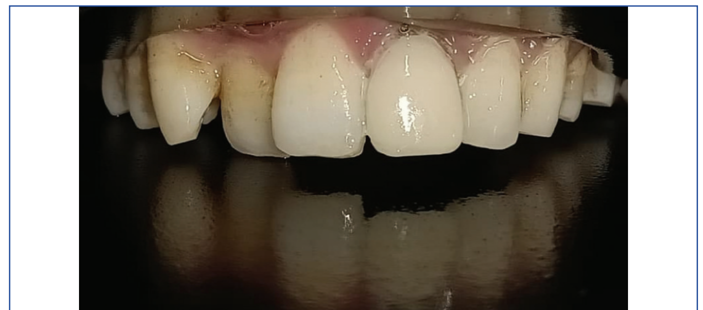

[Table/Fig-10]: Titanium-prepared platelet-rich fibrin obtained.


[Table/Fig-11]: Suturing done using 3-0 silk.

24 hours, follow a soft diet, and maintain oral hygiene. Instructions regarding flap care and suture maintenance were also given.

The patient was followed up at 1 month and showed significant healing [Table/Fig-12]. At the subsequent follow-up at 3 months, mobility was absent. After confirmation of satisfactory healing and restoration of function, the tooth was rehabilitated with a full-coverage ceramic crown to restore aesthetics and structural integrity [Table/Fig-13].


[Table/Fig-12]: Follow up radiological image after 1 month.


[Table/Fig-13]: Clinical image after 3 months with a full-coverage ceramic crown.

DISCUSSION

Endodontic surgery involves the surgical removal of diseased periapical tissue to promote optimal conditions for tissue healing, regeneration, and restoration of structural support to the affected tooth. When performed as a primary procedure, the success rate of endodontic surgery ranges from 78% to 91% [1-3]. However, the prognosis tends to decrease in retreatment cases, particularly when persistent periapical lesions are present [4]. These lesions often arise from endodontic failure due to factors such as bacterial infiltration through coronal leakage or inadequate root canal filling [5].

A common manifestation is the development of periapical granulomas-chronic inflammatory lesions composed of lymphocytes, plasma cells, polymorphonuclear leukocytes, macrophages, eosinophils, multinucleated giant cells, fibroblasts, and newly formed capillaries [6]. Such granulomas result from long-standing pulpal infections or extensive carious involvement. In some cases, clinical examination may reveal fenestration of the root apex through the cortical plate, or the presence of associated periapical cysts [7]. Because periapical radiolucency does not reveal the exact histological nature of a lesion at the time of treatment, definitive diagnosis often requires surgical intervention [8]. Approximately 10% of periapical lesions fail to resolve with conventional endodontic therapy alone and may necessitate surgical management after evaluating the patient's medical history, prior treatment outcomes, and overall clinical presentation [9,10].

The primary etiological factor in the development of periapical lesions is a compromised apical seal, which permits the passage of bacteria and their toxic byproducts into periradicular tissues [11]. While periradicular curettage removes inflamed or infected tissue, it does not address the root cause if the apical seal remains defective. Therefore, without resection of the root apex, there is a significant risk of lesion recurrence. Surgical resection of the apical 3 mm of the

root is recommended, as this region typically contains the majority of lateral canals and apical ramifications, which can harbour residual infection [12].

In the present case, MTA was selected as the orthograde filling material due to its superior properties, including excellent biocompatibility, reliable sealing ability, ease of handling under moist conditions, and its potential to strengthen structurally compromised roots [13,14].

T-PRF, a second-generation platelet concentrate, produces a more condensed fibrin network compared to traditional PRF, which acts as a scaffold for cellular migration and sustained release of growth factors such as Platelet-Derived Growth Factor (PDGF), Transforming Growth Factor Beta 1 (TGF-β1), and Vascular Endothelial Growth Factor (VEGF)-critical for neovascularisation, fibroblast proliferation, and osteogenesis. HA, an alloplastic bone graft, is highly biocompatible and osteoconductive, serving as a scaffold for new bone formation. When combined with biologically active agents such as T-PRF, HA enhances space maintenance and supports predictable regeneration of periapical osseous defects [15].

Recent clinical trials have shown that combining root-end resection (apicoectomy) with platelet-rich fibrin (or leukocyte-PRF) significantly improves healing rates of periapical lesions when used with MTA retrograde or orthograde filling [16]. In a case study by Soesilo D et al., apicoectomy with Leukocyte- and Platelet-Rich Fibrin (L-PRF) demonstrated over 90% healing at 9 months for large periapical lesions; Regenerative or Ridge Graft (RG) + L-PRF (root-end resection + MTA + L-PRF) also showed significantly lower lesion areas and symptom scores compared to groups without PRF [17]. Another recent case report described successful non-surgical healing of a large periapical lesion using injectable PRF in combination with MTA obturation [18].

Additionally, a recent comparative clinical investigation evaluated periapical surgery outcomes using PRF versus HA, showing more favorable radiographic and clinical healing in the PRF group than with HA alone [19]. A literature review on the efficacy of PRF in endodontic surgery highlights its role in accelerating bone regeneration, reducing postoperative discomfort, and improving soft tissue healing [20]. Moreover, in retreatment settings, studies comparing nano-HA with and without PRF have demonstrated that the addition of PRF results in better bone fill and earlier radiographic healing [21,22].

The integration of apicoectomy, MTA obturation, and T-PRF placement offers a synergistic approach that combines effective debridement and sealing with biologically driven regeneration. This method enhances bone healing, shortens recovery time, and improves outcomes, particularly in trauma-related periapical lesions.

CONCLUSION(S)

The present case highlights the role of surgical endodontics as a complementary approach in managing persistent periapical lesions. The synergistic use of MTA, T-PRF, and HA bone graft in apicoectomy can enhance periapical healing, offering a predictable regenerative approach for long-term tooth preservation.

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AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Sep 09, 2025
- Manual Googling: Oct 27, 2025
- iThenticate Software: Oct 29, 2025 (8%)

ETYMOLOGY: Author Origin

EMENDATIONS: 7

Date of Submission: **Aug 21, 2025**
Date of Peer Review: **Sep 10, 2025**
Date of Acceptance: **Oct 31, 2025**
Date of Publishing: **May 01, 2026**