

# Pendulum Appliance – Clinics and Results

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**Abstract:** *Very often in orthodontics it is necessary to extract teeth to achieve optimal occlusion and alignment of the teeth. In the last years with the new contemporary appliances there is a new approach in the orthodontics – non-extraction treatment of patients. The non-extraction treatment has negative sides - the duration of treatment is increased compared to the treatment with extractions. Most often the non-extraction cases are related with distalization of the upper molars. If the patient accepts the non-extraction treatment the practitioner has to be sure about the duration of the treatment and that the gained space would be sufficiently. Our survey is based on the average space gained through distalization with the usage of the “Pendulum” appliance and the duration of the treatment.*

**Keywords:** Distalization, pendulum appliance, space gaining, molar occlusal correction.

## 1. Introduction

With the method of distalization of upper molars, we increase the dimensions of the tooth arch in the distal area, gaining space in the middle and frontal segment for the alignment of the teeth [8]. This approach is appropriate alternative in borderline cases between treatment with extractions and non-extraction treatment of patients with class II malocclusion [4]. If the patient's teeth can be accommodated in the available alveolar arches without creating problems with the profile, soft tissues, axial inclination, arch width and occlusion, non-extraction should be the treatment of choice [3]. The borderline cases between extraction and non-extraction treatment require appropriate knowledge about the ways of non-extraction treatment and the time, which is required to achieve the desired result. Very often the lack of space in the tooth arch is smaller than the dimensions of a premolar, but orthodontist want to be sure that the space will be gained. The Pendulum is a contemporary, intraoral, mechanical, fixed in the upper jaw appliance, which creates space (Fig.1) [14]. It is constructed by Hilgers (1992) [5], [6], but many times modified [7], [12]. In our clinical practice, we use the modification called “M-Pendulum”, suggested by Scuzzo and Takemoto [9], [10], [11].



**Figure 1:** Fixed pendulum before and after the distalization of the upper molars

Before starting the orthodontic treatment, the patient should be informed about the duration of distalization of the molars and the dimensions of movement. This would affect the patient's choice between extraction and non-extraction treatment, because the duration of extraction treatment is shorter [1]. The process of distalization of the upper first molar begins with correction of the rotation of the molar, followed by distal movement of the crown, and uprighting of the roots [15], [16]. The correction of the rotation also gains space in the tooth arch, even enough to solve the problem

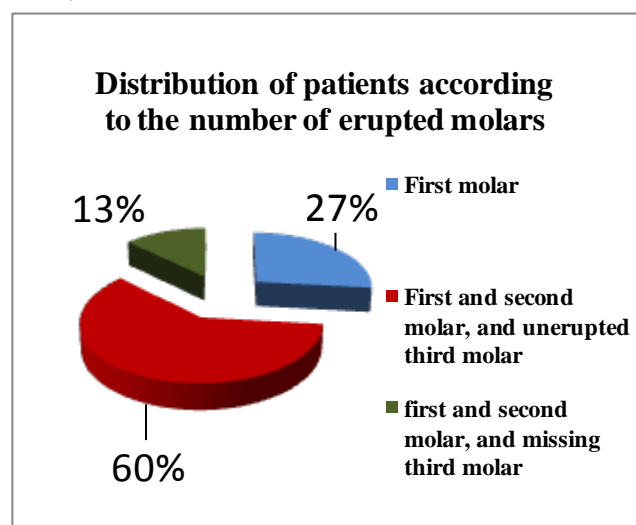
with mild crowding in the middle segment. In some cases only the correction of the rotation of the first molar leads to molar class 1 occlusion.

## 2. Aim

Aim of this survey is to research the average level of distal movement of upper molars and the time for its achievement. To define changes related with the correction of the rotation of molars and the gained space after this process.

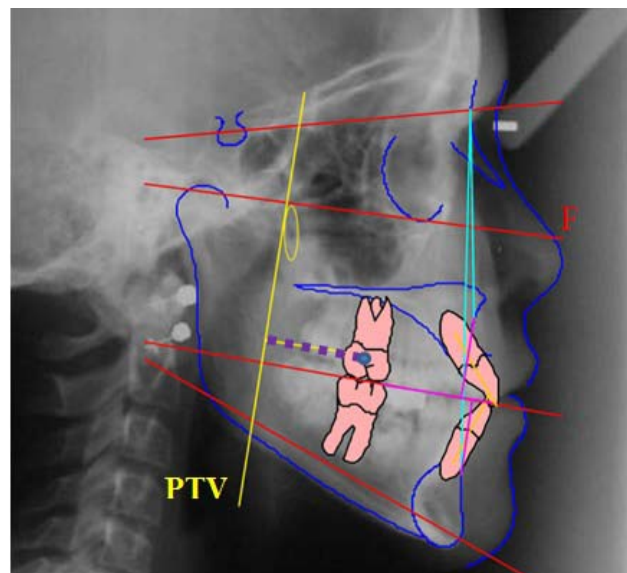
## 3. Material and Methods

We analyzed the data of 86 treated in our clinic patients diagnosed with class II malocclusion. Their first stage of treatment included the usage of the M-pendulum appliance to distalize the upper molars. The patients are selected in the range between 9 and 21 years old (growing patients). They are distributed by the number of erupted molars (Fig. 2): with erupted only first molar – M1 (23 patients -26.8%); with erupted first (M1) and second molar – M2 and presence of germ of the third molar (52 patients – 60.1%) and erupted first and second molar and missing third molar (11 patients – 13.1%).

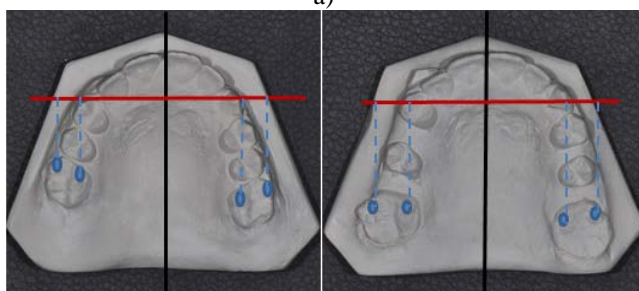


**Figure 2:** Distribution of patients according to the number of erupted molars

To define the dimension of distalization of upper molars, we used cephalometrics of patients before and after the treatment with the "M-pendulum" appliance. We made measurements between the point "Centroid" (the midpoint between the greatest mesial and distal convexity of the crown as seen in cephalometric [2]) in upper first molar and the PTV plane (Fig. 4-a).



a)



b)

**Figure 4:** Methods of analyzing: a)cephalometric and b)plaster casts.

We made measurements also on plaster casts (before and after treatment with this appliance) between the rugae line created by us (we constructed a perpendicular line, starting from the midline of upper jaw, tangent to the convex mesial surface of the first rugae palatinae) and the top of the medio-buccal and medio-palatal tubercle of the first permanent molar (Fig. 4-b).

#### 4. Results and Discussion

The researched contingent included 86 participants with average age  $13.28 \pm 2.16$  years old in the interval from 9 to 21 years old. Thirty-four of them (39.5%) are from male gender and 52(60.5%) from female gender. Most of the participants (84%) in the survey are in the age group between 10 and 15 years old, followed by the group between 16 and 20 years old – 14%, and at last the group from 0 to 9 years old (2%). The data is processed with the statistical program IBM SPSS Statistics 19.0 with allowed value of  $p < 0.05$ . We found out

that the average treatment time is  $5.98 \pm 1.28$  months, displayed from the treatment interval from 3 to 9 months.

**Table 1:** Variable analysis of the distal movements

Indicator	$\bar{X}$	Min	Max
Distal movement of upper first molar – M1(mm)	4,52	9,00	1,50
Distal movement of upper second molar – M2 (mm)	3,88	7,50	1,00

The highest level of average distal movement is observed in the upper first molar, followed up by the average distal movement of the second upper molar (with a difference with about 0.5mm) (Tabl.1).

Distal movement of the upper second molars was reported only in 63 cases in the groups 2 and 3 (with erupted first and second molar and presence or missing third molar) (Tabl. 2).

The maxillary arch is the template for the mandibular arch. If we unlock and develop this it permits transverse uprighting and development of the lower arch within periodontal support.

More interesting are the revealed values of changed position of the medio-buccal and medio-palatal tubercle of the upper first molars, which is one of the characteristics of rotation of these teeth. The average increase in the dimension between the medio-buccal tubercle of upper right molar and the rugae line is 4.39mm and for the medio-palatal tubercle is 3.30mm. The average increase in the dimensions between the medio buccal tubercle of upper left molar and the rugae line is 4.51mm and for the medio palatal tubercle is 3.49mm (Tabl. 3).

The difference in the values of distalization of the buccal and palatal tubercle at one molar is a sign of medio-buccal rotation of its crown in the process of his distal movement. The correction of the rotation gains space between the distal surface of upper second premolar and the medial surface of upper first molar. This process of correction is about 2.5 to 3 months according to our clinical trials.

Very often the severe rotation of upper first molar is the reason that leads to lack of space in the tooth arch. Subsequently the effect of the appliance for correction of the rotation improves not only the tooth position, but the occlusal relations between upper and lower teeth.

#### 5. Conclusion

The process of distalization is possible and successful in cases with one or two erupted molars, even in cases with presence of germ of the third molar. The distalization doesn't depend on the number of molars, but only on the correct use of the appliance. This makes the "M-pendulum" appliance appropriate to use in mixed dentition (early – with stable primary molars) and permanent dentition in young orthodontic patients and permanent dentition in adult orthodontic patients.

If the conditions are followed for appropriate treatment with distalization, it is more preferred than extraction treatment, because the space gained with distalization is almost equal to the space gained with the extraction of the first premolars. The use of the “M-pendulum” appliance stimulates the

process of self-correction of the position of the lower jaw, after the etiologic factor is removed (the blockage from the upper jaw) [13].

**Table 2:** Comparable analysis of sagittal changes during the teeth movement

Distance	N	Before treatment				After treatment				P
		$\bar{X}$	SD	95% TI		$\bar{X}$	SD	95% TI		
				Lower limit	Upper limit			Lower limit	Upper limit	
M1/PTV	86	24,77	4,34	24,03	25,52	20,25	4,58	19,46	21,04	<0,001
M2/PTV	63	15,84	3,99	15,10	16,59	11,96	4,03	11,20	12,71	<0,001

**Table 3:** Comparable analysis of the researched distances before and after the treatment

Distance	N	Before Treatment				After treatment				p
		$\bar{X}$	SD	95% TI		$\bar{X}$	SD	95% TI		
				Lower limit	Upper limit			Lower limit	Upper limit	
Buccal tubercul 16	86	17,04	1,79	16,73	17,35	21,43	2,70	20,97	21,90	<0,001
Palatal tubercul 16	86	19,59	1,76	19,28	19,89	22,89	2,56	22,45	24,34	<0,001
Buccal tubercul 26	86	16,99	1,80	16,68	17,30	21,50	2,47	21,08	21,93	<0,001
Palatal tubercul 26	86	19,30	1,85	18,98	19,62	22,89	2,28	22,39	24,18	<0,001

## 6. Future Scope

Early orthopedic intervention and non-extraction approaches provide for best functional occlusion, structural stability, with a full esthetic smile and lip support. The appropriate diagnostics and assessment of the clinical case, allows to be applied the contemporary technics of distalization of upper molars. The valuable clinical and scientific experience, which has been gained during the years, gives us the confidence to recommend the use of the “M-pendulum” in the orthodontic practice.

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## Author Profile



**Dr. Greta Yordanova** has completed a master's degree in dentistry in 1991. She has post-graduated in Orthodontics and developed dissertation entitled “Clinical results in treatments with Pendulum” and obtained PhD degree. Since 1995 she is Assistant Professor at the Department of Orthodontics at the Medical University of Sofia. Her research interests are in the area of Non-extraction treatment and problems of ectopic and impacted teeth and working with 3D technology.