

ORTHODONTIC TREATMENT OF ANKYLOSED PERMANENT TEETH AFTER SURGICAL LUXATION

Branislav Vidović¹, Ana Todorović², Marko Igić³

Tooth ankylosis is the process of the fusing of a tooth root to the surrounding alveolar bone whereby the periodontal ligament is lost, and in later stages, a tooth root is replaced by the bone, which eventually results in the tooth loss. The etiology of this condition includes trauma, genetic factors, metabolic anomalies, local anomalies, endocrine anomalies, iatrogenic causes as well as idiopathic factors. The consequences are evident and involve prevented ankylosed tooth growth causing non-occlusion, adjacent teeth inclination, opponent teeth eruption and cause malocclusion. Therapy can be surgical, conservative, orthodontic or combined. The case presented in this paper illustrates the efficacy of the surgical luxation of ankylosed teeth followed by the immediate application of orthodontic elastic force. The outcome may be debatable, but considering a poor prognosis for ankylosed teeth, the suggested treatment represents a better therapeutic choice than facing potential consequences of administering or not administering the usual treatment of ankylosed permanent teeth.

Acta Medica Medianae 2019;58(2):62-69.

Key words: permanent tooth ankylosis, etiology, prognosis, therapy

¹Specialist Orthodontic Dental Practice Ortis, Novi Sad, Serbia

²Clinic for Dentistry, Department of Orthodontics, Niš, Serbia

³University of Niš, Faculty of Medicine, Department of Prosthodontics, Niš, Serbia

Contact: Branislav Vidović
Vojvode Putnika 11, 21000 Novi Sad, Serbia
E-mail: ortis.co@gmail.com

Introduction

Ankylosed permanent teeth are clinically most commonly noticed by the lack of or incomplete eruption (not reaching the occlusal plane) of one or a group of teeth. The harmful effect of this condition can be more serious of that causing the possible loss of the ankylosed tooth. Its most common consequences are the inclination of adjacent and the extrusion of opposing teeth in the space which should be filled with insufficiently erupted teeth, thus normal occlusal relation becomes permanently disturbed. In addition, due to the absence of ankylosed tooth eruption, the reduction or the absence of full growth of surrounding alveolar process occurs. The prognosis of ankylosed teeth is poor. The cementum tissue of dental root transforms into bone tissue, which is followed by instability and permanent tooth loss within a period of 3 to 7 years (1).

The tooth and the alveolar bone form the gomphosis joint (Figure 1). Joint surfaces represent cementum and bone tissue. As these are two histologically similar tissues, bone and cementum cells fusion would be a natural phenomenon. However, this process does not occur under physiological conditions due to the presence of periodontal ligament which represents a physical barrier for the fusion of these two tissues. If the lesion of fibrous tissue which creates the periodontal ligament occurs (Figure 2), the barrier between the dental root cementum cell and alveolar bone cells becomes disturbed. In this place, bone and cementum cells penetration occurs and a bone bridge is formed, i.e. tooth ankylosis occurs (Figure 3). Any absence of PDL integrity creates the space for the fusion of periodontium cells by which the natural morphological and functional surrounding of the tooth is disturbed.

Diagnosis

As a result of bone and cement tissue fusion, a solid connection is formed between the tooth and the alveolar bone. Therefore, the absence of physiological mobility typical for healthy teeth is clinically noticed. An ankylosed tooth very often does not reach the occlusal plane or even remains impacted in the alveolar ridge. This occurs as a result of impossible mobility of the ankylosed tooth, so it cannot follow the vertical growth of the alveolar bone and adjacent teeth. Percutaneously, muffled sounds are heard (as in hitting the bone) due to the fusion of cementum and bone tissues. The most visible sign of tooth an-

kylosis is the lack of its mobility after forces being applied by orthodontic appliance. X-rays can show spots of periodontal ligament obliteration although such an occurrence may remain unnoticed due to relatively small surfaces of cells fusion, as well as the localisation of newly-formed bone bridges in loca-

tions which interpose the very dental root (2). The advancement of radiography and the appearance of the three-dimensional computed tomography enable measuring the extent of dental root ankylosis and its precise localisation (3). Anamnestically, patients often indicate the injury of ankylotic tooth.

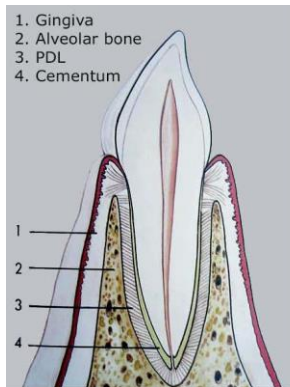


Figure 1.

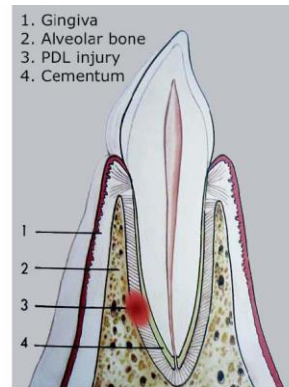


Figure 2.

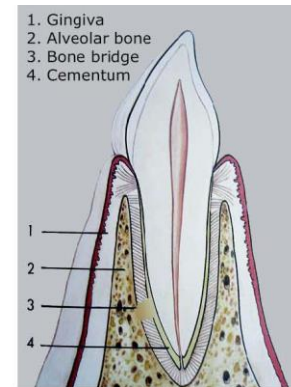


Figure 3.

Etiology

Generally, it is believed that tooth injuries are the most common cause of ankylosis (4) as they are often followed by the injuries of periodontium and even ruptures of periodontal ligament. The next most frequent cause of tooth ankylosis is tooth replantation, especially if performed unprofessionally. Iatrogenic factors, such as traction of impacted teeth by a steel ligature in the shape of a loop positioned on the enamel – cementum junction also frequently lead to ankylosis as a result of periodontal ligament injury with steel ligature. There are suggestions that ankylosis may occur for completely unknown reasons changing the fibrous of the periodontal ligament with the adjacent bone tissue (5, 6). Many papers discuss the occurrence and causes of ankylosis (7-10). A connection has been observed between the endocrine disruptions, metabolism disorders and tooth ankylosis. It is also related to genetic predispositions, local dysfunctions such as infections, trauma to the given area, hard pressure on soft tissues or the deficit in bone growth. We have to say, however, that we lack the full understanding of the essence of this process and that the idiopathic ankylosis is very common, especially in those cases where the visible external signs such as trauma or pathological lesion of periodontal ligament are missing.

Therapy

In the literature, conflicting opinions can be found about the possibilities for ankylosed permanent teeth treatment (11) which reflect insufficient knowledge of etiological processes behind this condition. Some authors believe that the prognosis of such teeth is hopeless and suggest their surgical

removal as the treatment of choice (12, 13). However, those treatments are often connected with bone fractures and massive bone defects which disable the quality of prosthetic rehabilitation. This is why tooth decoronation is suggested as an alternative to this method, which implies mucoperiosteal flap elevation and surgical removal of the tooth crown while the root remains to be replaced with bone tissue. Distraction osteogenesis is one of the methods of placing the tooth in the dental arch (14, 15) although in those cases we have to closely monitor patient's growth because his vertical dimension can be highly compromised. Others believe that ankylotic teeth, even if they have a longer term prognosis, cannot be moved by orthodontic forces (16), thus they recommend conservative, prosthetic or some other non-orthodontic therapy which often collides with biological needs of growing patients. The third suggest surgical luxation of the ankylotic tooth and its extraction unless a spontaneous eruption occurs following this intervention (17). Extraction and replantation of the ankylotic tooth is also suggested. This method is connected to vitality loss and frequent re-ankylosis unless the tooth is immediately moved from the replantation place by orthodontic appliance. A minor segmental osteotomy with repositioning of the tooth and the adjacent alveolar bone as a whole is recommended (18-20). The disadvantage of this method is that it does not affect the ankylosis itself but it changes the position of the tooth. Tooth luxation is a method of mechanical ankylotic contacts breaking preserving vasculature and innervation of the ankylotic tooth. Orthodontic movement of the tooth following luxation enables the restoration of periodontal area so that a functional tooth within healthy bone surrounding is obtained as a result of this method.

Aim

The aim of this paper is to indicate the causes and possible preventive measures, as well as to present therapeutical possibilities that are available to practitioners when they encounter the problem of ankylotic tooth in their clinical practice. The case presented in this paper illustrates a successful treatment of ankylotic upper central incisor. Immediately after the surgical luxation, the method of ankylotic tooth traction was applied with orthodontic appliance after which occlusal problems that occurred as a result of the tooth malposition were solved. Simultaneously, the restitution of the periodontal area occurred and the mobility of the treated tooth was en-

abled which persisted for even nine months after the surgical luxation.

Case report

A female patient, 21 years old, with maxillary retrognathism, open bite, bilateral crossbite and crowding in upper dental arch, came with the problem of unerupted upper left central incisor. (Figure 4, 5). Anamnesticly, the information was gained that the patient had already been orthodontically treated for the existing problem, and could not recall any trauma. Percutaneously, the tooth makes a muffled tone. There is no physiological mobility. Periodontal ligament obliteration is noticed on retroalveolar X-ray (Figure 6).



Figure 4.



Figure 5.



Figure 6.

Figure 4, 5. Patient before the beginning of the therapy
Figure 6. The arrow marks the place of periodontal ligament obliteration

Therapy plan

- ◇ Creating space for positioning the tooth 21 in the dental arch
- ◇ Ankylotic tooth undergoing surgical luxation to retain mobility
- ◇ Vertical traction of the luxated tooth immediately upon surgical intervention
- ◇ Correction of sagittal and vertical jaw relations, extension of upper dental arch, alignment of tooth arch midlines

Creating the space for positioning of the tooth 21 in dental arch was done by fixed orthodontic appliance, using steel springs (Figure 7). Regardless of the space secured for the tooth eruption, there was no reaction at all. Frontal elastic traction was also applied but the reaction occurred only in the sense of lower frontal teeth extrusion due to the traction of ankylotic tooth 21 and intrusions of upper frontal teeth, whereas tooth 21 remained unmoved. (Figure 8). Surgical luxation was performed, followed immediately by the traction of the tooth 21 with

elastic bands and round .014 NiTiarchwires (Figure 9). It took 4 months to reach its occlusal surface (Figure 10).

Nine months upon performed luxation and after more than five months of absolute inactivity, tooth 21 was still reacting to orthodontic forces which indicates that it was set in a completely morphologically and physiologically normal and healthy surrounding. Due to this fact, we were able to move it medially by 1.5 mm which aligned midlines (Figure 10, 11, 12).

Fixed orthodontic appliance was removed twenty-three months after the performance of surgical luxation. Figures 13, 14, 15 show normal incisaloverjet, incisal overbite andmidline alignment. Occlusion is in class I. Tooth 21 shows signs of physiological mobility and percutaneouslyproduces a resonant sound. The vitality of the tooth is entirely intact. Retroalveolar X-ray film does not show signs of periodontal ligament obliteration and welldevelopedtrabecular bone structure can be seen (Figure 16).Figure 16 shows resorption of apex 11 developed in stage I of the therapy due to the intrusion of upper frontal teeth.



Figure 7.



Figure 8.



Figure 9.



Figure 10.



Figure 11.



Figure 12.



Figure 13.



Figure 14.



Figure 15.



Figure 16.

Discussion

In respect to poor prognosis of ankylosed teeth, it is important to take a preventive action. This primarily refers to the prevention of injuries (orthodontic treatment of class II/1, protectors, etc.) and after that to a satisfactory recovery of traumatised teeth as the most common cause of ankylosis. In this respect, the focus of the problem is shifted from the fight against root canal inflammation more towards procedures for the preservation of physiological integrity of the periodontal ligament. This is why it is important to conduct the procedure of tooth replantation correctly if the avulsion occurred after the injury. Two procedures are suggested in this case depending on whether they are performed less or more than 60 minutes from the time of avulsion:

Treatment < 60 min

- Rinse the root canal with physiological solution
- Remove the coagulum with physiological solution jet
- Examine the presence of injuries in surrounding tissues and perform Treatment for their recovery
- Replant the tooth with gentle finger pressure

Treatment > 60 min

- Remove necrotic tissue (pdl included)
- Remove the coagulum with physiological solution jet
- Examine the presence of injuries in surrounding tissues and perform Treatment for their recovery
- Submerge the tooth in 2.4% sodium fluoride pH5.5 for at least 5 minutes
- Or, if possible, in emdogain
- Replant the tooth with gentle finger pressure

After such a treatment it is necessary to:

- Treat the wound and verify the position of the tooth with x-ray
- Apply flexible splint (only for 7 days)
- Administer antibiotics
- Refer the patient to the doctor
- Administer anti-tetanus serum
- Perform endodontic treatment after 7-10 days if necessary
- Carry out a soft food diet
- Recommend cleaning teeth with a soft tooth brush
- Rinse mouth twice a day with octenidol mouth rinse for 7 days

The tooth and the alveola which surrounds it represent a joint. To avoid ankylosis after luxation or subluxation of the tooth it is necessary to perform a "tilting" exercise, i.e. minimal movement of the injured tooth within 1 mm range. This is why placing an elastic splint is necessary. Partial and full fixed appliances with round archwires can serve the purpose perfectly. Exercise needs to be performed immediately after placing the elastic splint, 7 days at the latest following the injury. Continuous shearing of the tissue in the healing stage leads to fibrous-like instead of bone-like fusion, which is exactly the way in which

joints should heal. In the end of the process, periodontium is the most similar to its anatomic structure, with fibrous tissue between the bone and cementum (Figure 17). Rigid immobilisation is undesirable as it leads to re-ankylosis with all the potential consequences and whose final stage is the substitution of dental root for the bone tissue, which begins from the very first moment of establishing the communication through the injured periodontal ligament and ends in instability and tooth loss (Figure 18).

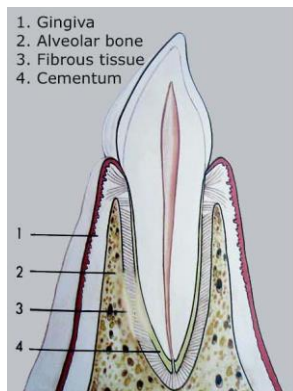


Figure 17.

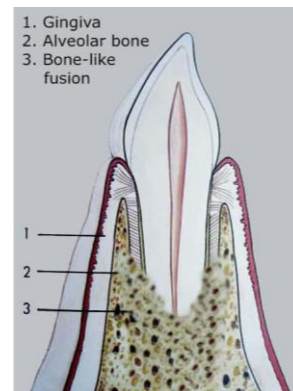


Figure 18.



Figure 19.



Figure 20.

Antibiotic protection is necessary to be administered during 7-10 days in order to avoid the infection of periodontal ligament. The antibiotic of choice is tetracycline. Unlike amoxicillin, it not only reduces the risk of infection but has the inhibitory effect on osteoclasts which lead to dental root resorption (21). In order to minimise the initial inflammatory stage and therefore reduce the activation of osteoclasts, local application of steroids (dexamethason) is recommended (22). The use of emdogain is recommendable as it forms a matrix for fibrocyte development. Tilting exercises or continuous orthodontic force, if needed, can be applied 1 day after the tooth replantation (4). The prevention of ankylosis implies avoiding any therapeutic methods that lead to lesions of periodontal ligament.

If ankylosis still occurs, the chance for ankylosed teeth to survive without undergoing orthodontic treatment is little. Rhizolysis, which has the form of external inflammatory rhizolysis, includes the dental root and the bone substitutes the dental root cementum. Granulation tissue, which is present in the condition of ankylosis, resorbs the root in the same manner. In both cases the loss of dental root occurs and the tooth falls out (Figure 18). This process is not irreversible unless the necrosis of periodontal ligament exceeds 20% of the radicular surface (23).

The therapy that we administered was recommended by Proffit (18): anesthesia and mild luxation of the ankylosed tooth in order to break bone fibres between the dental root and alveolar bone. If this procedure is performed, it is extremely important for the orthodontic force to be applied immediately after luxation. Otherwise, it is only the matter of time when re-ankylosis will occur. Orthodontic forces must be reactivated every 10 days until the moment when the tooth is positioned in its place in the dental arch (4).

The method of tooth luxation and its orthodontic movement is risky. It can lead to root fracture, especially in multi-rooted teeth. Apart from that, external and internal rhizolysis can follow such a procedure. Pulp devitalisation is also one of the potential problems. An alternative to this method is the survival of the ankylosed tooth in the jaw with all the consequences that go with it. Prosthetic, conservative or surgical treatment can reduce patient's difficulties, but only to a certain extent. With all the risks they take, combined orthodontic-surgical treatments are the only ones that can lead to full recovery of the ankylosed tooth and preservation of the natural conditions in patient's mouth, which provide him or her with comfortable dental future (Figure 19, 20).

References

- Andersson L. Dentoalveolar ankylosis and associated root resorption in replanted teeth. Experimental and clinical studies in monkeys and man. *Swed Dent J Suppl* 1988; 56:1-75. [[PubMed](#)]
- Geiger A, Bronsky M. Orthodontic management of ankylosed permanent posterior teeth: A clinical report of three cases. *Am J Orthod Dentofacial Orthop* 1994; 106(5):543-8. [[PubMed](#)]
- Paris M, Trunde F, Bossard D, Farges JC, Coudert JL. Dental ankylosis diagnosed by CT with tridimensional reconstructions. *J Radiol* 2010; 91(6):707-11. [[CrossRef](#)][[PubMed](#)]
- Graber MT, Vanarsdall LR. *Orthodontics: current principles and techniques*. 2nd ed. St. Louis: Mosby; 1994.
- Line SE, Polson A, Zander HA. Relationship between periodontal injury selective cell repopulation and ankylosis. *J Periodontol* 1974; 45(10):725-30. [[CrossRef](#)][[PubMed](#)]
- Melcher AH. Repair of wounds in the periodontium of the rat: influence of periodontal ligament on osteogenesis. *Arch Oral Biol* 1970; 15(12):1183-204. [[CrossRef](#)][[PubMed](#)]
- Biederman W. The problem of the ankylosed tooth. *Dent Clin North Am* 1968; 409-24. [[PubMed](#)]
- Kronfeld R. Bony union (ankylosis) of roots and alveolus. In: *Histopathology of the teeth and their surrounding structures*, 2nd ed. Philadelphia: Lea & Febiger; 1939.
- Noyes FB. Submerging deciduous molars. *Angle Orthod* 1932; 2:77-87.
- Vanarsdall RL. *Management of ankylosed teeth: Special Interest Clinics*. Washington DC: American Association of Orthodontists annual session; 1979.
- Alruwaithi M, Jumah A, Alsadoon S, Berri Z, Alsaif M. Tooth Ankylosis And its Orthodontic Implication. *IOSR-JDMS* 2017; 16(2): 108-12. [[CrossRef](#)]
- Moyers RE. *Handbook of orthodontics*. 4th ed. Chicago: Year Book; 1988.
- Schafer WB, Hine MK, Levy BM. *A textbook of oral pathology*. 3rd ed. Philadelphia: WB Saunders; 1983.
- Dolanmaz D, Karaman IA, Pampu A, Topkara A. Orthodontic Treatment of an Ankylosed Maxillary Central Incisor through Osteogenic Distraction. *Angle Orthod* 2010; 80(2):391-5. [[CrossRef](#)][[PubMed](#)]
- Aludden H, Jensen T. Dentoalveolar Segmental Osteotomy Combined with Orthodontic Treatment for an Impacted and Ankylosed Upper Canine: A Case Report. *Open Journal of Stomatology* 2016; (6): 97-102.
- Andreasen JO. *Traumatic injuries of the teeth*. 2nd ed. Philadelphia: WB Saunders; 1981.
- Biederman W. Etiology and treatment of tooth ankylosis. *Am J Orthod* 1962; 49: 670-84. [[CrossRef](#)]
- Proffit WR. *Contemporary orthodontics*. 2nd ed. St Louis: Mosby Year Book; 1993.
- Chae JM, Paeng JY. Orthodontic treatment of an ankylosed maxillary central incisor through single-

- tooth osteotomy by using interdental space regained from microimplant anchorage. *Am J Orthod Dentofacial Orthop.* 2012; 14(2): 39-51. [[CrossRef](#)][[PubMed](#)]
20. Metin-Gürsoy G, Okur B, Türkyilmaz F, Bozkaya S. Corticotomy assisted orthodontic treatment of ankylosed and impacted upper canine. *J Case Rep Images Dent* 2017; 3: 20-24.
21. Sae Lim V, Wang CY, Choi GW, Trope M. The effect of systematic tetracycline on resorption of dried replanted dogs' teeth. *Endod Dent Traumatol*1998; 14(3): 127-32. [[CrossRef](#)][[PubMed](#)]
22. Sae Lim V, Metzger Z, Trope M: Local dexamethasone improves periodontal healing of replanted dogs' teeth. *Endod Dent Traumatol*1998; 14(5): 232-6. [[CrossRef](#)][[PubMed](#)]
23. Tronstad L. *Clinical endodontics*. 3rd ed. New York: Georg ThiemeVerlag;2009.

Prikaz bolesnika

UDC: 616.314-007-089.23
doi:10.5633/amm.2019.0211

ORTODONTSKI TRETMAN ANKILOZE STALNIH ZUBA NAKON IZVEDENE HIRURŠKE LUKSACIJE

Branislav Vidović¹, Ana Todorović², Marko Igić³

¹Specijalistička stomatološko-ortodontska ordinacija Ortis, Novi Sad, Srbija

²Klinika za stomatologiju, Niš, Služba za ortopediju vilica, Niš, Srbija

³Univerzitet u Nišu, Medicinski fakultet, Katedra za stomatološku protetiku, Niš, Srbija

Kontakt: Branislav Vidović
Vojvode Putnika 11, 21000 Novi Sad, Srbija
E-mail: ortis.co@gmail.com

Ankiloza zuba je proces srastanja korena zuba za okolno koštano tkivo u kome dolazi do gubitka periodontalnog ligamenta, a u kasnijim fazama do pretvaranja korena zuba u koštano tkivo i do gubitka samog zuba. Etiologija ovakvih stanja kreće se od traume, genetske predispozicije, poremećaja metabolizma, lokalnih poremećaja, endokrinih poremećaja, jatrogenih uzroka pa do idiopatskih faktora. Posledice su evidentne i odnose se na izostanak rasta ankilotičnih zuba usled čega dolazi do nonokluzije, inklinacije susednih zuba, erupcije zuba oponenata i narušavanja cele okluzije. Terapija može biti hirurška, konzervativna, ortodontska ili kombinovana. Slučaj prikazan u ovom radu svedoči o efikasnosti hirurške luksacije ankilotičnih zuba praćene neposrednom primenom ortodontske elastične vuče. Ishod može biti diskutabilan, ali s obzirom na lošu prognozu ankilotičnih zuba, hirurška luksacija predstavlja bolji terapijski izbor od suočavanja sa mogućim posledicama izostanka ili primene uobičajenih tretmana ankilotičnih zuba.

Acta Medica Medianae 2019;58(2):62-69.

Ključne reči: ankiloza stalnih zuba, etiologija, prognoza, terapija