

## ORIGINAL RESEARCH



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## Occlusal sequelae of the loss of first permanent molars among children and adolescents.

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### Abstract

**Objective:** The purpose of the present study is to evaluate the disintegration of the contact point system, the occlusal changes, and the masticatory force following the loss of the first permanent molars (FPM).

**Material and methods:** Clinical examinations were performed among 8-18-year-olds following the changes in the contact points and their effects on the dento-maxillary apparatus. The sample comprises 422 individuals, 220 girls and 202 boys. The occlusal masticatory force was measured using the T-Scan in the case of the opening of contact points. For the statistical data analysis, was used correlation and Chi Square Test in the GraphPad InStat program.

**Results:** A very weak reverse dependence was found between the size of the edentulous space and the deflection of the upper and lower interincisal lines ( $r=-0.02$ ) and between the age and size of the edentulous space ( $r=-0.05$ ). There is a statistically significant chance of mandibular lateral deviation by dental migration following edentulism ( $p=0.043$ ). In the case of the opening of contact points, there are 1.42 times higher risks of modified sagittal relationship in the molar segment ( $p=0.016$ ) and 2.7 times greater risks of the tipping of the neighbouring teeth ( $p=0.021$ ). Following the evaluation of the T-Scan measurements, we found in each case a significant decrease in the masticatory force in the edentulous area and the opening of the interproximal contact points.

**Conclusion:** Based on the obtained results, we can state that the opening of contact points decisively influences the stability of the occlusion and the size of the masticatory force.

**Keywords:** first permanent molar, contact points, early extraction.

### Introduction

The first permanent molar (FPM) emerges at the age of six, so is more prone to dental caries and possible premature extraction before permanent dentition is completed. FPM has a major role in maintaining a balanced occlusion, normal masticatory function and dentofacial harmony. FPM loss due to dental caries negatively affects both arches and has adverse effects on occlusion. It is reported that early extraction of these teeth results in tilting of neighboring teeth towards the existing spaces, supereruption of the teeth in the opposite arch, unilateral chewing, shift in midline and dental malocclusion [1].

Andrews' (1972) six keys to occlusion defines characteristics of normal occlusion. His fifth key requires tight contact points, with no space. The proper interproximal contact plays an important role in the stability and maintenance of the integrity of the dental arches.

However, a weak or slightly open proximal tooth contact would permit food impaction and cause subsequent dental caries, halitosis, periodontal disease, or drifting of teeth. On the other hand, excessive proximal tooth contact would result in wedging of teeth and undesirable tooth movement and trauma of periodontium. Therefore, it is important to maintain proper interproximal tooth contact [2-4].

The purpose of our study is to determine the relationships between the opening of interproximal contact points and the change of occlusal relations and the occlusal force following the loss of FPM. The evaluation of the groups concerning epidemiological investigation is very important. Through the present study, we want to get a broad picture of the children's and the adolescents' dental status of Satu Mare county.

The null hypothesis of the study: the disappearance of interproximal contact points following the extraction of FPM decisively

influences the stability of the occlusion and the occlusal force.

### Material and methods

The clinical trial began after signing of the consent documents, first by the headteachers of the schools (Reformed High School of Satu Mare, "Petőfi Sándor" Lower Secondary School of Livada, Lower Secondary School of Orasu Nou), then by the children's legal representatives.

The present transversal study was conducted during a six months period. The inclusion criteria were: communicative, healthy children, aged between 8 and 18, with FPM completely erupted. The exclusion criteria were: healthy but non-communicative children, children with mental retardation, less than 8 years old children, subjects undergoing orthodontic treatment during the examination. 422 children were examined in the three educational establishments, 220 girls and 202 boys.

57,6% of the examined population comes from rural areas, of which 47,9% girls and 52,1% boys. The examinations were carried out in educational establishments by one person.

The materials used in the clinical examinations were: single-use protective materials, articulating paper, dental floss, millimeter gradation measurements, retractors, and light sources.

A datasheet was used for each patient to facilitate handling and to record the data. In each case, we noted the patient's name, age, and sex; if subject has ever received dental treatment, the dental status, the consequences of the extraction – the inner relations of upper and lower interincisal lines (Figure 1), the occlusal relations of the canines, the premolars and the molars in both parts, in all the three planes, the interproximal relations, the tipping, the rotations, the extrusions, the mesiodistal size of the edentulous space (Figure 2).



Figure 1. The measuring of the distance between the upper and the lower interincisal lines.



Figure 2. The mesio-distal size of the postextractional space (the distance between the marginal ridges of the second permanent molar and the second bicuspid).

The independent variables were the sex, age, location, size of the edentulous space, and the change of contact points. The independent variables were the consequences of extractions and dental status.

The interproximal relationships were tested by using waxed dental floss. If the floss penetrated without resistance through the interdental space, we assessed the distance between the surrounding teeth using articulating paper with a thickness of 100  $\mu\text{m}$ . (Figure 3).



Figure 3. The traces of the evaluation of interproximal relationships by using articulating paper

The occlusal force was measured with the T-Scan III apparatus (Tek-Scan Inc. Boston, MA, USA) in patients with open interproximal spaces and missing FPM spaces. 9 individuals were chosen to whom we have conducted this complementary investigation. This investigation aimed to emphasize the importance of the interproximal contact points. Mostly, we examined patients with unilateral edentulous space and a few cases with bilateral lower edentulous spaces, using the T-Scan systems force mode.

The obtained data were introduced in Excel tables. By going through the descriptive statistics steps, the data that statistically deviates from the

majority were highlighted with the Grubbs test, we performed the KS test which showed that the frequency distribution of our data does not differ significantly from a Gaussian distribution. The correlation exam was used for statistical analysis of numerical data. The major part of the analyses was carried out with the Chi2 sample. The significance threshold used is 0.05.

## Results

In our research, we examined 422 children, with an average age of 13 (8-18) of which 220 girls and 202 boys (Table 1).

Table 1. The distribution of the study group

Variables	Number (n=422)	Percentage (%)
<b>Gander</b>		
Male	202	47,9
Female	220	52,1
<b>Area of origine</b>		
Urban	179	42,4
<b>Gander</b>		
Male	75	41,9
Female	104	58,1
<b>Dental treatment</b>		
Have revieved	174	97,2
Have not yet received	5	2,8

Rural	243	57,6
<b>Gander</b>		
Male	127	52,3
Female	116	47,7
<b>Dental treatment</b>		
Have reviewed	182	74,9
Have not yet received	61	25,1

In 11.6% of the cases we encountered the missing of the FPM, the most common cases were over the age of 11, when the spontaneous

closure of space is no longer carried out (Figure 4).

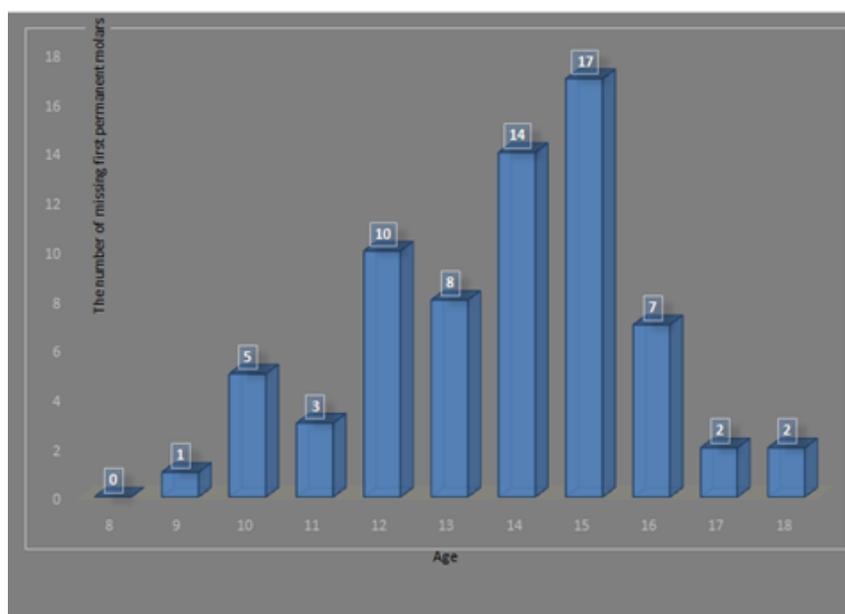


Figure 4. The distribution of the absence of first permanent molars according to the child's age

The number of absent FPM in the examined population was 69. The most common missing molar was the lower left FPM, 30 of 69 missing teeth.

57,6% of the examined population comes from a rural environment (Table I). The prevalence of the absence of the first permanent molar is higher in the rural population (12.75%) than in the urban population (10%).

The prevalence of dental deficiency is also more increased in the case of the girls (57%) than in boys (43%). There is a very slight inverse dependence between the age and the size of the edentulous space ( $r = -0.05$ ) respectively

between the size of the edentulous space and the distance between the upper and lower interincisal lines ( $r = -0.02$ ). 0.25% respectively 0.04% of the observed variance effect is due to the extractions. This finding would have been more relevant if we could accurately determine the timing of the extractions, since the width of the edentulous spaces have been measured as a function of the time elapsed since the extraction.

There is a statistically significant positive association (O.R. = 1.91, 95% C.I. = 1.01 - 3.61) between the edentulous space and the mandibular lateral deviation through the dental migration (Table 2).

Table 2. The lateral deviation of the interincisal lines (IIL) in the presence of the edentulous space

	IIL≠	IIL=	The Chi <sup>2</sup> sample.	The P-Value	O.R.
The patients with edentulism.	26	18	4,09	0,016	1,91 95% C.I. = 1.01 - 3.61
The patients without edentulism.	154	204			

IIL≠ - the IIL does not coincide; IIL= - the IIL coincide.

There are 1.42 times higher risks (C.I. = 1.04-1.84) of the pathological relations at the molar level (Table 3) and 2.7 times higher risks (C.I. = 1.03-15.3) of the tipping of the neighboring teeth in the case of the opening of contact points (Table 4).

However, the modification is not significant (R.R.=1.1, C.I. = 0.82-1.63) from a statistical point of view in the canines and the premolars (Table III) also with the rotations (RR = 1.3 CI = 0.63-5.10) of the neighboring teeth (Table 4).

Table 3. The interocclusal changes according to the contact points (PC)

	The M relationships		The Chi <sup>2</sup> sample	The P-Value	R.R.
	Class I relation	Class II or III relation			
The open PC	35	30	4.12	0,042	1,42 C.I. = 1.04-1.84
The unmodified PC	112	185			
	The C-PM relationships		The Chi <sup>2</sup> sample.	The P-Value	R.R.
	Class I relation	Class II or III relation			
The open PC	32	40	0,99	0,32	1.1 C.I. = 0.82-1.63
The unmodified PC	67	111			

Table 4. The statistical evaluation results of the relationships between the changes of the contact points and the tippings, respectively, of the rotations in cases with missing molars

	Tipping		The P-Value.	R.R
	Present	Absent		
The open PC	27	8	0,021	2,7 C.I. = 1.03-15.3
The unmodified PC	2	5		
	Rotation		The P-Value.	R.R
	Present	Absent		
The open CP	20	15	0,68	1.3 CI = 0.63-5.10
The unmodified CP	3	4		

There is no statistically significant difference in the changes of contact points in the mixed and

in the permanent dentition (RR = 0.74 CI = 0.59-1.04) (Table 5).

Table 5. The frequency of the opening contact points in the permanent and mixed dentition in case of lack of the permanent first molar

	The open CP	The unmodified CP	The P-value.	R.R
Mixes dentition	11	5	0,085	0.74 CI = 0.59-1.04
Permanent dentition	24	2		

15.6% of the subjects studied have not yet received an examination or dental treatment. The vast majority of these children, 92.4% come from rural areas (Table 1).

Following the evaluation of the T-Scan measurements, we found in each case a significant decrease of the masticatory force in the edentulous spaces and the opening of contact points. In this case, due to the lack of

tooth 2.6, we noticed the opening of contact points in the premolar-canine area.

On the three-dimensional image, it is obvious the decrease of the occlusal force in the respective area, which is also justified by the percentage data, because the masticatory force measured on the right side (65%) is much higher than the one recorded on the opposite side (35%) (Figure 5).

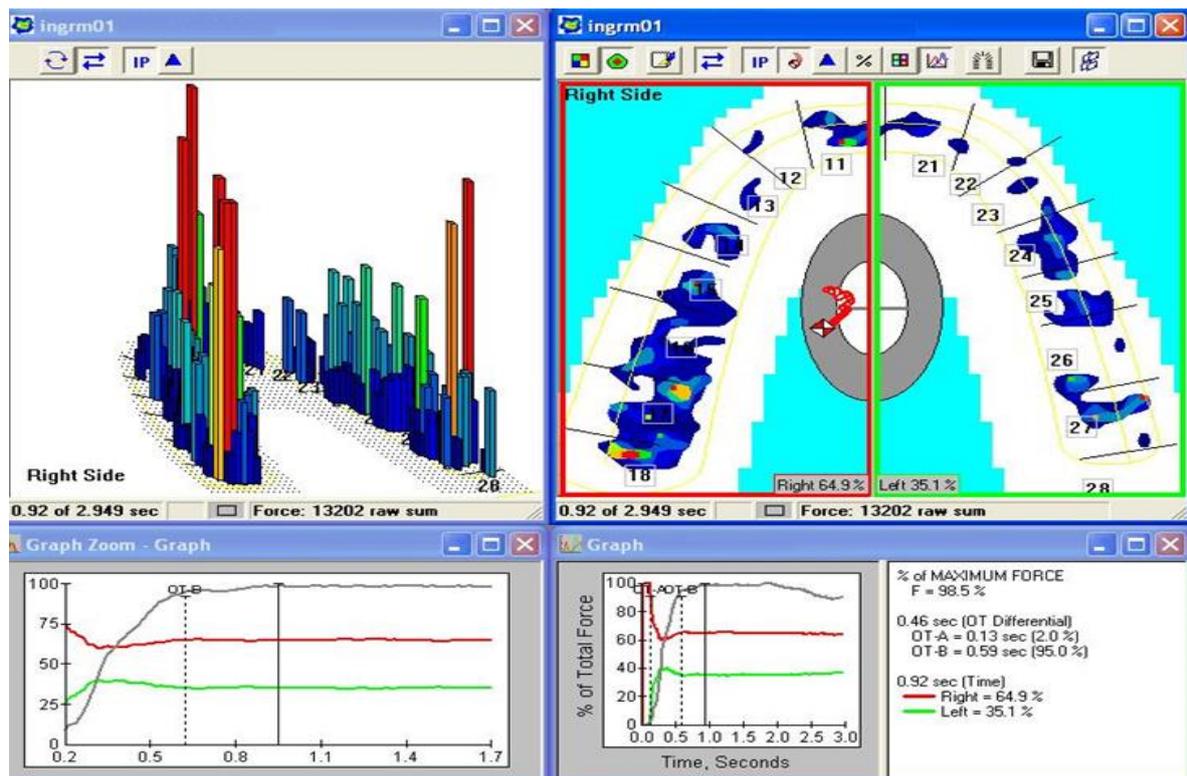


Figure 5. The digital representation of the masticatory force in case of unilateral absence of the first upper left permanent molar

However, we considered the occlusion to be balanced because the force center is within the physiological limits.

## Discussions

Through the present study, we analyzed the effect of the open interproximal contact points on the stability of the occlusion and the masticatory force. The prevalence of the missing of the FPM determined by this study is consistent with the data from the researched scientific literature [5-10].

The weaknesses of the present study are:

- We have not received relevant information regarding the date of the extractions.

- We have only carried out clinical examinations without the patients' radiological analysis.

The prevalence of the FPM shortage increases with the patients' age. According to the scientific data, we have also found that the extractions of the FPM are more common in the lower arch [5, 6, 7, 10]. The horizontal migrations are much more common than the vertical migrations [5].

Teo et al categorized the closure of the edentulous space in five categories:

1. The total closure of the edentulous space by making interproximal contact between the 12-year-old molar and the second bicuspid. There are no rotations, no tipping

scans in the mentioned teeth. The second premolar present no distal tipping.

2. 1-5 mm distances between the contact areas of the second permanent molar and the second bicuspid.
3. 5-10 mm distances between the parts mentioned above.
4. Over 10 mm distances between the parts mentioned above.
5. The presence of the rotations or tipplings at the level of the second permanent molar and premolar.

The first category reflects the ideal position of the 12-year-old molar as the replacement of the FPM during the eruption process [11]. According to these studies, the population examined by us, in 96% of the cases, falls into the fifth category. Therefore, in patients who had the FPM extracted before the eruption of the second permanent molar, it is very important with regards to the patients' comfort and health to review the patient regularly and to determine any need for orthodontic treatment [12].

According to Ast et al. studies, and our results obtained from the study states the fact that the case of malocclusion, the opening of contact points and mandibular lateral deviations by dental migrations, are more frequent in case of missing FPM than with integral dental arches [1,13]. Besides Kern et al. evaluating changes in interdental spacing depending on two different treatments (partial removable dental prosthesis for molar replacement and premolar occlusion according to the shortened dental arch concept), major interdental spacing could not be observed in neither of the groups [14].

The mandibular migration in patients with edentulous spaces was present in 60% of our cases and on the level of the integral arches in 43% of the cases. Miller et al. achieved a much higher percentage in the same theme, precisely in over 70% of the cases, the population examined in this study had mandibular lateral deviations by dental migration [15]. We explain the difference between the obtained results by the non-coincidence of the age groups of the two surveyed populations.

Y. Yamasaki et al. investigated mastication predominance in healthy dentate individuals and patients with unilateral posterior missing

teeth using objective and subjective methods. The results suggest that the individuals with missing unilateral posterior teeth exhibited greater mastication predominance and were more aware of mastication predominance than healthy dentate individuals. At the same time findings suggest that an objective evaluation of mastication predominance is more precise than a subjective method [16]. For this reason we used objective evaluation to determine masticatory force.

### Conclusions

1. The prevalence of the permanent first molar shortage increases with the patients' age.
2. The early extraction of the FPM and the opening of contact points following them significantly influences the occlusal stability, because:
  - Through the present study, we examined four (molar relationship, tip, rotations, spaces) of the ideal occlusion six keys. We obtained significant statistical results in three cases (molar relationship, tip, spaces).
  - The horizontal migration of the adjacent teeth and the vertical displacement of the antagonistic teeth are complex and involve the modification of all elements of the dento-maxillary apparatus.
  - Tipping and losing space contributes to space deficiency.
3. The masticatory force decreases provenly in the areas with the open contact points.
4. Losing occurs in the static occlusion, the number of interocclusal contacts decreases and even their location differs from the usual ones.

**Conflict of interest:** None declared.

### References

1. Saber AM, Altoukhi DH, Horaib MF, et al. Consequences of early extraction of a compromised first permanent molar: a systematic review. *BMC Oral Health*. 2018;15(1):59.
2. Kim HS, Na HJ, Kim HJ, et al. Evaluation of proximal contact strength by postural changes. *J Adv Prosthodont*. 2009;1:118-123.

3. Vardimon AD, Matsaev E, Lieberman M, et al. Tightness of dental contact points in spaced and nonspaced permanent dentitions. *Eur J Orthod.* 2001;23(3):305-314.
4. Kim KH, Jung JH, Kim HJ, et al. Evaluation of tightness of proximal tooth contact in permanent dentition. *J Korean Acad Prosthodont.* 2008;24(4):371-379.
5. Raducanu AM, Victor F, Claudiu H, et al. Prevalence of loss of permanent first molars in a group of Romanian children and adolescents. *OHDMBSC.* 2009;8(3):3-11.
6. Gupta DK, Singh SP, Utreja A, Verma S. Prevalence of malocclusion and assessment of treatment needs in  $\beta$ -thalassemia major children. *Prog Orthod.* 2016;17(1):7.
7. Casanova-Rosado AJ, Medina-Solis CE, Casanova-Rosado JF, et al. Factors associated with the loss of the first permanent molar in school children in Campeche, Mexico. *Acta Odontologica Venezolana.* 2005;43(3):268-275.
8. Sutcliffe PH. A longitudinal study of caries experience and extraction of permanent first molars in English children. *Community Dentistry and Oral Epidemiology.* 2008;2(4):182 – 186.
9. After PE. Clinical and specific changes of dental arches and occlusal relations after first permanent molar loss, in teenagers and young adults. *Romanian Journal of Oral Rehabilitation.* 2015;7(4):73-77.
10. Varshney A, Hegde MN, Yelapure M. Prevalence of Missing First Molar in South Canara District Population. *International Journal of Medical and Oral Research.* 2018;3(1):26-30.
11. Theo TK, Ashley PF, Parekh S, Noar J. The evaluation of spontaneous space closure after the extraction of first permanent molars. *Eur Arch Paediatr Dent.* 2013;14(4):7–12.
12. Serindere G, Bolgul B, Parlar T, Cosgun A. Effects of first permanent molar extraction on space changes observed in the dental arch using data mining method. *Niger J Clin Pract.* 2019;22(7):936-942.
13. Dimberg L. Malocclusions and Quality of Life. Cross-sectional and longitudinal studies in children. *Swed Dent J Suppl.* 2015;237:1–88.
14. Kern J, Wolfart S, Hilgers R, et al. The randomized shortened dental arch study: influence of two different treatments on interdental spacing over 5 years. *Clin Oral Invest.* 2017;21:1945–1951.
15. Miller EL, Bodden WR Jr, Jamison HC. A study of the relationship of the dental midline to the facial median line. *The Journal of Prosthetic Dentistry.* 1979;41(6):657-660.
16. Yamasaki Y, Kuwatsuru R, Tsukiyama Y, Oki K, Koyano K. Objective assessment of mastication predominance in healthy dentate subjects and patients with unilateral posterior missing teeth. *J Oral Rehabil.* 2016;43(8):575-582.

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