



## IDEAL SPONTANEOUS SPACE CLOSURE AFTER LATE EXTRACTION OF PERMANENT FIRST MOLAR TEETH

### ABSTRACT


**Objectives:** Before they haven't completed its development, permanent first molar (PFM) teeth which have been decayed and treated with root canal therapy is mostly extracted before the child even reaches adult hood. With correct evaluation of patient, these extracted teeth's space can be ideally closed by permanent second molars (PSM). The aim of the study is to learn under which conditions we can provide ideal closure and occlusion in patients who refer to us in a late stage.


**Materials and Methods:** 695 patients aged 6-16 years who had PFM tooth extracted at a Faculty of Dentistry were retrospectively evaluated from the system. 117 patients had their PFM tooth extracted after the ideal age range and 15 of them were found to meet the inclusion criteria. Panoramic films of 21 teeth of 15 patients with spontaneous ideal closure were evaluated before extraction and after eruption of PSM teeth. The contact between the PSM and the second premolar was recorded and intraoral photographs were taken. Rotations in the PSM and second premolars, axis disturbances towards the lingual/buccal, midline deviations in both jaws, TMJ dysfunctions and chewing habits were evaluated.

**Results:** When PFM extraction was performed, PSM development stage was determined as Demirjian G in 19 teeth and H stage in 2 teeth. Tipping was observed in 80%, and rotation in 9.5% of the PSM teeth. Clinically, it has been determined that 85% of the patients don't notice the PFM deficiency, don't complain about their teeth and don't consider orthodontic treatment.

**Conclusions:** Within the limits of this study, it has been observed that ideal spontaneous space closure and ideal occlusion can be achieved, although it was extracted in late period. In ideal occlusion, rotation or tipping after extraction in late period; permanent third molar presence and eruption pressure were more effective than the eruption direction and angle of the PSM tooth.

**Keywords:** Molar, first, tooth extraction, pediatric dentistry, malocclusion, extraction timing, orthodontic space closure.

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## **INTRODUCTION**

Permanent first molar (PFM) teeth are more susceptible to coronal defects such as MIH and hypoplasia caused by metabolic or physiological disorders in early infancy, as they begin to develop from pregnancy and calcify at birth.<sup>30</sup> It is the first permanent tooth in the mouth, and since it is thought to be a primary tooth by families and not maintained properly<sup>29</sup> and has a fissured anatomy<sup>32</sup>, it is prone to decay. Furthermore, limited hand skills of children under the age of 8 also prevent them from performing effective teeth brushing.<sup>26,40</sup> With the addition of poor oral hygiene to these coronal defects and predispositions, permanent first molars become the teeth with the worst prognosis<sup>30</sup> and decay and extraction are inevitable in a very short time.<sup>5,24,36</sup>

When performing root canal treatment in pediatric patients, the desired cooperation may not be achieved. In cases where the prognosis of the tooth is doubtful in the long term, the fact that keeping these teeth in the mouth with root canal treatment is seen as a temporary solution, which creates a dilemma between extraction and root canal treatment for the physician.<sup>2,25</sup> In PFM teeth with deep caries and doubtful long-term prognosis, extraction is a saving treatment option.<sup>1,2,7,13,27</sup>

When the prognosis of the tooth is poor and extraction is inevitable; with planned and timed extractions, it can be ensured that the remaining teeth of the patient are directed and the occlusion is not deteriorated due to missing teeth and is minimally affected. In the literature, it has been reported that an optimum occlusion can be provided for the child with the appropriate timing and case selection for PFM tooth extraction.<sup>16,37,38</sup> The ideal time varies according to the physical and dental development of the child. The ideal time for the extraction of a PFM is the time when calcification begins to form in the bifurcation area of permanent second molars (PSM) and usually corresponds to the age range of 8-10 years.<sup>1,20,38</sup> These ages correspond to "E" in the Demirjian classification which is widely used, and 6th and 7th stages in the Nolla classification.<sup>10,21</sup> However, patients who present for PFM tooth

extraction are generally older than this ideal age range.<sup>1</sup> Studies in the literature indicate that the extraction area will not be completely closed<sup>13</sup> and that weak contacts will form between teeth in case the teeth extraction is delayed.<sup>6,11</sup> However, it has been reported in recent studies that successful results can be obtained, especially in the upper jaw, up to the age of 11.5 years.<sup>12</sup> Although the results of extraction of PFM teeth can be clinically indicated, there is little scientific evidence as to which factors are effective other than the ideal extraction timing to minimize unwanted negative consequences such as the tipping and/or rotation of the second premolars or PSM teeth.<sup>37,38</sup>

There are controversial opinions about the effects of some criteria other than timing on the prognosis of the extraction space to ensure ideal occlusion.<sup>37,38</sup> Many researchers find that the correct timing is not enough alone for successful spontaneous closure of the extraction gap. They argued that the determination of the germ of the permanent third molar and the second premolars radiographically, the patient's current occlusion type, the initial eruption angle of the permanent second molar tooth, and the compensation or balance extractions are at least as important as timing.<sup>1,7,13,23,24,35</sup>

The idea that only extractions made at the ideal time will be successful has changed. The desire is, of course, the ideal treatment at the ideal time, but even when the patient arrives very late, optimum occlusion can be achieved with correct planning. Clinical studies conducted by evaluating factors more effective than the extraction time will contribute to the literature on this subject. In this case series, cases showing ideal closure despite being extracted after the ideal time were examined. This study evaluates which factors affect the occlusion and ideal closure place after extraction of PFM teeth, based on historical clinical data. The aim of the study is to learn under which conditions we can provide ideal closure and occlusion in patients who present to us in a late stage.

## **MATERIALS AND METHODS**

In this study, the occlusion of 695 patients between the ages of 6 and 16 who came to the

Department of Pedodontics of a university hospital and who had their PFM teeth extracted in this clinic between 2015 and 2018 was evaluated. The pre- and post-extraction films of 695 patients were retrospectively evaluated within the scope of a pilot study (Ethics number: 2019/338). 117 patients were detected who extracted DBM tooth after the tooth development stage Demirjian E, which is shown as the ideal time. Among them; 38 patients with spontaneous ideal space closure<sup>36</sup> on radiography were contacted by phone and informed about the study. The ideal space closure was determined by modifying the scale created by Teo in his study.<sup>36</sup> 21 teeth of 15 of the patients who agreed to come for examination and intraoral photographs were found to meet the inclusion criteria. Ethics committee approval for this prospective clinical study, which includes patient examinations and intraoral photographs, was obtained from the Health Sciences Clinical Research Ethics Committee affiliated to the Scientific Research and Publication Ethics Committee of our university (Decision No: 2020/113).

For the inclusion of patients in the study, the conditions sought for were;

- \* Having a panoramic film before PFM tooth extraction,
- \* Having the PFM tooth extracted in our clinic and after the Demirjian stage E,
- \* Spontaneous space closure of the PSM tooth to the extraction gap of the PFM tooth and ideal contact with the distal of the second premolar tooth,
- \* Having a panoramic film after the PSM tooth erupts and contacts with antagonist,
- \* The parents' permission for the child's intraoral photos to be taken and used in the study by signing the consent form.

Patients who received orthodontic treatment after PFM extraction were excluded from the study.

During the clinical examination of the patients, the closure relationships of the teeth were evaluated. The contact between PSM and the second premolar was recorded and intraoral

photographs were taken. Rotations in PSM and second premolars, axis abnormalities towards the lingual/ buccal, midline deviations in both jaws, TMJ dysfunctions and chewing habits were evaluated. Radiographic examination was performed in two panoramic radiographs before and after extraction. In the panoramic radiography before extraction; the radiographic development stage of the tooth, the eruption angle of the PSM tooth and the presence/absence of permanent third molar were evaluated. In pre-extraction radiographic examination; a line was drawn passing through the bifurcation perpendicular to the line passing through the cusp tips, as described by Heckmann *et al.*<sup>15</sup> The angle between this reference line and the line passing through the right and left gonion was calculated.<sup>17,41</sup> After determining reference lines, the program automatically took the angular measurements (Figure 1).

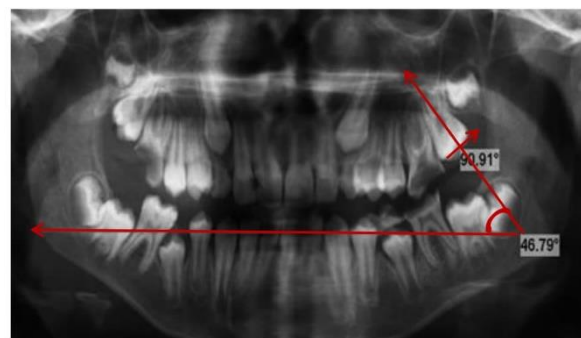


Figure 1: Angular Measurements for the left upper PFM

In cases where PFM deficiency in the mouth was not noticed and SPM was showed ideal contact in the clinical control after extraction; Radiography was taken to evaluate the PSM/second premolar long axis and the presence of tipping. In the post-extraction radiography, the parallelism of the long axes of the PSM and the second premolar and the presence of tipping were evaluated.

## RESULTS

Of the 15 patients included in the study, 7 were girls and 8 were boys, with an average age  $12.8 \pm 1.03$ . A total of 21 teeth were evaluated, of which were 9 mandibular and 12 maxillary molar. When PFM extraction was performed, PSM development stage was determined as Demirjian G in 19 teeth and H stage in 2 teeth. All patients have a permanent third molar tooth. Midline

deviation was detected in only 1 patient. TMJ dysfunction was detected in 1 patient and unilateral chewing habit in 3 patients. Postextraction control radiographs of all patients

were taken at least 3 years later. Tipping was observed in 80%, and rotation in 9.5% of the PSM teeth. PSM angles are as in Table 1.

**Table 1:** Clinical and Radiographical Evaluation

Patient's Age At Extraction	Demirjian Stage At Extraction	Teeth Number	Permanent Third Molar Presence	PSM Angulation	Tipping		Rotation		Midline Deviation	Patient's Age at Postextraction Evaluation
					Second Premolar	PSM	Second Premolar	PSM		
13	G	16	+	131.57 <sup>0</sup>	-	-	-	+	-	19
13	G	26	+	133.21 <sup>0</sup>	-	-	-	-	-	19
12	G	46	+	60.46 <sup>0</sup>	+	+	+	-	-	17
13	G	16	+	114.79 <sup>0</sup>	-	+	-	-	-	17
13	G	26	+	118.65 <sup>0</sup>	-	+	-	-	-	17
12	G	46	+	46.81 <sup>0</sup>	-	+	-	-	-	17
13	G	26	+	127.05 <sup>0</sup>	-	+	+	-	-	19
13	G	46	+	63.77 <sup>0</sup>	-	+	+	-	-	19
11	G	16	+	101.05 <sup>0</sup>	+	+	-	-	-	18
11	G	26	+	116.91 <sup>0</sup>	+	-	+	-	-	18
11	G	36	+	65.16 <sup>0</sup>	-	+	+	-	-	16
13	G	16	+	135.74 <sup>0</sup>	-	+	+	-	-	16
13	G	36	+	65.82 <sup>0</sup>	-	+	-	-	-	16
15	G	36	+	48.03 <sup>0</sup>	-	+	-	-	+	18
12	G	36	+	71.47 <sup>0</sup>	-	+	+	-	-	17
12	G	26	+	58.05 <sup>0</sup>	-	+	+	+	-	17
14	G	46	+	66.45 <sup>0</sup>	-	+	-	-	-	17
13	H	16	+	64.41 <sup>0</sup>	-	+	-	-	-	17
13	G	26	+	57.73 <sup>0</sup>	-	+	-	-	-	17
14	H	36	+	70.91 <sup>0</sup>	-	+	-	-	-	17
11	F	16	+	132.64 <sup>0</sup>	-	-	-	-	-	14

Tipping was detected in 14.2% and rotation in 38% of the second premolar teeth.

The parents of the patients who accepted to participate in our study were informed again when they came to our clinic, and the consent form was signed. Clinically, it has been determined that 85% of the patients do not notice the PFM deficiency, don't complain about their teeth and don't consider orthodontic treatment. Some of the panoramic films and intraoral photographs taken from the patients are shown below (Figure 2,3,4,5).



**Figure 2:** 2a: Pre-extraction radiography of the patient whose upper left PFM tooth was extracted while the PSM tooth was in the G stage 2b: Radiography taken 6 years after PFM extraction 2c: Intraoral photo 6 years after PFM extraction



**Figure 3:** 3a: Pre-extraction radiography of the patient whose lower left PFM tooth was extracted while the PSM tooth was in the G stage 3b: Radiography taken 5 years after PFM extraction 3c: Intraoral photo 5 years after PFM extraction



**Figure 4:** 4a: Pre-extraction radiography of the patient whose upper right PFM tooth was extracted while the PSM tooth was in the H stage 4b: Radiography taken 4 years after PFM extraction 4c: Intraoral photo 4 years after PFM extraction



**Figure 5:** 5a: Pre-extraction radiography of the patient whose lower right PFM tooth was extracted while the PSM tooth was in the G stage 5b: Radiography taken 5 years after PFM extraction 5c: Intraoral photo 5 years after PFM extraction

## DISCUSSION

It is thought that the treatment success of PFM teeth with large restorations or excessive crown destruction will be low.<sup>1,22,31</sup> When the prognosis of the tooth is not good, keeping these teeth in the mouth with root canal treatment will be a temporary solution.<sup>2,25</sup> In these teeth with deep caries, extraction appears as a saving treatment option.<sup>2</sup> Unfortunately, no randomized controlled clinical study evaluating the extraction timing of non-restorative PFM teeth has been found in the literature<sup>12</sup>. Although prevention of complications is the most important issue in cases of PFM extraction, there is little scientific evidence about the timing of extraction to minimize unwanted adverse effects.<sup>12</sup> Extraction at ideal time or early extraction are mostly mentioned in literature.<sup>1,9,13,18,24,34</sup> There are very few clinical studies about late extractions.<sup>12</sup>

It has been reported that late extractions in the mandible will cause cross-bite and non-working side conflicts with the mesiolingual tipping of the PSM tooth, the second premolars to tip distally, and the development of periodontal diseases and alveolar bone atrophy due to poor contact relations between the PSM and the second premolars.<sup>2,28,34</sup> It has been reported that the second molar teeth can be drifted into the mesial, or even tipped and cause rotation as a result of late extractions in the maxilla.<sup>2,28</sup>

In the literature, there are cases that are extracted at the ideal time and do not show ideal closure, and cases that show ideal closure extracted after the ideal time. In the meta-analysis study conducted by Eichenberger *et al.*<sup>12</sup>, it was reported that the late extractions showed less satisfactory but still good clinical results. According to the results of this study, it was shown that 50% of the extracted teeth had good results between the ages of 8-10.5, while this rate was found to be 59% between the ages of 10.5-11.5.<sup>12,31</sup> It has been reported that the clinical results in children younger than 8 years or older than 11.5 years are 34% and 44% respectively, and they give less satisfactory results. As a result of the studies, it has been observed that there is a heterogeneous situation, especially in the mandible. All these data show that factors other than age are also effective in spontaneous space closure.

It was stated that there are factors more important than time in Teo *et al.*<sup>36</sup> clinical study done with 236 teeth, most of which are in the G stage. According to this study, they reported that the mesial angulation of the PSM tooth and the presence of a permanent third molar is a stronger indicator of spontaneous closure of the extraction space compared to the developmental stage of the PSM tooth. Again, according to the study of Teo *et al.*, 92% of the upper extractions caused a good closure regardless of the timing, while only 66% of the lower PFM teeth showed positive results despite the 'ideal time' extraction. Jälevik and Möller also obtained similar results in their study evaluating the spontaneous closure of the space after extraction of hypomineralized PFM teeth.<sup>18,36</sup>

No statistically significant difference was found between extraction times in the maxilla.<sup>12</sup> However, timing is more critical in the mandible than in the maxilla.<sup>12,13</sup> The reason for this, is that the maxilla is more spongy and tooth movement is easier.<sup>38</sup> In addition, the PSM apex in the maxilla has a mesial angle with respect to the crown; the tendency of the crown to be closed by drifting mesially due to the more distal angle of the PSM apex of the mandible<sup>8,12</sup> is also an important factor. In this study, all of the cases (14%) who showed an ideal contact despite being extracted in

the late period and who did not show tipping and rotation in the PSM and second premolar teeth, were in the upper jaw. In accordance with the literature; in this study, even though clinical contact was observed when PFM extraction was performed while PSM teeth were in Demirjian G or H stage in the mandible, radiographic tipping was detected in all PFM teeth.

Although it was in contact with the antagonist teeth in such a way that the patient does not notice the missing tooth, it was determined radiographically that this result was achieved by PSM tipping. As a result of the late extractions performed in this study, it was observed that the patients did not complain about the lack of PFM, and they even did not feel the deficiency due to the place closed by the pressure of the third molar. Even if the deficiency is not noticed in the mouth, it has been determined as a result of the radiographs taken, that in some cases, closure occurs by the rotation of the premolars and/or the tipping of the PSM.

Panoramic radiographs have been used around the world for a long time and play an important role in dental radiology. Therefore, similar to the opinion of Bayram *et al.*<sup>4,28</sup>, it is thought that there is no need for other radiographs to evaluate the eruption of PSM after PFM extraction. Although panoramic radiography has disadvantages such as image magnification and distortion, the consistency between angle measurements and measurements can be assessed by continuous use of the same device and settings.<sup>14,19</sup> Larheim and Svanaes<sup>19</sup> reported that horizontal dimensions can be measured with acceptable reliability if the patient is properly stabilized during irradiation.<sup>31</sup> In this study, measurements were made on the radiographs taken using the same equipment and settings, and the margin of error was minimized.

PFMs have been found to be decayed in more than 50% of children over the age of 11.<sup>39</sup> In a study, it was found that the most common age of PFM extraction was 11, followed by 10 and 12 years respectively, and 14 was the most common evaluation age.<sup>28</sup> It was stated that the reason why the patients present to the clinic in a late period,

was that parents think that PFM is a primary tooth and permanent teeth will replace PFM teeth. During the eruption of a PFM tooth, neither the child nor the family are usually aware of the eruption of the permanent teeth in the mouth.<sup>33</sup> As a result, they think that PFM teeth are also primary teeth, and that it is unnecessary to spend time/money to provide adequate oral care for children<sup>29</sup> and because only 13.4% have an idea about PFM eruption<sup>42</sup>, it is too late to treat PFM teeth.

Extracting the teeth always in their ideal developmental stage is the least risky, and enables the most ideal results possible for that patient. However, what is important here is to make an indication by evaluating each patient's own specific occlusion. The late arrival of patients does not mean that dentists still cannot achieve the ideal occlusion. Especially for PFM teeth in the upper jaw, extraction can be applied without any hesitation. In the lower jaw, extraction can be done considering;

- Long-term prognosis of restored PFM tooth
- The dental age of the patient
- Distal inclined eruption angle of the PFM
- Type of malocclusion
- Current degree of crowding
- The presence of the permanent third molar tooth.

Failure in the extraction timing causes vertical resorption of the alveolar bone, promoting tipping and rotation of neighboring teeth. As a result, it causes occlusal conflicts, TMJ dysfunctions and skeletal asymmetry in the anterior region<sup>28</sup>. When early extraction is made, this non-compensatory path is entered, but relatively less and local damage (vertical bone loss in PSM teeth) occurs in late extractions. This is caused by the eruption direction of the PSM teeth being distal, the presence of permanent third molars and the eruption pressure. If the patient meets these conditions, even applied in a late period, ideal closure is observed in extractions made before the PSM teeth eruption, and the patient's future graft + implant necessity are eliminated. By evaluating special conditions for each patient, it is possible to



support the development of the jaw and occlusion with the patient's own healthy teeth.

## CONCLUSIONS

It is anticipated that this study will contribute to the limited literature available and will provide a much better clinical picture about treatment in such cases. In patients with accompanied orthodontic problems, it is difficult to make correct recommendations and make evidence-based decisions about prognosis, and long-term vision is essential when planning.<sup>3</sup> Within the limits of this study, it has been observed that ideal spontaneous space closure and ideal occlusion can be achieved, although it was extracted in the late period. In ideal occlusion, rotation or tipping after extraction in a late period; permanent third molar presence and eruption pressure were more effective than the eruption direction and angle of the PSM tooth. Clinical studies done with more patients are needed to make clear decisions on this issue.

## DECLARATIONS

- **Availability of data and material:** The data sets used and/or analysed during the current study are available from the corresponding author on reasonable request. We guarantee that the data and the the patients' informed consent will be shared if requested by your journal.

## CONFLICTS OF INTEREST STATEMENT

All authors declare that they have no competing interests that may have influenced either the conduct or the presentation of the research.

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### ***Daimi Birinci Molar Dişin Geç Dönemde Çekiminden Sonra İdeal Spontan Yer Kapanması: Bir Olgu Serisi ÖZ***

**Amaç:** Henüz gelişimini tamamlamadan çürüyen ve kök kanal tedavisi yapılan daimi birinci molar dişler, çocuk erişkinliğe bile ulaşmadan kaybedilmektedir. Doğru değerlendirme ile çekilen bu dişlerin yeri daimi ikinci molarlar tarafından ideal bir şekilde

kapatilabilir. Çalışmanın amacı geç dönemde bize başvuran hastalarda da ideal yer kapanması ve oklüzyonu hangi koşulda sağlayabileceğimizi öğrenmektir. **Gereç ve Yöntemler:** Bir üniversiteye bağlı Diş Hekimliği Fakültesinde DBM dişini çekirmiş 6-16 yaş arası 695 hasta retrospektif olarak sistemden taranmıştır. 117 hasta ideal yaş aralığından sonra daimi birinci molar dişini çekirmiş ve 15 tanesi dahil edilme kriterlerine uygun bulunmuştur. Radyografide spontan ideal yer kapanması gözlenen 15 hastanın 21 dişinin çekim öncesi ve daimi ikinci molar diş sürdükten sonra panoramik filmi değerlendirilmiştir. Daimi ikinci molar ile 2. premolar arasındaki kontakt kaydedilmiş ve ağız içi fotoğraf kayıtları alınmıştır. Daimi ikinci molar ve 2. premolardaki rotasyonlar, linguale/bukkale doğru aks bozuklukları, her iki çenede orta hat sapmaları, TME disfonksiyonları ve çiğneme alışkanlıkları değerlendirilmiştir. **Bulgular:** DBM çekimi yapıldığında daimi ikinci molar gelişim evresi 19 dişte Demirjian G, 2 dişte Demirjian H evresi olarak tespit edilmiştir. Radyografik olarak daimi ikinci molar dişlerinin %80'inde devrilme, %9.5'inde rotasyon görülmüştür. Klinik olarak hastaların %85'inin diş eksikliğini fark etmediği, tamamının dişlerinden şikayetçi olmadığı ve ortodontik tedavi düşünmediği tespit edilmiştir. **Sonuçlar:** Bu çalışmanın sınırları dahilinde, geç dönemde çekilmesine rağmen ideal spontan yer kapanması ve ideal oklüzyonun oluşturulabileceği gözlenmiştir. Geç dönemde çekim sonrası ideal kapanma, rotasyon veya devrilmede; DİM dişin sürme yönü ve açısından ziyade daimi üçüncü molar varlığı ve sürme baskısı daha etkili olmuştur. **Anahtar Kelimeler:** Birinci molar, diş çekimi, çocuk diş hekimliği, maloklüzyon, çekim zamanlaması, ortodontik yer kapanması.

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