Revista Odontológica Mexicana
Órgano Oficial de la Facultad de Odontología UNAM

Clinical case

Dental fracture: Interdisciplinary Treatment

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Received: October 2021
Accepted: March 2023

Cite as:
Lino-Aguilar V, Calixto-Arellano F, Galán-Torres G, Hernández-Ávila Y. Fractura dental: tratamiento interdisciplinario. [Dental fracture: Interdisciplinary treatment]. *Rev Odont Mex*. 2022; 26(4): 62-69. DOI: 10.22201/fo.1870199xp.2022.26.4.81041

Abstract

Introduction: Dental fractures that extend to the subcrestal level represent a challenge to execute a restoration that meets function and aesthetics. In these cases, procedures such as crown lengthening can be carried out which allows the supracrestal tissue space to be respected. However, sometimes aesthetics are limited, so additional alternatives are required, such as forced extrusion, that allows good results in order to keep the tooth in optimal conditions in the oral cavity. Especially because in some cases the invasive surgery therapy can have negative effects such as the reduction of the supporting alveolar bone structure of the adjacent teeth. **Objective:** To carry out an interdisciplinary treatment of a dental fracture, which was treated involving the contribution of periodontics, orthodontics, oral rehabilitation and endodontics, to keep tooth

11 in optimal conditions in the oral cavity. **Case presentation:** A 21-year-old male patient who attends an appointment for oral rehabilitation. During the examination we observed the dental fracture of tooth 11. Considering the type of tooth, age, availability and good oral hygiene of the patient, we decided to offer him an interdisciplinary treatment, starting with orthodontic treatment, to align the teeth and perform the forced extrusion of tooth 11. Subsequently, treatment was carried out by the following areas: endodontics, periodontics and oral rehabilitation. **Conclusions:** In this clinical case, because the patient is a young person, we decided to preserve the tooth by conducting procedures that allowed favourable aesthetic and functional results.

Keywords: dental fracture, forced orthodontic extrusion, gingivectomy, restoration, root canal treatment.

INTRODUCTION

Traumatic injuries to the teeth and their supporting tissues usually occur in young people between 6 and 13 years old, with damage ranging from enamel fracture to avulsion fracture, with or without pulp involvement or bone fracture[1]. Crown-root fracture comprises 5% of all traumatic injuries, resulting from a horizontal impact and involving enamel, dentin and cementum[2]. The maxillary anterior teeth are the most affected and 80% of them are maxillary central incisors[1]. Treatment for tooth fractures depends on the level of the fracture line and the amount of remaining tooth structure. These fractures can be treated through clinical crown lengthening through a surgical procedure or forced orthodontic extrusion[3], both of which have the objective of obtaining an adequate amount of tooth for rehabilitation.

In cases of dental fracture there are aspects that must be taken into account, such as the probability of indicating endodontic treatment, size of the future restoration, endodontic post requirement, prosthetic rehabilitation requirement, position of the bone crest, root length, condition of adjacent teeth, oral hygiene, patient compliance, cost[4] and, in case of premolars and molars, to evaluate the location of the furcation. To restore teeth that have subgingival cavities or fractures below the gingival attachment, a clinical crown lengthening procedure is needed to establish the biological width[5]. It is of great importance because in the study by Carvalho *et al.*,[6] a statistically significant relationship was found between bleeding on probing and gingival recession in patients who presented intrabone defects due to invasion of the biological width, which may also be related to the thickness of the keratinized tissue.

Forced eruption is preferred to surgical removal of supporting alveolar bone structure, as forced eruption preserves biological width, maintains aesthetics, and at the same time exposes healthy tooth structure for placement of restorative margins[7]. Biologically and when possible, conservative treatment always represents the best option, where the correct selection of prosthetic materials could be decisive[4]. The following clinical case presents the interdisciplinary management of a subgingival fractured tooth, in which forced orthodontic extrusion with fixed appliances, root canal treatment, restoration of the biological width through periodontal surgery (gingivectomy) and final restoration were carried out.

CLINICAL CASE PRESENTATION

A 21-year-old male patient who attended a dental consultation for rehabilitation. During the intraoral clinical examination, good hygiene was observed, with no suspicious lesions on the mucosa. On tooth 11, an uncomplicated coronal fracture was observed, which extended below the gingival margin, involving enamel, dentin, and cementum, in accordance with the International Association for Dental Traumatology (IADT) guidelines[8, 9]. As expressed by the patient during questioning, the fracture is the result of a bicycle accident he had at the age of 11, as well as a fracture of tooth 37 (non-rehabilitable) and absence of tooth 46 (Figure 1.A-B). According to the scale of severity described by Samet and Jotkowitz,[10] a Class X was established for tooth 11, where the next were assessed: periodontal condition and supporting alveolar bone structure, remaining healthy tooth structure, endodontic condition, occlusal plane and tooth position. By consulting with periodontics, orthodontics and endodontics, a comprehensive treatment plan was developed, with the goal of improving the prognosis in general terms, but above all, rehabilitating tooth 11 and achieving Class B in accordance with Samet and Jotkowitz[10].

Treatment began with dental surgery, removing carious lesions and filling with resins, to be referred later to orthodontics. During the orthodontic phase, passive self-ligating brackets with standard torque, 0.22" slot were used. It started with a 0.014" Copper NiTi archwire; for the second phase, 0.018" Copper NiTi and 0.018" X 0.025" archwires were used, and at the end with TMA 0.019" x 0.025" archwire. The choice of archwires was based on the advantages that these archwires present, such as light, continuous and controlled forces.

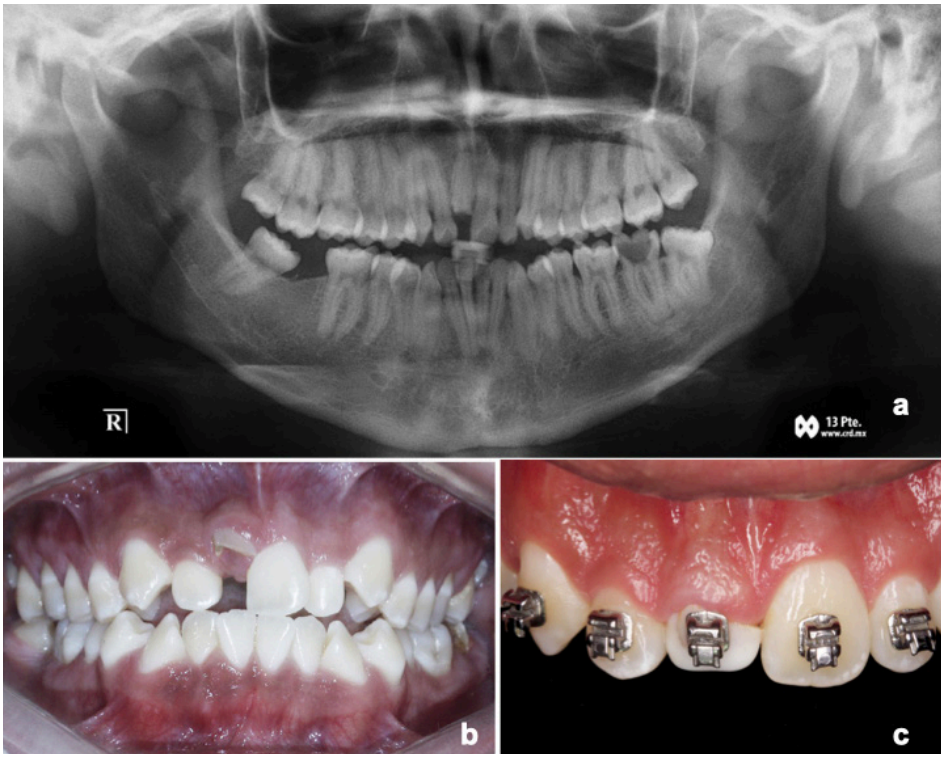

Figure 1. Presentation of the case with completion of orthodontic treatment. A. Initial radiograph. B. Initial clinical photograph. C. Completion of orthodontic treatment and correct placement of tooth 11 in the dental arch.

For the extrusion of tooth 11, the dental arches were first aligned and shaped. During the procedure, a NiTi open coil was placed to open the extrusion space. During the mechanics it was necessary to start with indirect traction. After two months of traction he was referred to endodontics and then continue with the traction of the tooth, where it was necessary to reposition the bracket to achieve the desired extrusion. A slow dental extrusion was performed, since it is intended to carry the alveolar bone, as well as the height of the bone attachment along the root and that it is approximately the same at the beginning as at the end[11]. The endodontic treatment was carried out with a ProTaper rotary file system and irrigation with 5.25% sodium hypochlorite (NaClO); calcium hydroxide ($Ca(OH)_2$) was placed for a period of seven days.

After a week it was filled with gutta-percha and a temporary filling of more than 6 mm was placed for a week. After the root canal treatment, a temporary reconstruction of the tooth was done, in order to continue with the extrusion. Once accomplished, a better dental reconstruction was created with the aim of improving aesthetics and support. The final result of the extrusion was 2 mm and was obtained after 8 months. Once the tooth was in the correct position within the dental arch (Figure 1.C) and before starting post-endodontic rehabilitation, a gingivectomy was performed to eliminate excess post-extrusion soft tissue and form the gingival margin of teeth 11 and 12 (Figure 2.A-B).

After 8 weeks of having implemented the gingivectomy, post-endodontic rehabilitation was continued by placing a fiberglass post (Kit Parapost Fiber Lux®, Coltène, Altstätten, Switzerland) with reconstruction of resinous core material (Clearfil™ DC Core Plus, Kuraray Noritake Dental Inc., Okayama, Japan) and stratified resin (Clearfil™ AP-X ES-2, Kuraray Noritake Dental Inc., Okayama, Japan) as a provisional during orthodontic treatment (Figure 2. C) according to root dilaceration (Figure 2.D). Figure 3.A-B shows the radiographs before and after treatment. Finally, the verticalization of the root of tooth 11 continued, as well as the mesiodistal

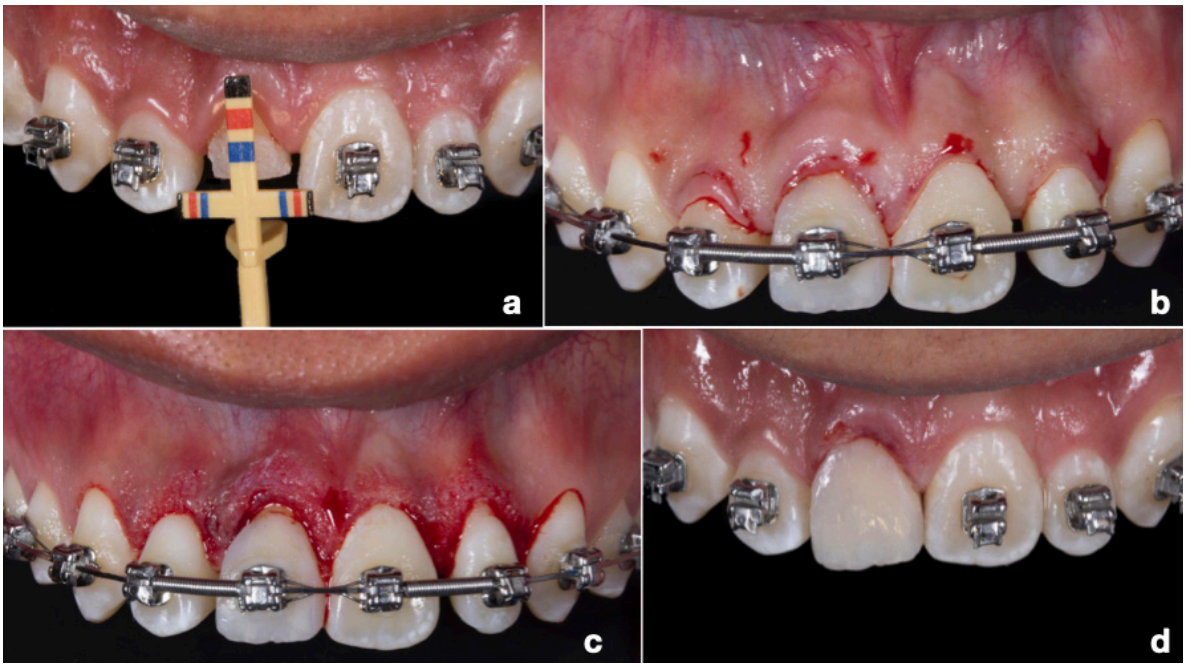

Figure 2. Periodontal procedure and provisionalization. A. Pre-surgical measurements. B. Gingival remodelling. C. Stratified resin as a provisional during orthodontic treatment. D. Placement of definitive provisional.

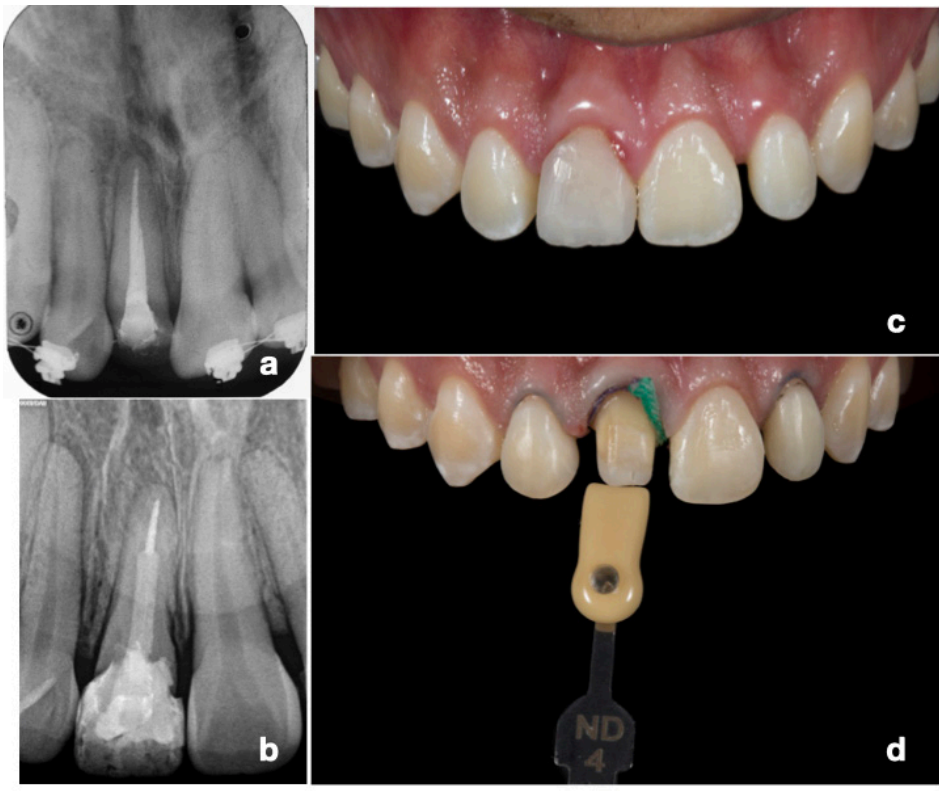

Figure 3. Treatment progress. A. Final radiograph of root canal treatment. B. Radiograph of the reconstruction with temporal stratification. C. Healing of the surgical procedure. D. Colour taking of the nuclei.

distribution of the spaces in the anterior area, for the aesthetic phase. Once orthodontic goals were accomplished, the patient was referred to oral rehabilitation (Figure 3.C).

The crown preparation of tooth 11 was carried out with a carbide bur and dentin hybridization was carried out with the Resin Coating[12] technique (Clearfil™ SE Bond Kit + Clearfil™ AP-X Esthetics Flow, Kuraray Noritake Dental Inc., Okayama, Japan) complementing the preparations for lithium disilicate veneers (IPS e.max Press, Ivoclar Vivadent AG, Liechtenstein) of the anterior teeth 12, 21 and 22, taking core colour (Figure 3.D) to carry out the restorations (Figure 4.A). For cementation, the Resin coating was reactivated with aluminium oxide (Al_2O_3) at 50 µm at 3.5 bar for 5 s with a distance of 10 mm[13]. Finally, cementation was completed with amine-free, dual-cure, self-etching, long-term cement (Panavia™ V5 Clear, Kuraray Noritake Dental Inc., Okayama, Japan) to guarantee transparent colour stability and compensate for the attenuation of lithium disilicate in the loss of light energy (Figure 4.B-C).

DISCUSSION

For many years, crown lengthening had been the most used method in fractured teeth; however, this surgical procedure usually causes an uneven contour of the gingival margin in the anterior region. As an alternative, mini screws have now been used as Temporary Anchorage Devices to perform orthodontic tooth movements, including forced extrusion[15]. Forced extrusion is an

Figure 4. Treatment completed. A. Restorations finished on models. B. Cementation of final restorations. C. Final photograph.

orthodontic technique to extrude a tooth out of its alveolar bone socket through movement. It is a procedure that closely resembles the natural eruption of the tooth, managing to maintain a crown-root ratio of approximately 1:1. To perform this procedure, a force of 0.2-0.3 N is required with a movement of 2-4 mm for the central incisor and 4-6 mm for the lateral incisor. To reach optimal periodontal health, it has been recommended to maintain a distance of 3-4 mm from the alveolar crest to the coronal extension of the remaining tooth structure[3].

It is important to highlight that there are other treatment alternatives, among which we can mention surgical procedures such as alveolar decortication, which in combination with orthodontic therapy significantly reduces the time of forced eruption of impacted canines in the palate[16]. For forced orthodontic extrusion, an extracanal insertion has also been suggested, which does not compromise the filled canal space and may be a solution for post-traumatic crown fracture. The procedure described for forced orthodontic extrusion using an extracanal pin attachment is effective and convenient, and for the clinician it does not require to apply force directly to the provisional crown. Therefore, there is less risk of loosening the provisional crown and the canal space remains intact with the final restoration or dressing material[17].

Several authors have recommended that the maximum force for slow movement should not exceed 30 g, while for fast extrusions, forces greater than 50 g are applied[18,19]. After a dormant period of a few days to a few weeks, including a period of hyalinization, slow extrusion occurs at a rate of about 1 mm or less per week. Brown & Welbury report that in practice there is always some movement of the surrounding bone and gingival tissue when the tooth is extruded, but such changes were less prominent when extrusion was carried out with lighter forces and at a slower speed[20].

Thus, in the clinical case presented, forced orthodontic extrusion was chosen, to preserve the biological width and improve the remodelling of the tissues caused by the tension force applied to the periodontal ligament and alveolar bone during the movement of extrusion, thus

inducing bone apposition. Studies evaluating the metrics of gingival movement associated with orthodontic extrusion indicated that the free gingiva and attached gingiva moved approximately 80 – 90% of the total extruded distance, resulting in periodontal stability and exposure of the tooth structure, to obtain a good definitive restoration and preserve the tooth with good aesthetics[21]. It is important that prior to the definitive restoration, the root must be retained in its new position, to avoid recidivism[20].

CONCLUSIONS

In our clinical case, factors such as the patient's age, the tooth involved (maxillary anterior) and the patient's good oral hygiene were taken into account, allowing the search for alternatives to fulfil aesthetic and functional results. Orthodontic procedures, forced extrusion, root canal treatment, placement of an endodontic post, gingivectomy and crown restoration allowed the tooth to be preserved in optimal conditions, thus achieving its stability and periodontal health. Interdisciplinary work allowed us to provide more and better treatment options to patients, and although at first it may be thought that the procedures are lengthy and tedious, in the long term they end up being a better option for patients.

BIBLIOGRAPHIC REFERENCES

1. Zerman N, Cavalleri G. Traumatic injuries to permanent incisors. *Dent Traumatol*. 1993; 9(2): 61-64. DOI: 10.1111/j.1600-9657.1993.tb00661.x
2. Ulusoy AT, Tunc ES, Cil F, Isci D, Lutfioglu M. Multidisciplinary treatment of a subgingivally fractured tooth with indirect composite restoration: A case report. *J Dent Child (Chic)*. 2012; 79(2): 79-83. https://www.ingentaconnect.com/content/aapd/jodc/2012/00000079/00000002/art00008
3. Verma KG, Juneja S, Kumar S, Goyal T. Orthodontic extrusion of subgingivally fractured tooth using a removable appliance: An alternative treatment to reestablish biological width. *Indian J Dent Res*. 2014; 25(5): 678-680. DOI: 10.4103/0970-9290.147128
4. Pulcini MG, Vitelli C, Dian A, Radaelli K, Basso M. Single tooth prosthetic restoration through surgical crown lengthening, conservative therapies and CAD-CAM milled restoration in lithium-disilicate: A case report. *Acta Stomatol Croat*. 2019; 53(3): 371-378. DOI: 10.15644/asc53/4/8
5. Oh SL. Biologic width and crown lengthening: case reports and review. *Gen Dent*. 2010; 58(5): e200-e205. https://www.researchgate.net/profile/Se-Lim-Oh/publication/46191242_Biologic_width_and_crown_lengthening_Case_reports_and_review/links/0fcfd5023232a96792000000/Biologic-width-and-crown-lengthening-Case-reports-and-review.pdf
6. Carvalho BAS, Duarte CAB, Silva JF, Batista WWDS, Douglas-de-Oliveira DW, de Oliveira ES, *et al*. Clinical and radiographic evaluation of the periodontium with biologic width invasion. *BMC Oral Health*. 2020; 20: 116. DOI: 10.1186/s12903-020-01101-x
7. Patil PG, Nimbalkar-Patil SP, Karandikar AB. Multidisciplinary treatment approach to restore deep horizontally fractured maxillary central incisor. *J Contemp Dent Pract*. 2014; 15(1): 112-115. DOI: 10.5005/jp-journals-10024-1498
8. Andreasen JO, Andreasen FM, Tsukiboshi M. Crown-root fractures. En: JO Andreasen, FM Andreasen, L Andersson (eds). *Textbook and color atlas of traumatic injuries to the teeth*. 4 ed. Chichester, UK: Wiley Blackwell; 2007. pp. 314-334.

9. Bourguignon C, Cohenca N, Lauridsen E, Flores MT, O'Connell AC, Day PF, *et al*. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 1. Fractures and luxations. *Dent Traumatol*. 2020; 36(4): 314-330. DOI: 10.1111/edt.12578
10. Samet N, Jotkowitz A. Classification and prognosis evaluation of individual teeth– A comprehensive approach. *Quintessence Int*. 2009; 40(5): 377–387. PMID: 19582242
11. Proffit WR, Fields HW, Sarver DM. *Ortodoncia Contemporánea*. 5 ed. Madrid: Elsevier; 2013.
12. Jayasooriya PR, Pereira PNR, Nikaido T, Tagami J. Efficacy of a resin coating on bond strengths of resin cement to dentin. *J Esthet Restor Dent*. 2003; 15(2): 105-113. DOI: 10.1111/j.1708-8240.2003.tb00325.x
13. Özcan M, Lamperti S. Effect of mechanical and air-particle cleansing protocols of provisional cement on immediate dentin sealing layer and subsequent adhesion of resin composite cement. *J Adhes Sci Technol*. 2015; 29(24): 2731-2743. DOI: 10.1080/01694243.2015.1087254
14. Ural Ç, Duran İ, Tatar N, Öztürk Ö, Kaya İ, Kavut İ. The effect of amine-free initiator system and the polymerization type on color stability of resin cements. *J Oral Sci*. 2016; 58(2): 157-161. DOI: 10.2334/josnusd.15-0619
15. Horliana RF, Horliana ACRT, Wuo AV, Perez FEG, Abrão J. Dental extrusion with orthodontic miniscrew anchorage: A case report describing a modified method. *Case Rep Dent*. 2015; 2015: 909314. DOI: 10.1155/2015/909314
16. Ferguson DJ, Rossais DA, Wilcko MT, Makki L, Stapelberg R. Forced-eruption time for palatally impacted canines treated with and without ostectomy-decortication technique. *Angle Orthod*. 2019; 89(5): 697-704. DOI: 10.2319/111418-809.1
17. Keinan D, Szwec J, Matas A, Moshonov J, Yitschaky O. Applying extrusive orthodontic force without compromising the obturated canal space. *J Am Dent Assoc*. 2013; 144(8): 910-913. DOI: 10.14219/jada.archive.2013.0208
18. Kudou Y, Kubota M. Replantation with intentional rotation of a complete vertically fractured root using adhesive resin cement. *Dent Traumatol*. 2003; 19(2): 115-117. DOI: 10.1034/j.1600-9657.2003.00101.x
19. Bach N, Baylard JF, Voyer R. Orthodontic extrusion: Periodontal considerations and applications. *J Can Dent Assoc*. 2004; 70(11): 775–780. PMID: 15588553
20. Brown GJ, Welbury RR. Root extrusion, a practical solution in complicated crown–root incisor fractures. *Br Dent J*. 2000; 189: 477-478. https://www.nature.com/articles/4800804 Citados en: Ansar J, Jain P, Bhattacharya P, Agarwal DK. Aesthetic rehabilitation of subgingival fractures with forced eruption: Case reports. *J Clin Diagn Res*. 2015; 9(5): ZD13-ZD15. DOI: 10.7860/JCDR/2015/12187.5900
21. Kajiyama K, Murakami T, Yokota S. Gingival reactions after experimentally induced extrusion of the upper incisors in monkeys. *Am J Orthod Dentofacial Orthop*. 1993; 104(1): 36-47. DOI: 10.1016/0889-5406(93)70025-J