Predictability of Exfoliation Time of Deciduous Teeth

Cakir A*

Department of Pediatric Dentistry Karaman, Karamanoğlu Mehmetbey University, Turkey

*Corresponding author: Asu Cakir, Ahmet Keleşoğlu Faculty of Dentistry, Department of Pediatric Dentistry Karaman, Karamanoğlu Mehmetbey University, Turkey, Email: asucakir@kmu.edu.tr

Abstract

Background: The predictability of the eruption time of primary teeth has an important place in clinical applications, forensic medicine, planning of orthodontic treatments and age estimation.

Aim: In this study, we tried to contribute to dental literature by trying to prove the predictability of the falling time of primary teeth.

Design: From the periapical radiographs taken from the patients who applied to the clinic with the complaint of primary second molars, primary first molars were detected without caries and with 1 to 3 months to fall. The teeth of the patients for whom follow-up was recommended, which were due to fall out and adhered only to the gingiva, were extracted with the help of cotton, according to the patient's complaint. Fall times were recorded.

Results: Null Hypothesis test was applied to estimate the falling time of the teeth followed in the study, and the success rate in the 90-day exfoliation period was statistically significant, but no statistically significant difference was found in the 30-day samples.

Conclusion: We think that, besides estimating the falling time of primary teeth in stem cell research, orthodontic treatment, clinical treatment planning and age determination, examining of primary teeth with correct without causing ethical problems will make a significant contribution to the literature.

Clinical Benefit: Naturally and physiologically shedding deciduous teeth are unique ex vivo human tissue resources with abundance of multiple cells, including stem cells. The predictability of shedding time of deciduous teeth would be very important while planning sensible stem cell experiments.

Keywords: Primary Teeth; Eruption Time; Predictability; Stem Cell

Introduction

Stem cells, one of the most important and perhaps the most important scientific studies to improve the quality of life, are described as cell populations that have the capacity of self-renewal in the human organism, are found in all tissues, have the potential to live for a very long time, and can produce new cells without causing genetic errors [1-3]. In stem cell studies, teeth, especially dental pulp, have importance as a source of stem cells [4]. On the other hand, primary teeth are naturally thrown away from the body when the time comes. As a source of stem cells, it is a controversial issue that human tissues can be obtained easily and without creating an ethical problem. For this reason, pulp and periodontal ligament tissues of primary teeth that have to be pulled out with suitable indications or that have

naturally fallen (exfoliated) are quite valuable for stem cell research [5-7]. Primary teeth, which are the source of stem cells that are the most unproblematic to get ethically; gain this qualification by having normal physiological resorption. Physiological resorption is the major difference between primary and permanent teeth. It has been reported that primary teeth in the physiological resorption stage preserve pulp tissue integrity until the advanced stages of exfoliation [8,9]. It is thought that this situation might have advantages for getting stem cells from primary teeth. In addition, it has been reported that the greatest difference between primary and adult teeth stem cells is that primary teeth stem cells have the capacity of higher proliferation and colony forming [10-12].

Resorption is a dynamic event based on the destruction of hard tissues and the removal of demolished substances by cellular elements [13]. The first stage of root resorption, which occurs in 4 stages in primary teeth, is the active root resorption stage. In a dent in surrounding a Howship lacuna, where there are odontoclasts, a 0.5 μm deep demineralization area has been formed. In this area, it is observed that the organic matrix is completely destroyed [14,15]. In the resting phase, which is the second phase when resorption event stops and there are no odontoclasts in the environment, the tissue crystals or ions released during resorption in order to protect the pulp tissue from external factors precipitate into the dentin canals of the deeper layers as salt complexes again and occlude these canals [15,16]. Since the resorption stops in the third stage characterized by cellular cementum formation, where root repair is observed, cementoblasts have the opportunity to secrete a tissue called presement, which can show little mineralization [15]. The stage where the resorption process in question in primary teeth is close to exfoliation is the last stage [17].

When the resorption of the primary tooth root approaches to the collet, the gingival epithelium proliferates under the root from the collet and separates it from the female organism by reuniting with the other epithelial group coming from the opposite side. Hence, at a stage close to the completion of root resorption, the tooth falls out with a minor trauma. At the site of the fallen tooth, a red granulation tissue covered by a gingival epithelium is observed. Generally, a very short time (1-2 days) after the tooth falls out, the permanent tooth appears in this part. However, in the absence of permanent tooth germ, primary tooth root resorption occurs [18-20]. This resorption occurs more slowly than when there is an underlying permanent tooth. Primary tooth roots are more susceptible to resorption than permanent tooth roots. The resorption process has also been associated with changes in the pulp. Dental pulp cells have cytokine-producing cells that form osteo/odontoclasts and play a role in exfoliating of primary teeth [21-24].

Primary tooth resorption and subsequent eruption of permanent teeth is a process that affects the normal development of the craniofacial complex. The presence of a reliable predictor of deciduous tooth resorption status may be useful for the planning of orthodontic treatments in cases in which extraction and closure of the primary teeth are not recommended and there is no shortage of space. The treatment of delayed primary tooth resorption differs depending on the eruption of the underlying permanent tooth germ. In addition to this, treatments are recommended for the resorption of delayed primary tooth, such as removing obstacles in eruption and ensuring that the tooth erupts with orthodontic treatment or spontaneously. Shortly, it has been reported that the physiological resorption of primary teeth might affect the duration of orthodontic treatment and the amount of force applied to the tooth [25,26]. On the other hand, it has been indicated in the studies that structural changes in the tooth which includes root resorption could be used to define the age [27,28].

Primary teeth exist in 3 different periods in the mouth: crown and root development, root maturation and root resorption-tooth loss. The developmental period takes about 1 year, root maturation about 3 ¾ years, and root resorption and tooth eruption about 3 ½ years [13]. In the study by Yıldırım S [25], the length of each extracted primary tooth was measured to determine the resorption phase, and the root surface length was determined as the distance between the enamel-cementum junction and the most apical part of the intact cementum surface. Teeth with a root length of up to 1-3 mm from the enamel-cementum line were evaluated as teeth that had completed their resorption [25]. In the light of this information, we can estimate the approximate time that the primary tooth will fall out with additional x-rays depending on the age of the patient. The age of the patient depending on the tooth structure might be estimated with the radiographs taken in the studies [29]. The aim of this study is to indicate the predictability of the eruption time of primary teeth during routine pedodontic treatments. In this study, in the light of the above information, we planned this study with the aim of accurately predicting the estimated time of falling out depending on the age of the patient and the duration of the fall of primary teeth in the radiographs taken in the absence of any systemic disease, pathology, or absence of any underlying permanent tooth.

Material and Methods

Inclusion Criteria

The applicants to the Karamanoğlu Mehmetbey University Ahmet Keleşoğlu Faculty of Dentistry Pedodontic Clinic whose general health status and oral hygiene were good, cooperative, and also the patients with primary

first molar teeth whose time to exfoliate in the mouth was approximately 1 mouth (n=30) or 3 months (n=30) were included. Since it is known that the exfoliation time of a primary tooth that has started to resorb can be determined radiographically in resorptions exceeding the root 1/3 distance and it is known that there is approximately 1-3 months before the exfoliation of a tooth that has completed root 2/3 resorption.

Furseth R [30], the said exfoliation times can be determined approximately. Teeth with advanced root resorption were included in the 1-month part of the study, whereas teeth that completed 2/3 root resorption were included in the 3-month part. These resorption stages were determined radiographically and classified according to Şimşek and Durutürk [31] (Table 1). The teeth in the 1/B group according to the resorption degree of this classification formed the study group.

Study Setting and Design

Caries lesion depth	
1	Caries-free or enamel caries
2	Superficial dentin caries
3	Deep dentin caries
Root resorption degrees	
A	If the degree of root resorption includes 0-1/3 of the root length
B	If the degree of root resorption includes 1/3-2/3 of the root length
Combination of depth of carious lesion and degrees of root resorption	
1/A	Depth of lesion without caries or 1st degree, degree of root resorption 0-1/3
1/B	Depth of lesion without caries or 1st degree, degree of root resorption 1/3-2/3
2/A	2nd degree lesion depth, root resorption degree 0-1/3
2/B	2nd degree lesion depth, root resorption degree 1/3-2/3
3/A	3nd degree lesion depth, root resorption degree 0-1/3
3/B	3nd degree lesion depth, root resorption degree 1/3-2/3
Despite the differences in the depth of the caries lesion, all carious and non-carious teeth	
4/A	All decayed and non-carious teeth, root resorption degree 0-1/3
4/B	All decayed and non-carious teeth, root resorption degree 1/3-2/3
All resorbed teeth despite differences in degree of root resorption (C)	
1/C	All resorbed teeth, free of caries or lesion depth 1
2/C	All resorbed teeth, free of caries or lesion depth 2
3/C	All resorbed teeth, free of caries or lesion depth 3

Table 1: Depth of tooth decay and degrees of root resorption and combination of these parameters.

Ethical Approval

Approval numbered 04-2021/17 was obtained from the Ethics Committee of Karamanoğlu Mehmetbey University Faculty of Medicine for the study. The parents of the children who suit the research criteria were informed about the study and the "Informed Volunteer Consent Form to participate in a Clinical or Experimental Study" was read and their written consent was obtained.

Methodology

In the study, the operations on the indicated teeth of the patients which form the samples were continued and the completion of physiological root resorption was followed with frequent controls. In the controls, it was aimed to pull out the patient's tooth in the normal exfoliation process under the supervision of a dentist in order to prevent it from being swallowed during eating due to the patient's complaint when it comes to the stage where they are attached by mucosal retention.

Statistical Analysis

Data were collected and analysed with the Null Hypothesis.

Findings

The exfoliation times of the teeth according to the age gender of the patient included in the study are given in Table 2.

Patient's gender and age (3 months)	Tooth number (3 months)	Exfoliationtime (3 months)	Patient's gender and age (1 months)	Tooth number (1 months)	Exfoliation time (1 months)
F;9	74/84	81 day/93 day	F;10	54/74	23 day/25 day
M;10	54	103 day	F;9	74/84	30 day/36 day
F;9	74/84	110 day/97 day	F;10	74/84	21 day/28 day
F;10	74/84	86 day/99 day	F;8	64	33 day
F;9	64	98 day	M;10	64	26 day
M;10	64	107 day	F;9	74/84	23 day/32 day
F;8	54	109 day	F;9	74/84	22 day/38 day
F;9	64	101 day	F;8	54	30 day
F;9	74/84	80 day/96 day	M;9	84	37 day
M;10	54	92 day	M;9	84	33 day
F;9	54	91 day	F;9	84	39 day
F;10	54/74	84 day/96 day	F;10	74	32 day
F;9	64/74	85 day/80 day	F;9	84/74	21 day/38 day
M;9	84/54	99 day/94 day	M;9	64	25 day
F;9	54	98 day	M;9	74	27 day
F;9	84	99 day	M;10	54/74	30 day/39 day
M;10	74/84	82 day/94 day	F;9	84/74	22 day/26 day
F;8	54	88 day	F;9	74	21 day
M;9	54/64	95 day/90 day	F;10	84	29 day
M;9	54/64	83 day/85 day	F;11	84	33 day
			F;9	74	30 day
			F;9	64	36 day

Table 2: The exfoliation times of the teeth, which are thought to exfoliate in 3 months and 1 month, after the first examination: *F: Female, M: male (F;9, 9 years old female patient).

The Null Hypothesis test was used for the success rates of predictability in exfoliation periods. Accordingly, the success rate in the 90-day exfoliation period was statistically significant (P<0.05). No statistically significant difference was found in the 30-day samples (P>0.05). However, there is no statistical difference between 30 day and 90 day (Table 3).

Exfolation Time	N	Mean± St.Dev
30 day	30	5,666±0,572
90 day	30	5,845±0,268

Table 3: There is no statistically significant difference between exfoliation periods (p>0.05).

Discussion

In this study, it was tried to prove the radiographically predictability of physiological resorption in human primary teeth. Obtained results show that the exfoliation times of primary teeth in children without any systemic disease can be estimated statistically significant and with a quite high degree of accuracy, depending on the periapical radiographs taken. Primary teeth fall out and they are discarded when it is time for exfoliation in the natural flow of life. Avery JK [13] stated that the root resorption and tooth eruption will take approximately 3½ years. In their study to investigate the causes of primary tooth extraction; Tunc ES, et al. [32]

found that the extraction rate due to physiological fall time is 53.3%. In this study, it is proved that primary teeth exfoliate in a statistically significant predicted time. Nevertheless, as proved in this study, it is believed that it will be an advantage in stem cell studies in terms of follow-up, control and tissue preservation, as teeth on different sides (for example, primary first molars) of the same jaws of the same patients will be symmetrically resorbed and exfoliated in a near period of time. In 2003, Miura M, et al. [7] found that primary teeth could be an ideal source of stem cells to repair damaged tooth structures, induce bone regeneration, and possibly treat neural tissue injury or degenerative diseases.

Thus, it has been reported that primary teeth are the most unproblematic tissues which can be used as a source of stem cells politically and ethically [7,33-35]. Lee S, et al. [36] compared mesenchymal root/progenitor cells obtained from supernumerary teeth with stem cells obtained from human exfoliated primary teeth, and found that the proliferation rate of supernumerary dental pulp stem cells was lower than that of pulpal stem cells in exfoliated primary teeth. Wang X, et al. [12] compared stem cells obtained from human primary tooth and permanent dental pulp stem cells in vitro, and showed that primary tooth stem cells showed higher proliferation rate and differentiation ability compared to permanent dental pulp stem cells; even so, they found out that the stem cells of the teeth have a higher mineralization ability compared to the permanent teeth as vitro. From this point of view, it seems that potential exfoliating primary teeth are the most suitable, the most accessible and ethically the most fretless teeth to obtain high-quality mesenchymal stem cells. Similarly, Saez DM, et al. [37] reviewed extant information based on the keywords and/or abbreviations of 'stem cells from human exfoliated primary teeth' from the full-text scientific studies published between 2003 and 2015 and concluded that on account of high proliferative capacity, easy access, multiline age differentiation capacity, non-invasiveness, and few ethical concerns, stem cells derived from human exfoliated primary teeth are the most valuable source of stem cells for tissue engineering and cell-based regenerative medicine treatments.

Primary tooth root resorption is one of the important factors to be considered while planning treatment in clinics. It has been shown that the success rate of root canal treatments in teeth without root resorption is 91.7%, and this rate drops to 23.1% in cases where root resorption is more than 1 mm. As a result of this, it was stated that the existing root resorption degree before treatment is the most important determining factor in the success of primary tooth root canal treatments [38]. It has been reported that physiological root resorption of primary teeth should not be ignored while root canal filling pastes used in the root

canal treatment of primary teeth are preferred in pedodontic clinics [39]. The same goes for amputation treatment. Root resorption and estimated exfoliation time should be taken into consideration at the indication stage. In the study, it was stated that amputation is not preferred for patients at this age group, considering that physiological root resorption might be fairly advanced in children older than 8 years [40]. From this point of view, the estimation of the eruption time of the primary tooth is one of the most important factors affecting the treatment process in routine clinical studies [41].

When it can be predicted when the teeth will fall out radiographically, it can help the patient have less trauma because of extraction in orthodontic treatments that require primary tooth extraction, because if the primary tooth is to be used in orthodontic treatments, the root resorption of the primary tooth will be accelerated by orthodontic strengths and the tooth will be exfoliated early. In such cases, it should be seriously evaluated whether the use of primary teeth in orthodontic treatment planning and the patient's exposure to early root resorption will provide more benefits for her or him. It has been suggested that the start of the treatment process can be delayed until the patient's completion of the mixed dentition, when it is predicted when the primary teeth will fall out in the x-rays [21].

In this case, the treatments for primary teeth, whose fall time can be predicted, can be planned. Clinically asymptomatic teeth with hard dentin caries that will fall out in the near future, can be left in the mouth without intervention with rotary instruments within the scope of Ultra conservative treatment (UCT), with the hygiene training given to the patient and regular controls [42,43]. It is believed that the predictability of the exfoliation of primary teeth will make significant contributions to the literature in the research and understanding of dental tissues within the ethics committee approval, considering the ethical concerns that cause substantial discussions today.

Conclusion

In our study, primary teeth with root resorption, which are predicted to fall out after one month and three months, were evaluated. During the observation phase of one and three months, it was observed that the teeth were exfoliated to approximately coincide with this phase. We think that these results will primarily aid stem cell studies in the future, and will also guide in orthodontic treatments and help plan the treatments be applied to teeth of which falling times are predicted. Besides, we believe that the estimation of the falling time can make significant contributions to the literature, inasmuch as the deciduous tooth tissues can be examined in the laboratory environment.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

References

1. Evans MJ, Kaufman MH (1981) Establishment in culture of pluripotential cells from mouse embryos. Nature 292(5819): 154-156.

2. Thomson JA, Eldor JI, Shapiro SS, Waknitz MA, Swiergiel JJ, et al. (1998) Embryonic stem cell lines derived from human blastocysts. Science 282(5391): 1145-1147.

3. Wobus AM, Boheler KR (2005) Embryonic stem cells: prospects for developmental biology and cell therapy. Physiol Rev 85(2): 635-678.

4. Gronthos S, Mankani M, Brahim J, Robey PG, Shi S (2000) Postnatal human dental pulp stem cells (DPSCs) in vitro and in vivo. Proc Natl Acad Sci USA 97(25): 13625-13630.

5. Hasler P, Zouali M (2005) Immune receptor signaling, aging and autoimmunity. Cell Immunol 233(2): 102-108.

6. Carlson ME, Conboy IM (2007) Loss of stem cell regenerative capacity within aged niches. Aging cell 6(3): 371-382.

7. Miura M, Gronthos S, Zhao M, Lu B, Fisher LW, et al. (2003) SHED: Stem Cells from Human Exfoliated Deciduous Teeth. Proc Natl Acad Sci 100(10): 5807-5812.

8. Sahara N, Okafuji N, Toyoki A, Ashizawa Y, Yagasaki H, et al. (1993) A histological study of the exfoliation of human decidious teeth. J Dent Res 72(3): 634-640.

9. Sasaki T (2003) Differentiation and functions of osteoclasts and odontoclasts in mineralized tissue resorption. Microsc Res Tech 61(6): 483-495.

10. Nakamura S, Yamada Y, Katagiri W, Sugito T, Ito K, et al. (2009) Stem cell proliferation pathways comparison between human exfoliated decidious teeth and dental pulp stem cells by gene expression profile from promising dental pulp. J Endod 35(11): 1536-1542.

11. Govindasamy V, Abdullah AN, Ronald VS, Musa S, Aziz ZACAA, et al. (2010) Inherent differential propensity of dental pulp stem cells derived from human decidious and permanent teeth. J Endod 36(9): 1504-1515.

12. WangX, Sha XJ, Li GH, Yang FS, Ji K, et al. (2012) Comparative characterization of stem cells from human exfoliated decidious teeth and dental pulp stem cells. Arch Oral Biol 57(9): 1231-1240.

13. Avery JK (1988) Comparison of Primary and Permanent Teeth. In: Oral Development and Histology. Decker Inc., Pensylvania, pp: 180-190.

14. Avery JK (2000) Eruption and Shedding of Teeth. In: Steel PF, et al. (Eds.), Essentials of Oral Histology and Embriology. 2nd(Edn.), Mosby Inc, New York, pp: 71-83.

15. Sasaki T, Watanabe C, Shimizu T, Debari K, Segawa K (1990) Possible role of cementoblasts in the resorbant organ of human decidious teeth during root resorption. J Periodontal Res 25(3): 143-151.

16. Manisalı Y, Koray F (1982) Oral-dental embryology and histology. Innovation Press, Istanbul, 12: 206.

17. Sahara N, Okafuji N, Toyoki A, Suzuki I, Deguchi T, et al. (1992) Odontoclastic resorption at the pulpal surface of coronal dentin prior to shedding of human decidious teeth. Arch Histol Cytol 55(3): 273-285.

18. Gülhan A (1994) Pedodonti. IU Basımevi, Istanbul, pp: 168-172.

19. Marks SC, Schroeder HE (1996) Tooth eruption: teories and facts. Anat Rec 245(2): 374-393.

20. Eronat C, Eronat N, Aktug M (2002) Histological investigation of physiologically resorbing primary teeth using Ag-Nor Staining method. Int J Paed Dent 12(3): 207-214.

21. Consolaro A (2015) Orthodontic movement in decidious teeth. Dental press J Orthod 20(2): 16-19.

22. Hajishengallis EH (2007) Physiologic root resorption in primary teeth: molecular and histological events. J Oral Sci 49(1): 1-12.

23. Rodrigues LV, Vasconcelos AC, Campos PA, Brant JMC (2009) Apoptosis in Pulp Elimination During Physiological Rooth Resorpsion in Human Primay Teeth. Braz Dent J 20(3): 179-185.

24. Yildirim S, Yapar M, Sermet U, Sener K, Kubar A (2008) The role of dental pulp cells in resorption of decidious teeth. Oral Surg Oral Med Oral Pathol Oral Radiol endod

Cakir A. Predictability of Exfoliation Time of Deciduous Teeth. Pediatr Neonat biol 2022, 7(2): 000171.

Copyright© Cakir A.

105(1): 113-120.

25. Yildirim S (2008) Sut Disi Periodontal Ligamenti Ve Pulpasında Osteoprotegerin Ve Rankl Proteinlerinin Ekspresyonunun Enzim Immuno Histokimyasal Yöntemle Arastırılması. Selçuk Üniversitesi Sağlık Bilimleri Enstitüsü, Konya.

26. Hua F, Zhang L, Chen Z (2007) Trigger osteoclast formation and activation: moleculer treatment strategy of delayed tooth eruption. Med Hyptheses 69(6): 1222-1224.

27. Dincer Hİ (2015) Adli Tıpta Yas Tayininde Dislerin Muayenesi ile Elde Edilen Bilgilerin Degerlendirilmesi. Ege Üniversitesi Tıp Fakültesi Adli Tıp Anabilim Dalı, İzmir.

28. Sütçü S (2006) Forensic Dentistry and Identification (DVI). Journal of Ankara Chamber of Dentists, pp: 5-6.

29. Karadayı B, Afşin H, Karadayı Ş, Özaslan A (2014) Yas Tahmininde Dis Gelisim Atlasının Yeri Ve onemi. Adli Tıp Bülteni 19(2): 75-80.

30. Furseth R (1968) The resorption processes of human decidious teeth studied by light microscopy, microradiography and electron microscopy. Arch Oral Biol 13(4): 417-431.

31. Şimşek Ş, Durutürk L (2005) A flow cytometric analysis of the biodefensive response of deciduous tooth pulpto carious stimuli during physiological root resorption. Arch Oral Biol 50(5): 461-468.

32. Tunç EŞ, Özen B, Özer L, Özalp N, Çetiner S (2009) Reasons for Withdrawal of Milk. Dicle Journal of Dentistry 10(2): 50-54.

33. Yildirim S, Fu SY, Kim K, Zhou H, Lee CH, et al. (2011) Tooth regeneration: a revoluation in stomatology and evolution in regenerative medicine. Int J Oral Sci 3(3): 107-116.

34. JO YY, Lee HJ, Kook SY, Choung HW, Park JY, et al. (2007) Isolation and Characterization of Postnatal Stem Cells from Human Dental Tissues. Tissue Eng 13(4): 767-773.

35. Ünsal G, Özmekik Ö, Ulukapı I (2014) Dental Stem Cells and the Importance of Decıdıous Teeth for Stem Cell Studıes. J Dent Fac Atatürk Uni 24(Suppl 8): 98-106.

36. Lee S, An S, Kang TH, Kim KH, Chang NH, et al. (2011) Comparison of mesenchymal-like stem/progenitor cells derived from supernumerary teeth with stem cells from human exfoliated decidious teeth. Regen Med 6(6): 689-699.

37. Saez DM, Sasaki RT, Neves AC, Silva MCP (2016) Stem Cells from Human Exfoliated Decidious Teeth: A Growing Literature. Cells Tissues Organs 202(5-6): 269-280.

38. Coll JA, Sadrian R (1996) Predicting pulpectomy success and its relationship to exfoliation and succedaneous dentition. Pediatr Dent 18(1): 57-63.

39. Özalp N, Saroğlu I, Sonmez H (2005) Evaluation of various root canal filling materials in primary molar pulpectomies: An in vivo study. Am J Dent 18(6): 347-350.

40. Godhi B, Sood PB, Sharma A (2011) Effects of mineral trioxide aggregate and formocresol on vital pulp after pulpotomy of primary molars: An in vivo study. Contemp Clin Dent 2(4): 296-301.

41. Alaçam A (2000) Endodontics. Peace publications, Ankara.

42. Mijan M, Amorim RG, Leal SC, Mulder J, Oliveira L, et al. (2014) The 3.5-year survival rates of primary molars treated according to three treatment protocols: a controlled clinical trial. Clin Oral Invest 18(4): 1061-1069.

43. Mijan MC, Amorim RG, Mulder J, Frencken JE, Leal SC (2015) Exfoliation rates of primary molars submitted to three treatment protocols after 3.5 years. Community Dent Oral Epidemiol 43(3): 232-239.

Cakir A. Predictability of Exfoliation Time of Deciduous Teeth. Pediatr Neonat biol 2022, 7(2): 000171.

Copyright© Cakir A.