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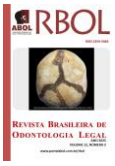

Legal dentistry

HISTOPATHOLOGICAL CHANGES IN THE PERIODONTAL LIGAMENT AS A RISK FACTOR FOR MAXILLARY TUBEROSITY FRACTURES: AN ADDITIONAL ASPECT OF INFORMED CONSENT?

Alterações histopatológicas no ligamento periodontal como fator de risco para as fraturas de tuber da maxila: outro aspecto para o consentimento informado?

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ABSTRACT

Maxillary third molar removal can lead to complications, particularly maxillary tuberosity fractures. While the periodontal ligament is essential for load distribution, histological evaluations of the periodontal ligament in relation to these fractures are notably absent from the literature. This report presents a case where a significant fracture occurred during a third molar removal. Histopathological analysis of the specimen revealed marked tissue alterations, including free and attached concentric calcifications and pronounced cementum irregularities. These findings, indicating a localized disruption of the periodontal ligament integrity, were not detectable through standard preoperative imaging. Therefore, these histological changes may represent a novel and previously undocumented risk factor. This case underscores the importance of a thorough preoperative evaluation and transparent risk communication during the informed consent process. Further studies are warranted to validate these findings and understand their prevalence.

KEYWORDS

Forensic Dentistry; Periodontal ligament; Risk management; Intraoperative complications.

INTRODUCTION

Bleeding, swelling, pain, trismus, damage to adjacent teeth and surrounding tissues, displacement of teeth into adjacent spaces, dry socket, infection, root fracture, and maxillary tuberosity fracture (MTF) are some of the accidents and potential complications that can occur during or after maxillary third molar removal[1]. Infections, in particular, can be severe and progress to life-threatening deep neck infections with high mortality rates[2]. In this context, it is

worth noting that accidents are considered transoperative undesired events, whilst complications are postoperative[3].

MTF following third molar removal is rare. In a study with 8455 patients, MTF accounted for 0.15% of all accidents and complications[4]. According to Shmuly et al (2022)[5], the percentage of fractures involving only the maxillary third molar was 18%.

Patient-related risk factors include maxillary sinuses that extend into the maxillary tuberosity, early maxillary tooth loss, isolated molars, apical chronic periodontitis, radicular cysts, systemic and behavioural factors, and dentoalveolar ankylosis[6]. Operator-related risk factors include inadequate planning and excessive force[5]. The periodontal ligament (PDL) promotes tooth stability, acts as a sensory organ, and stores cells for tissue homeostasis and regeneration[7, 8]. The specific risk factors associated with PDL in MTF include dentoalveolar ankylosis and hypercementosis.

In addition to the clinical implications of MTF during third molar removal, it may lead to ethical and legal disputes if there is an allegation of medical malpractice[9].

Considering the lack of evidence in the literature regarding the histological analysis of the PDL in cases of MTF during maxillary third molar removal, this case report aims to discuss the influence of histopathological changes in the PDL as a risk factor for MTF during upper-third molar removal and its ethical and legal implications, highlighting the importance of informed consent.

CASE REPORT

A 23-year-old female patient presented to the School of Dentistry of the Federal University of Goiás, Brazil, for the removal of the left maxillary third molar (#28) following orthodontic recommendations.

The patient had no significant medical history and reported no allergies or previous surgeries. A panoramic radiograph revealed an unrestored, fully developed, erupted third molar (Figure 1).

Figure 1. Observe the radiographic aspects of tooth #28 (arrow).

Before surgery, treatment options were discussed, and an informed consent form for oral surgery was signed by the patient; this document contained the risks generally involved in oral surgical procedures, especially dental extractions.

Surgery was performed under local anaesthesia using 1.5 cartridges of mepivacaine 2% with adrenaline 1:100,000 (DFL, Taquara, Brazil). An initial syndesmotomy was performed and followed by a mechanical removal using a straight elevator (Quinelato, Rio Claro, Brazil) to push the third molar occlusally and distally. During luxation, a fracture of the maxillary tuberosity occurred, with a significant fractured segment remaining attached to the distal part of the tooth (Figure 2).

Figure 2. Macroscopic image of the tooth #28 with attached maxillary tuberosity.

After removal, the surgical site was sutured using a cross-stitch technique with two simple interrupted sutures, each made with a 4-0 nylon suture (Shalon, São Luís de Montes Belos, Brazil). The patient was prescribed dipyrone 500mg every 8 hours for two days and nimesulide 100mg every 12 hours for two days for post-operative pain management.

The fractured segment and the extracted tooth were fixed in 10% buffered formalin solution and sent to the Oral Pathology Laboratory of the Faculty of Dentistry of the Federal University of Goiás for histopathological analysis. Following fixation, the specimen was processed and then embedded in paraffin wax, sectioned at a thickness of approximately 4-6 µm, and stained with Hematoxylin and Eosin for microscopic examination. Histological examination of the specimen revealed histopathological changes in the periodontal ligament (PDL). In particular, there were both free and attached concentric calcifications within the PDL (Figures 3a and 3b). In addition, there was a loose distribution of collagen fibers and pronounced undulations of the cementum surface in the periapical region (Figure 3c).

Following the procedure, the patient was informed of the incident, given appropriate postoperative care instructions, and scheduled for follow-up visits to monitor the healing process and manage any potential complications arising from the fracture. Seven days after the removal, post-operative care was carried out with the removal of the stitches without any complications.

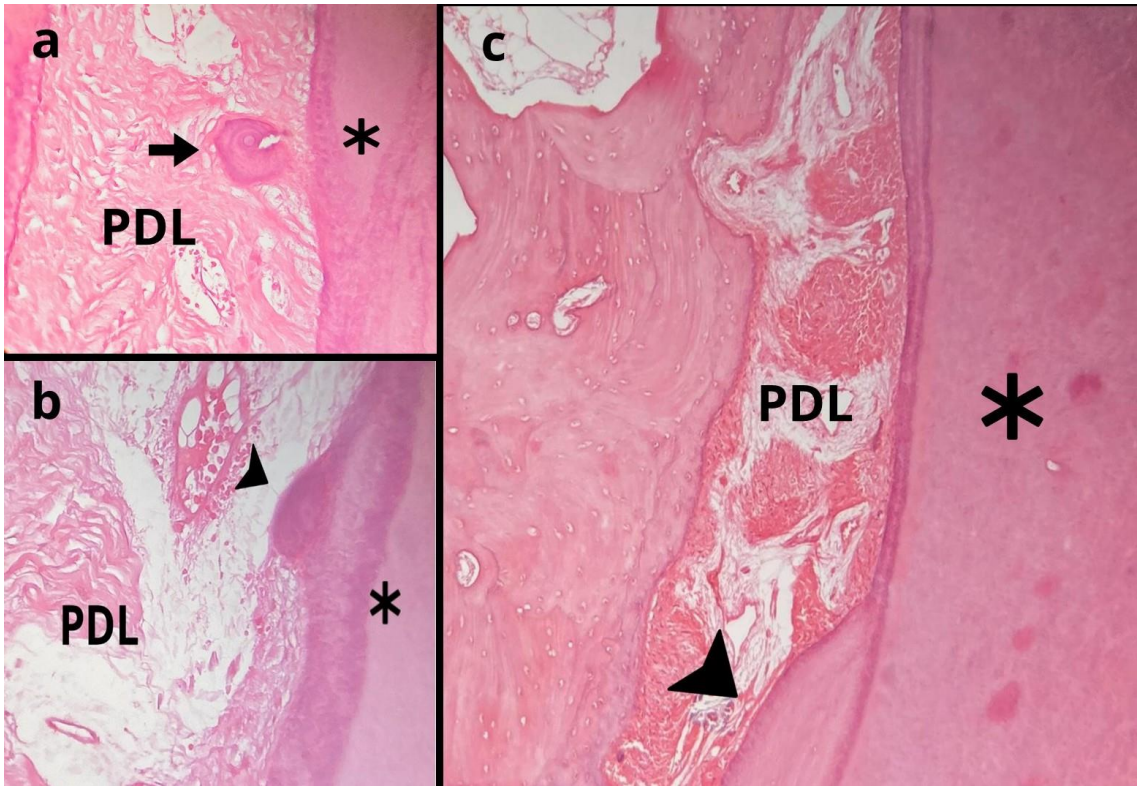

Figure 3. Histological findings of the periodontal ligament (PDL) and cementum. (a) Free concentric calcification (arrow), PDL, and cement (*). (b) Concentric calcification adhered to the cementum (arrowhead), PDL, and cement (*). (c) Cementum undulations (arrowhead), PDL, and cement (*). Hematoxylin and eosin stain, original magnification ×40.

DISCUSSION

Maxillary tuberosity fracture (MTF) after maxillary third molar removal underscores the complex nature of oral surgery and the importance of a meticulous diagnostic approach, including a comprehensive clinical examination, detailed patient history registration, and proper use of imaging investigation. These components play a fundamental role in ensuring accurate preoperative assessment[6].

Radiographic examination of the maxillary third molar by means of panoramic imaging allows the assessment of its relationship with the maxillary sinus, extension of the maxillary sinus, root morphology and anatomy, and adjacent teeth. From an imaging perspective, cone beam computed tomography[10] and panoramic and periapical radiographs allow the surgeon to anticipate and attempt to prevent MTF. However, the apposition of cementum and inherent calcifications detected and reported in this case cannot be seen on radiographic images.

Microscopically, healthy PDL consists of osteoblasts, osteoclasts, fibroblasts, epithelial rests of Malassez, macrophages, undifferentiated mesenchymal cells, and an extracellular compartment composed of collagen fibers and a non-collagenous extracellular matrix. The PDL maintains its width through regulation by local cells. Certain events can cause an imbalance in this mechanism, such as failure of eruption due to dentoalveolar ankylosis and lack of cementum formation,

leading to tooth exfoliation[11]. Functional forces to the PDL can increase up to 50% of its width and bone deposition/resorption. As a consequence, changes to the alveolar bone associated with the PDL might occur[11]. In the present case, histopathological evaluation showed the presence of free concentric calcifications within the PDL, calcifications adhering to the cementum, and undulations on the cementum surface in the periapical region. The presence of these concentric calcifications, both free and attached, suggests a possible alteration in the PDL's normal architecture and function.

Legal and ethical aspects

Any dental practice should be guided by the technical standards outlined in the scientific literature[12]. It is the dentist's responsibility to consider each case, assess the level of complexity, and determine whether to refer the patient to another professional. If the risk factors are identified in this process, the dentist must try to avoid them. However, if the procedure is unavoidable, the patient must be informed of the risks, consequences, and alternative treatments[6]. Therefore, informed consent and discussion with the patient are essential before the surgery, even though this practice is not always routinely performed by all professionals[13].

Obtaining informed consent is critical to the surgeon-patient relationship[3], as it is now possible to obtain informed consents for oral surgery quickly and reliably using artificial intelligence[14].

In the context of maxillary third molar removal, discussing the potential risk of MTF is essential, and the professional must strive to provide the most appropriate information to their patient, including the associated treatment risks[15]. This is particularly relevant as studies indicate a high number of dentists do not routinely use informed consent forms, with 37.5% of those surveyed reporting not using them in their clinical practice[16]. The primary justifications given for this omission are having complete dental records signed by the patient or maintaining a good relationship with them. However, the literature emphasizes that these reasons do not ethically or legally replace the role of a signed informed consent form and that the lack of this document exposes the dentist to potential ethical and legal penalties[16]. This case highlights the importance of transparent communication with patients about possible complications.

Although the histopathological changes observed in this case, such as calcifications in the periodontal ligament, are not identifiable during preoperative or intraoperative examinations, they underscore the need for thorough postoperative histological evaluation. This risk factor, which can only be detected after surgery, emphasises the importance of informing patients about the possibility of unforeseen risks that may arise despite careful preoperative planning.

Irrespective of the circumstances, the dentist responsible for the surgery that led to MTF should offer support to the patient to speed up the healing process and mitigate potential complications. More extensive studies, such as case series, are encouraged to confirm and extend our findings. Whilst this case report provides a

novel observation, it is important to acknowledge that a single case cannot establish a direct causal relationship or generalise these findings to a broader population. Further research is needed to determine the prevalence of these changes in patients undergoing third molar removal and to investigate their potential causal role in MTF.

Such investigations could contribute significantly to our understanding of the specific mechanisms by which subtle histopathological alterations compromise PDL integrity and predispose to fracture, thereby contributing to the broader field of periodontal homeostasis research.

FINAL CONSIDERATIONS

This case report aimed to explore the possible influence of histopathological changes in the periodontal ligament on maxillary tuberosity fractures during maxillary third molar removal. The findings revealed the presence of concentric calcifications and distinct structural changes, such as undulations on the cementum surface, that were not detectable through standard preoperative imaging techniques.

Whilst these observations from a single case do not establish a direct causal relationship, they suggest that such histopathological alterations, indicative of a localized disruption of periodontal ligament homeostasis and its biomechanical properties, may act as contributing factors to fractures in susceptible patients.

This underscores the critical importance of comprehensive clinical and radiographic evaluation, especially recognising the limitations of current imaging for microscopic PDL changes, alongside transparent risk communication and obtaining thorough informed consent prior to surgical procedures. Given the inherent limitations of single-case observations, further research involving larger sample sizes is warranted to investigate this potential association, clarify the aetiology and prevalence of these microscopic changes, and refine clinical decision-making protocols to enhance patient safety and care.

RESUMO

A remoção do terceiro molar superior pode levar a complicações, particularmente fraturas da tuberosidade maxilar. Embora o ligamento periodontal seja essencial para a distribuição da carga, avaliações histológicas do ligamento periodontal em relação a essas fraturas são notavelmente ausentes na literatura. Este relato apresenta um caso em que ocorreu uma fratura significativa durante a remoção de um terceiro molar. A análise histopatológica da amostra revelou alterações teciduais marcantes, incluindo calcificações concêntricas livres e aderidas e irregularidades pronunciadas do cemento. Esses achados, que indicam uma ruptura localizada da integridade do ligamento periodontal, não foram detectáveis por meio de exames de imagem pré-operatórios padrão. Portanto, essas alterações histológicas podem representar um fator de risco novo e previamente não documentado. Este caso ressalta a importância de uma avaliação pré-operatória completa e da comunicação transparente dos riscos durante o processo de consentimento informado. Estudos adicionais são necessários para validar esses achados e compreender sua prevalência.

PALAVRAS-CHAVE

Odontologia legal; Ligamento periodontal; Gerenciamento de riscos; Complicações intraoperatórias.

REFERENCES

1. Sayed N, Bakathir A, Pasha M, Al-Sudairy S. Complications of Third Molar Extraction: A retrospective study from a tertiary healthcare centre in Oman. Sultan Qaboos Univ Med J. 2019 Aug;19(3):e230-5. https://doi.org/10.18295/squmj.2019.19.03.009.
2. da Silva Junior AF, de Magalhaes Rocha GS, da Silva Neves de Araujo CF, Franco

A, Silva RF. Deep neck infection after third molar extraction: A case report. J Dent Res Dent Clin Dent Prospects. 2017 Summer;11(3):166-169. https://doi.org/10.15171/joddd.2017.030.

3. Dos Santos Silva W, Silveira RJ, de Araujo Andrade MGB, Franco A, Silva RF. Is The Late Mandibular Fracture From Third Molar Extraction a Risk Towards Malpractice? Case Report with the Analysis of Ethical and Legal Aspects. J Oral Maxillofac Res. 2017 Jun 30;8(2):e5. https://doi.org/10.5037/jomr.2017.8205
4. Baniwal S, Paudel KR, Pyakurel U, Bajracharya M, Niraula SR. Prevalence of complications of simple tooth extractions and their comparison between a tertiary centre and peripheral centres: a study conducted over 8,455 tooth extractions. JNMA J Nepal Med Assoc. 2007 Jan-Mar;46(165):20-4.
5. Shmuly T, Winocur-Arias O, Kahn A, Findler M, Adam I. Maxillary Tuberosity Fractures Following Third Molar Extraction, Prevalence, and Risk Factors. J Craniofac Surg. 2022 Oct 1;33(7):e708-e712. https://doi.org/10.1097/SCS.0000000000008654
6. Chrcanovic BR, Freire-Maia B. Considerations of maxillary tuberosity fractures during extraction of upper molars: a literature review. Dent Traumatol. 2011 Oct;27(5):393-8. https://doi.org/10.1111/j.1600-9657.2011.01012.x.
7. Barczyk M, Bolstad AI, Gullberg D. Role of integrins in the periodontal ligament: organizers and facilitators. Periodontol 2000. 2013 Oct;63(1):29-47. https://doi.org/10.1111/prd.12027.
8. Wang T, Liu X, Li J, Yue Y, Li J, Wang M, Wei N, Hao L. Mechanisms of mechanical force in periodontal homeostasis: a review. Front Immunol. 2024 Aug 16;15:1438726. https://doi.org/10.3389/fimmu.2024.1438726.
9. Puzović D, Čolić S. Forensic interpretation of the maxillary tuberosity fracture caused by tooth extraction. Vojnosanit Pregl. 2010 Sep;67(9):777-80. Serbian. https://doi.org/10.2298/VSP1009777P.
10. Singh A, Kodali MVRM, Pentapati KC, Chattopadhyay A, Shetty R, Patil V, Gadicherla S, Smriti K. Role of CBCT in Prediction of Oro-antral Communication Post Third Molar Extraction: A Retrospective Study. Eur J Dent. 2023 Oct;17(4):1257-1262. https://doi.org/10.1055/s-0043-1760720.
11. Nanci A. Periodontium. In: Nanci A, editor. Ten Cate's Oral Histology-e-book: development, structure, and function. Elsevier Health Sciences; 2017.
12. Hupp JR. Instrumentation for Basic Oral Surgery. In: Hupp JR, Tucker MR, Ellis E, editors. Contemporary Oral and Maxillofacial Surgery-E-Book. Elsevier Health Sciences; 2013.
13. Shah I, Lahooti RA, Khan MN. Informed consent practices in oral and maxillofacial surgery setups – an audit report. J Pak Med Assoc. 2021 Apr;71(4):1197-1199. https://doi.org/10.47391/JPMA.298
14. Vaira LA, Lechien JR, Maniaci A, Tanda G, Abbate V, Allevi F, et al. Evaluating AI-generated informed consent documents in oral surgery: A comparative study of ChatGPT-4, Bard Gemini Advanced, and human-written consents. J Craniomaxillofac Surg. 2025 Jan;53(1):18-23. https://doi.org/10.1016/j.jcms.2024.10.002
15. Ramchandani JP, Cameron A, Garg M, Newman L. Can we do it better? Consent in dentoalveolar surgery. Br J Oral Maxillofac Surg. 2023 Nov;61(9):628-630. https://doi.org/10.1016/j.bjoms.2023.07.018
16. Graziele Rodrigues L, De Souza JB, De Torres EM, Ferreira Silva R. Screening the use of informed consent forms prior to procedures involving operative dentistry: ethical aspects. J Dent Res Dent Clin Dent Prospects. 2017 Winter;11(1):66-70. https://doi.org/10.15171/joddd.2017.013