PERMANENT TEETH IMPACTION IN YOUNG PATIENTS FROM THE NORTH-EASTERN REGION OF ROMANIA

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Abstract

This study performs a clinical, radiological and statistical evaluation of permanent teeth impaction on a sample of young patients from the North-eastern region of Romania. 67 orthodontic patients (29 boys and 38 girls), aged 6-37 years, were selected randomly during 1991-2010. Data from orthodontic records were evaluated according to social parameters, oral status, etiological causes, clinical features and treatment options. Statistical evaluation was done with the SPSS 20.0 package. The cuspid impaction was most frequent in girls (68.40%) and in boys was the central incisor impaction (55.20%). The most common was the single tooth impaction in upper arch (85.10%) and the severe impaction (76.10%). We found statistically correlations between the direction and localization of impaction and types of impacted teeth (p=0.002). 4.14:1 ratio was established between the conservative and the radical treatment. The risk factors (OR=1-5) and predictors for the extraction of impacted teeth (HL test, p=0.000) were identified.

Keywords: *impacted teeth, frequency, orthodontic treatment, risk factors, predictors of treatment.*

1. INTRODUCTION

Tooth impaction represents the intra-osseous or intra-mucosal retention of a permanent tooth with a fully developed root, after the normal eruption period, without any potential of eruption [1,2].

Most of the studies devoted to such topics reported an incidence of tooth impaction between 6.90-76.60%, depending on the tooth involved and on the studied population [3-6]. As to frequency, most commonly impacted were the third molars, cuspids, second premolars, central incisors and the supernumerary teeth [7,8]. Impaction is rarely encountered in deciduous teeth [9].

Previous studies have shown that the most frequent causes of teeth impaction were related to the lack of space in the dental arch, modification of tooth eruption sequence, supernumerary teeth, odontomas, persistent deciduous teeth and trauma in the area of the alveolar process. General factors include heredity, vitamin deficiency, endocrine disorders, febrile diseases and bone degeneration [10-13].

Radiological exams offer necessary information about the number, position, localization and axis of impacted teeth, for accurate diagnosis and therapeutic procedures. Radiographic analysis represents the main tool of the oral surgeon for determining the difficulty of the access pathway to the impacted tooth [13-15] for surgical exposure or extraction of the involved tooth [16].

Numerous cases reported in orthodontic literature have described various conservative individualized therapeutic (usually, surgical exposure of the impacted tooth followed by orthodontic traction for dental arch guiding and alignment) or radical (usually, tooth extraction followed by implant restoration) procedures [17-20].

Our research aims at investigating the clinical, radiological and statistical aspects of permanent teeth impaction, third molars excepted, on a sample of young patients from the North-eastern region of Romania. The purpose of the study is to evaluate the frequency, patterns, distribution, causes, clinical features and treatment options of

the impacted tooth, and to establish the risk factors and predictors for their extraction.

2. MATERIALS AND METHODS

Sample group

A retrospective study was conducted on 67 randomly selected orthodontic patients with impacted teeth, 29 (43.30%) boys and 38 (56.70%) girls, aged 6-37 years, from the North-eastern region of Romania. Patients with syndromes, cleft palate, impacted third molar and impacted supernumerary teeth were excluded.

The diagnosis of impacted tooth was established both clinically (permanent tooth absence and/or persistence of deciduous tooth on the dental arch) and radiographically (orthopantomogram, periapical and anterior occlusal radiogra***phies***). All patients were treated in the Orthodontics Clinic of the „St. Spiridon" University Emergency Hospital Iasi, Romania, during 1991-2010. The informed consent was obtained from all patients or from their parents.

Studied parameters

The data collected from orthodontic records and radiogra***phies*** were uniformly evaluated according to social parameters (gender, age and environment area), oral status (types of impacted teeth and Angle Class malocclusions, patterns of impacted tooth, number and distribution of impacted teeth in quadrants), etiological causes (reduced space, existence of possible obstructions and anatomic peculiarities), clinical features (according to intra-osseous position, severity, axis direction and localization of the impacted tooth inside the alveolar bone arch) and treatment options (conservative or radical).

The clinical classification of impacted teeth was established radiographically according to: (1) intra-osseous position (total, complete or high impaction, when the tooth was entirely intra-osseous; partial, incomplete or low impaction, when the crown of the impacted tooth was not fully covered by the bone, yet separated from the oral cavity by the pericoronal sac and gingival fibromucosa); (2) severity or distance of the impacted tooth from the occlusal plane (mild impaction, when the distance was lower than 12 mm; moderate impaction, when the distance was between 12-15 mm; severe impaction, when the distance exceeded 15 mm); (3) direction of impacted tooth axis (vertical impaction; horizontal impaction, with the crown positioned between the roots of the erupted teeth and the distally oriented root; mesially oblique impaction, with the mesially oblique crown inclined; distally oblique impaction, with the distal oblique crown inclined); (4) localization of the impacted tooth inside the alveolar arch (buccal impaction, with the buccally situated crown and the palatally oriented root; palatal or lingual impaction, with the palatally situated crown and the buccally oriented root; medium impaction, with the crown situated in the middle of the alveolar arch).

Statistical methods

Statistical analyses were performed using the SPSS 20.0 package (Chicago, Illinois, SUA) for Windows. The data were characterized through descriptive statistics and contingency tables, applying the Chi-square (χ^2) Pearson test, to compare the percentages on types of impacted teeth among different categories of patients, and to identify the significant differences ($p<0.05$). The risk factors for treatment options were calculated with the contingency tables, according to the Odds Ratio (OR) values: protective factors (OR<1), low risk factors (OR=1-1.5), moderate risk factors (OR=1.5-2), severe (OR=2-5) and very severe risk factors (OR>5); the Forward LR binary logistic regression model was used to classify these risk factors and to analyze their correlated predictive potential. The reliability of the binary logistic regression model was evaluated using the Hosmer-Lemeshow goodness-of-fit test (HL test, $p<0.05$), at a 5% level of significance.

3. RESULTS

The study includes 67 orthodontic patients, with a mean age of 13.97±5.346 years (males with mean age of 12.79±5.703 years and females with mean age of 14.87±4.944 years), 41 subjects (61.20%) from the urban area (mean age of 14.37±6.115 years) and 26 (38.80%) from the

rural area (mean age of 13.35±3.8 years), respectively. The types of impacted teeth are cuspids in 36 patients (53.70%), incisors in 25 patients (37.30%) and bicuspids in 6 patients (9.00%), from the Angle Class I malocclusions in 51 patients (76.10%), Class II in 10 patients (14.90%) and Class III in 6 (9.00%) patients (Table 1). Table 1 shows the baseline characteristics of the sample group; statistically significant differences as to the environment zone and impacted teeth types were observed between genders (p<0.05).

Table 1. Baseline characteristics of the sample group

Characteristics	Male (n=29)		Female (n=38)		Total (n=67)		c^2	p value
	n	%	n	%	n	%		
Age intervals							2.596	0.107
<18 years	27	93.1	30	78.9	57	85.1		
>18 years	2	6.9	8	21.1	10	14.9		
Environment							11.652	0.001*
Urban	11	37.9	30	78.9	41	61.2		
Rural	18	62.1	8	21.1	26	38.8		
Types of impacted teeth							8.007	0.018*
Cuspids	10	34.5	26	68.4	36	53.7		
Incisors	16	55.2	9	23.7	25	37.3		
Bicuspids	3	10.3	3	7.9	6	9.0		
Angle Class malocclusions							1.984	0.576
Class I	23	79.3	28	73.7	51	76.1		
Class II division 1	1	3.4	1	2.6	2	3.0		
Class II division 2	4	13.8	4	10.5	8	11.9		
Class III	1	3.4	5	13.2	6	9.0		
*statistically significant differences when p<0.05								

The patterns of impacted teeth in the studied sample are as follows: 1.1 impaction in 15 patients (22.40%), 1.3 impaction in 14 patients (20.90%), 2.3 impaction in 11 patients (16.40%), 1.3-2.3 impaction in 7 patients (10.40%), 2.1 impaction in 7 patients (10.40%), 3.3 impaction in 3 patients (4.50%) and 11-21, 14-24, 15, 15-25, 21-22, 22, 24, 25, 43, 45 impactions, respectively, in 1 patient (1.50%) (Fig. 1).

Depending on the number of impacted teeth, 56 patients (83.60%) had only 1 impacted tooth and 11 patients (16.40%) had 2 impacted teeth. 40 patients (59.7%) present impacted teeth in the 1st quadrant, 32 patients (47.80%) in the 2nd quadrant, 3 patients (4.50%) in the 3rd quadrant and 2 patients (3.00%) in the 4th quadrant, respectively (Table 2).

The causes of impacted teeth are: insufficient room in the dental arches in 33 patients (49.30%) (narrow alveolar arch in 46.30% patients, mesial drifts of the posterior teeth in 1.50% patients, or macrodontia in 1.50% patients); the obstacles encountered by the erupting tooth in 27 patients (40.30%) (previa formations in 28.30% patients or persistence of deciduous teeth after the normal exfoliation period in 11.90% patients), or anatomic particularity of the impacted tooth in 7 patients (10.40%) (deviation of eruption tooth's axis in 9.00% patients or angulation of the crown-root in 1.50% patients) (Fig. 2).

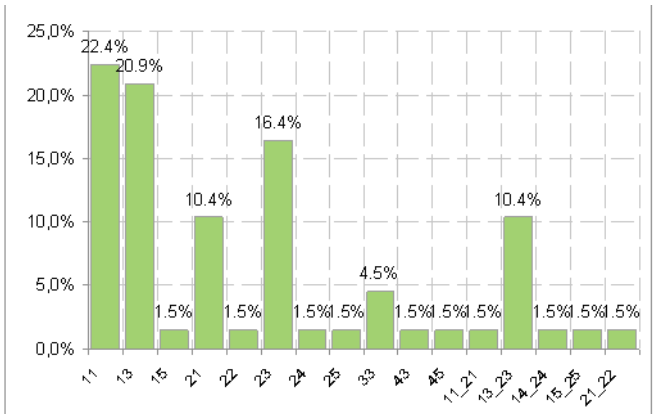

Fig. 1. Patterns of impacted teeth in the sample group

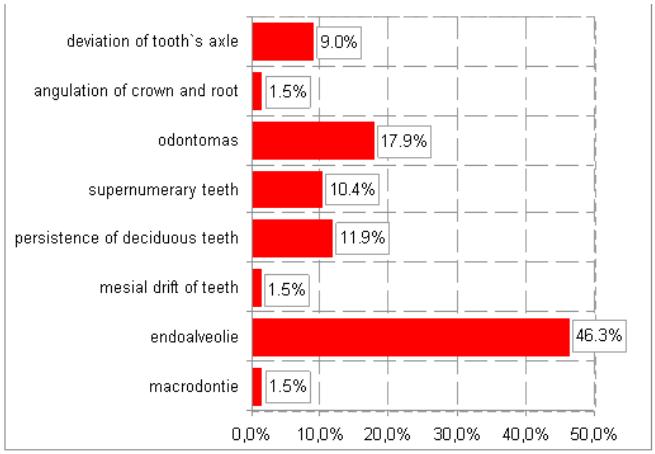

Fig. 2. Causes of impacted teeth in the sample group

According to the intra-osseous position of the impacted tooth, total impaction was observed in 51 patients (76.10%) and partial impaction, respectively, in 16 patients (23.90%). According to the distance of impacted tooth to the occlusal plane, mild impaction was found in 6 patients (9.00%), moderate impaction in 10 patients (14.90%) and severe impaction in 51 patients (76.10%). According to the direction of impacted tooth axis, vertical impaction (favorable position for conservative treatment) occurred in 28 patients (41.80%), horizontal impaction (favorable position for extraction) in 15 patients (22.40%), mesial oblique impaction in 23 patients (34.30%) and distal oblique impaction in 1 patient (1.50%). According to the localization of the impacted tooth inside the alveolar arch, buccal impaction was found in 25 patients (37.30%), palatal impaction in 25 patients (37.30%) and medium impaction in 17 patients (25.40%). The conservative surgical-orthodontic treatment (surgical exposure and tooth traction in favorable position on the dental arch) was applied to 54 patients (80.60%), and radical surgical treatment (extraction of impacted tooth in unfavorable position) to 13 patients (19.40%) (Table 2). Table 2 lists the statistically significant correlations between the types of impacted teeth and gender (p=0.018), age intervals (p=0.024), direction of impacted tooth axis (p=0.002) and impacted tooth localization inside the alveolar arch (p=0.007).

Table 2. Correlations between the types of impacted tooth and other statistical variables

Variables	Types of impacted teeth						Total		c^2	*p* value
	cuspids		incisors		bicuspids					
	n	%	n	%	N	%	N	%		
Gender	36	100.0	25	100.0	6	100.0	67	100.0	8.007	0.018*
male	10	27.8	16	64.0	3	50.0	29	43.3		
female	26	72.2	9	36.0	3	50.0	38	56.7		
Age intervals	36	100.0	25	100.0	6	100.0	67	100.0	7.497	0.024*
<18 years	28	77.8	25	100.0	4	66.7	57	85.1		
>18 years	8	22.2	0	0.0	2	33.3	10	14.9		
Environment	36	100.0	25	100.0	6	100.0	67	100.0	3.525	0.172
Urban	24	66.7	12	48.0	5	83.3	41	61.2		
Rural	12	33.3	13	52.0	1	16.7	26	38.8		
Angle Class malocclusions	36	100.0	25	100.0	6	100.0	67	100.0	10.757	0.096
Class I	23	63.9	24	96.0	4	66.7	51	76.1		
Class II	8	22.2	1	4.0	1	16.7	10	14.9		
Class III	5	13.9	0	0.0	1	16.7	6	9.0		
Number of impacted teeth	36	100.0	25	100.0	6	100.0	67	100.0	2.782	0.249
single tooth impaction	29	80.6	23	92.0	4	66.7	56	83.6		
two teeth impaction	7	19.4	2	8.0	2	33.3	11	16.4		
Localization of impacted teeth										
1st quadrant	21	58.3	16	64.0	3	50.0	40	59.7	0.455	0.797
2nd quadrant	18	50.0	10	40.0	4	66.7	32	47.8	1.535	0.464
3rd quadrant	3	8.3	0	0.0	0	0.0	3	4.5	2.704	0.259
4th quadrant	1	2.8	0	0.0	1	16.7	2	3.0	4.653	0.098
Causes of impacted teeth										
Reduced space	21	58.3	8	32.0	4	66.7	33	49.3	4.893	0.087
obstacles	12	33.3	14	56.0	1	16.7	27	40.3	4.680	0.096
anatomic particularity	3	8.3	3	12.0	1	16.7	7	10.4	0.484	0.785
Intra-osseous position	36	100.0	25	100.0	6	100.0	67	100.0	0.197	0.906
total impaction	27	75.0	19	76.0	5	83.3	51	76.1		
partial impaction	9	25.0	6	24.0	1	16.7	16	23.9		
Severity of impaction	36	100.0	25	100.0	6	100.0	67	100.0	5.126	0.275
mild impaction	5	13.9	1	4.0	0	9.9	6	9.0		
moderate impaction	3	8.3	5	20.0	2	33.3	10	14.9		
severe impaction	28	77.8	19	76.0	4	66.7	51	76.1		
Direction of tooth axis	36	100.0	25	100.0	6	100.0	67	100.0	21.471	0.002*
vertical impaction	9	25.0	16	64.0	3	50.0	28	41.8		
horizontal impaction	9	25.0	5	20.0	1	16.7	15	22.4		
mesial oblique impaction	18	50.0	4	16.0	1	16.7	23	34.3		
distal oblique impaction	0	0.0	0	0.0	1	16.7	1	1.5		
Location in the alveolar arch	36	100.0	25	100.0	6	100.0	67	100.0	14.016	0.007*
buccal impaction	17	47.2	8	32.0	0	0.0	25	37.3		
palatal impaction	14	38.9	10	40.0	1	16.7	25	37.3		
medium impaction	5	13.9	7	28.0	5	83.3	17	25.4		
Types of treatment	36	100.0	25	100.0	6	100.0	67	100.0	1.626	0.444
conservatory treatment	27	75.0	22	88.0	5	83.3	54	80.6		
radical treatment	9	25.0	3	22.0	1	16.7	13	19.4		
*statistically significant differences when $p<0.05$										

The risk factors calculated for the extraction of impacted tooth, according to the OR values, gave the following results: low risks in male patients (OR=1.155) and from urban areas (OR=1.018); moderate risks in patients with Angle Class I malocclusion (OR=1.925) and buccally or lingually impacted (OR=1.579); severe risks in patients under the age of 18 years (OR=2.400), with Angle Class III malocclusion (OR=2.273), impacted cuspids (OR=2.250), total impaction (OR=4.615), from the 4th quadrant (OR=4.417), anatomical causes of impacted tooth (OR=3.750). The values OR<1.00 correspond to protective factors: impacted incisors (OR=1.925) or bicuspid (OR=0.817); impaction's localization in the 1st (OR=0.504) or 2nd (OR=0.259) quadrant; impaction caused by reduced space (OR=0.580) or obstacles (OR=0.909); medium impaction (OR=0.198) (Table 3).

Table 3. Analysis of risk factors for impacted teeth extraction

Parameters	c^2	*p* value	OR	95% Confidence interval for OR	
				Lower Bound	Upper bound
Gender	0.054	0.816	1.155	0.342	3.900
Age intervals	0.665	0.415	2.400	0.276	20.850
Environment	0.001	0.977	1.018	0.293	3.533
Types of impacted teeth					
impacted cuspids	1.559	0.212	2.250	0.618	8.198
impacted incisors	1.398	0.237	0.436	0.108	1.769
impacted bicuspids	0.032	0.859	0.817	0.087	7.655
Angle Class malocclusions					
Class I	0.640	0.424	1.925	0.379	9.775
Class II division 1	0.496	0.481	0	0	0
Class II division 2	2.187	0.139	0	0	0
Class III	0.818	0.366	2.273	0.369	14.007
Number of impacted teeth	3.168	0.075	0	0	0
Localization of impacted teeth					
1st quadrant	1.230	0.267	0.504	0.149	1.712
2nd quadrant	3.939	0.047	0.259	0.064	1.045
3rd quadrant	13.046	0.000	0	0	0
4th quadrant	1.234	0.267	4.417	0.258	75.727
Causes of impacted teeth					
reduced space	0.752	0.386	0.580	0.168	2.002
obstacles	0.023	0.880	0.909	0.262	3.148
anatomic particularity	2.750	0.097	3.750	0.725	19.404
Intra-osseous position of teeth	2.325	0.127	4.615	0.551	38.649
Severity of impaction	2.325	0.127	4.615	0.551	38.649
Direction of tooth axis					
vertical impaction	11.580	0.001	0	0	0
horizontal impaction	55.916	0.000	0	0	0
mesially oblique impaction	8.431	0.004	0	0	0
Distally oblique impaction	0.244	0.621	0	0	0
Location inside the alveolar arch					
buccal impaction	0.539	0.463	1.579	0.464	5.376
palatal impaction	0.539	0.463	1.579	0.464	5.376
medium impaction	2.663	0.103	0.198	0.024	1.652

In order to analyze their correlated action and to establish their predictive potential, the previously identified risk factors were included in a model of binary logistic regression. The generated model was reliable (HL test, p=0.000), having a precision of 98.50%, identifying two predictive statistically significant factors for the treatment through extraction of the impacted teeth: Angle Class II division 1 malocclusion and horizontal direction of the impacted tooth axis (Table 4).

Table 4. Binary logistic regression analysis of predictor factors for the extraction of impacted teeth

Parameters	B	S.E.	Wald Statistics	p value
Angle Class malocclusions				
Class II division 1	22.609	22521.417	0.000	0.999
Direction of impacted tooth axis				
horizontal impaction	-23.730	5523.732	0.000	0.997

4. DISCUSSION

Permanent teeth impaction is a commonly found anomaly in any type of tooth in the general population. Most authors studied the clinical and radiological features of a single impacted tooth, most commonly the cuspid and the incisor in the upper arch, focusing on the frequency, distribution, patterns, causes and therapeutic procedures. Thus, an incidence between 0.80-3.60% and 5.00% of the maxillary impacted cuspids [5,7,21-24], and an incidence of the maxillary impacted central incisors between 0.006-2.00% and 2.60% [25-27] were reported.

In the orthodontic literature, few studies of dental impaction conducted on different populations and ethnicities, which highlight the specific features of the population, are available [28]. Topkara and Sari, who investigated clinically and radiographically the prevalence and distribution of permanent teeth impaction in a Turkish population, reported a global prevalence of 9.10% without statistical differences between gender, and a frequency of maxillary cuspids of 5.24%, mandibular second bicuspids of 2.23%, maxillary second bicuspids of 1.11%, mandibular cuspids of 0.92%, molars of 0.72% and incisors impactions of 0.65%, respectively. The decreased maxillary arch length has been reported in 14.00% of the patients and the mandibular length in 10.00% of them [4]. Kamiloglu and Kelahme, studying the incidence of cuspids impaction on panoramic radiographs in a Cypriot population, detected no statistical differences between genders, location and malocclusion. However, the incidence of the impacted maxillary cuspids was significantly more frequent than that of the impacted mandibular cuspids [5]. Gashi *et al.*, who investigated clinically and radiographically the incidence of impacted maxillary cuspids in the population of Kosovo, reported an incidence of 1.62%, with statistical differences between genders, and a more frequent unilateral and palatal statistical location [29]. Nezar *et al.*, studying patients in the Arabian community of Israel, reported a prevalence of 3.70% impacted maxillary cuspid, significantly higher in women than in men, with more frequent unilateral, maxillary and left side localization [16].

The present study analyzes the clinical, radiological and statistical aspects of permanent teeth impaction specific to a sample of young patients from the North-eastern region of Romania, for determining the frequency, patterns, distribution, causes, clinical features and treatment options, as well the risk factors and predictors for the extraction of the impacted tooth. Thus, the impacted cuspid was the most frequent, followed by impacted incisors and impacted bicuspid, the order of frequency between incisors and cuspid impactions being reversed, comparted to previous studies [30,31], due to the structure of the sample. Cuspid impaction was more frequent in girls than in boys, in a 2.6:1 ratio, as showed by Ericson and Kurol [32], and Richardson and Russell [33]. In the studied sample, the impacted central incisor was more frequent in boys than in girls, in a 2.1:1 ratio, while the impacted bicuspid had an equal percentage in the two genders (a 1:1 ratio). Most impactions were detected before 18 years, while those identified after the age of 18 did not exceed one third of the patients under study. The bicuspid and cuspid impactions were most

frequent in patients from the urban area, and incisor impaction in patients from rural area. Statistically significant correlations we found between the types of impacted teeth in patients with social variables (sex and age), which is a particular feature of the studied sample. Most of the detected inclusions were classified in Angle Class I malocclusion.

In the sample under study, single permanent tooth impaction had a higher percentage than two teeth impaction (a 5.1:1 ratio), the maxillary arch being more affected than the mandible (9.75:1 ratio). Single tooth impaction was studied *versus* two teeth impaction from the view point of the etiological factors involved (usually obstacles in the path of eruption), comparatively with previous studies devoted to unilateral *versus* bilateral impaction (usually reduced space in the arch) [16,29]. The most common cause for cuspid and bicuspid impaction was the reduced space in the dental arch while, for impacted incisors, the main cause was the presence of obstacles; the anatomical particularities of the tooth registered a low percentage. Most patients had total inclusion, the ratio to partial inclusion being 3.18:1. For all types of identified teeth, severe inclusion was more frequent, whereas moderate inclusion of bicuspids and incisors registered a low percentage.

Statistically significant correlations were found between the types of impacted teeth and the clinical features (direction and localization of the impacted tooth), which shows that each type of impacted tooth has different characteristics, as a function of these parameters. Thus, most frequently, impacted cuspids had a mesially oblique direction of tooth axis, with buccal or palatal arch localization, while the impacted incisors had most frequently a vertical direction of tooth axis, with buccal or palatal arch localization. In most of the cases, impacted bicuspids had a vertical direction of the tooth axis, with medium location in the alveolar arch.

Depending on localization, inclusion of permanent teeth produces serious localized, functional and aesthetic complications, the treatment being interdisciplinary, surgical and orthodontic [34-37]. The Needed Orthodontic Treatment Index (IOTN) using a five-point scale indicates a highest need for the treatment of dental inclusion, irrespective of its etiology [38,39]. In our study, a conservative treatment – involving surgical exposure and orthodontic traction of the impacted tooth in the dental arch - was the selected therapeutic option for most patients. The ratio between the conservative and radical treatment (extraction of impacted tooth) was 4.14:1. Both treatment options present some surgical risks. Thus, (low, moderate and severe) risk factors were identified in cases of impacted tooth extraction, as well as protective factors, depending on the peculiarities of the studied sample. Angle Class II malocclusion division 1 and the horizontal direction of the tooth axis were predictors recommending impacted teeth extraction. Such factors have not been investigated in previous studies.

Our research brings a benefit to the population study of impacted tooth, because it assesses the peculiarities of several types of impacted teeth in a sample of young patients of Romania, while proposing new aspects for further studies that may be extended to other populations, for obtaining comparable data.

5. CONCLUSIONS

The sample of patients of the studied population evidenced a significantly increased frequency of impacted cuspid in girls and of impacted central incisor in boys, detected before the age of 18 years. Maxillary single tooth impaction and severe clinical forms prevailed. The direction and localization of the tooth have been statistically correlated with the types of impacted teeth. A 4.14:1 ratio was found between the conservative and the radical treatment, and the risk factors and predictors for impacted teeth extraction were identified.

The present study outlines the importance of an early detection of this common dental anomaly, in order to prevent dental migrations and occlusal disorders, as well as radical surgical treatments.

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