

UNIVERSITY OF MEDICINE AND PHARMACY OF TÂRGU MUREȘ

FACULTY OF DENTAL MEDICINE

**Distalization – a readjustment method for space deficit.
Possibilities and limitations.**

SUMMARY OF THE DOCTORAL THESIS

PhD Student: LILIANA IOANA VÂȚĂ

Scientific Advisor: Prof. Univ. Dr. MARIANA PĂCURAR

2012

KEYWORDS: DISTALIZATION, MOLAR, CLASS II MALOCCLUSION, DENTAL CROWDING

TABLE OF CONTENTS

INTRODUCTION

THESIS AIMS

KNOWLEDGE STAGE

Chapter I. SPACE CRISIS ON THE DENTAL ARCH

- I.1. ASSESSING THE „SPACE CRISIS“ ON THE DENTAL ARCH – NECESSARY ANALYSIS
- I.2. QUALITATIVE ESTIMATE of the space crisis on the dental arch
- I.3. QUANTITATIVE ESTIMATE of the space crisis on the dental arch
- I.4. TREATMENT OF DENTAL CROWDING ACCORDING TO THE SIZE OF THE SPACE DEFICIT.

Chapter II. DISTALIZATION APPLIANCES. CLASSIFICATION. DESCRIPTION.

- II. 1. Extraoral appliances
- II. 2. Intraoral distalization appliances, *which require patient's cooperation*
- II. 3. Intraoral distalization appliances *that do not require patient's cooperation*
 - II.3.1. NON-COMPLIANCE DISTALIZATION APPLIANCES WITH INTERMAXILLARY ANCHORAGE
 - II.3.2. NON-COMPLIANCE DISTALIZATION APPLIANCES WITH INTRAMAXILLARY ANCHORAGE
 - II.3.3. DISTALIZATION APPLIANCES WITH BONE ANCHORAGE

Chapter III. ORTHODONTIC DENTAL DRIFTING

- III.1. DYNAMICS OF TISSUE TRANSFORMATION IN ORTHODONTIC DENTAL DRIFTING
- III.2. BIOMECHANICAL FUNDAMENTALS OF DENTAL DRIFTINGS
- III. 3. MOLAR DRIFTING BY DISTALIZATION
 - III.3.1. BIOMECHANICS OF M1 SUPERIOR DISTALIZATION WITH A FORCE APPLIED AT PALATINAL LEVEL
 - III.3.2. BIOMECHANICS OF M1 SUPERIOR DISTALIZATION WITH A FORCE APPLIED AT VESTIBULAR LEVEL
 - III.3.3. BIOMECHANICS OF THE DISTALIZATION OF THE INFERIOR MOLARS

PERSONAL CONTRIBUTION

Chapter IV. THE NEED OF MOLAR DISTILIZATION. DESCRIPTIVE CLINICAL AND STATISTICAL STUDY

AIMS

MATERIALS AND METHOD

RESULTS AND DISCUSSIONS

IV. 1. DEMOGRAPHIC STRUCTURE AND DESCRIPTIVE ANALYSIS OF THE ANALYSED BATCH

- ✓ Case distribution according to the age
- ✓ Distribution of the cases from the analysed batch according to patients' gender
- ✓ Case distribution on types of Class A anomalies
- ✓ Case frequency according to the disharmony type associated to the Angle class
- ✓ First permanent molar (M1) ectopia frequency on the analysed batch
- ✓ Frequency of the M1 medial position (superior, inferior, right, left, unilateral, bilateral) on the analysed batch
- ✓ Frequency of the medial position of lateral group (superior, inferior, right, left, unilateral, bilateral) on the analysed batch.
- ✓ Frequency of premature loss of deciduous teeth and reduction of the arches' length on the analysed batch

IV. 2. DIVISION OF THE ANALYSED BATCH FROM POINT OF VIEW OF THE THERAPY USED

IV. 3. STATISTICAL CORRELATIONS IN THE STUDIED BATCH

- Correlational analysis between the type of treatment used and the medial position of First permanent molar (M1) superior and inferior
- Correlational analysis between the type of treatment used and ectopia of First permanent molar (M1)
- Correlational analysis between the type of treatment used and the group medial position
- Correlational analysis between the type of treatment used and overjet
- Correlational analysis between the type of treatment used and overbite
- Association of patient's age to the type of treatment used
- Correlational analysis of the type of treatment used and the type of anomaly (Angle class)
- Correlational analysis between the type of treatment and the M2 permanent eruption stage
- Correlational analysis between the type of treatment used and the M3 eruption
- Correlational analysis between the type of treatment used and the dentition type
- Multi-varied analysis on the canine ectopia, First permanent molar (M1) medial position, lateral group medial position, frontal crowding, type of treatment by molar distalization and premature loss of deciduous teeth.
- Multi-varied analysis on the canine ectopia, M1 medial position, lateral group medial position, frontal crowding, type of treatment by molar distalization and caries of deciduous teeth.

IV. 4. DESCRIPTIVE ANALYSIS OF THE BATCH UNDERGOING MOLAR DISTALIZATION

- Types of distalization, therapeutic aims, results achieved
- Duration of the treatment by using molar distalization

- *Appliances used in molar distalization*
- *The space achieved on the arch following the molar distalization (mm)*
- *Orthodontic therapy following the molar distalization:*
- *Statistical correlations within the molar distalization batch*
 - Molar and lateral group distalization vs. type of anomaly.
 - Molar and lateral group distalization vs. premature loss of deciduous teeth
 - Molar and lateral group distalization vs. lateral group medial position
 - Molar and lateral group distalization vs. molar medial position
 - Molar and lateral group distalization vs. ectopia of the superior or inferior permanent canine
 - Molar and lateral group distalization vs. results/abandon
 - Molar and lateral group distalization and patient's age.
 - Molar and lateral group distalization and type of dentition.
 - Molar and lateral group distalization and degree of the M2 permanent eruption
 - Molar and lateral group distalization and M3 eruption degree

CONCLUSIONS

Chapter V. ANGULATION CHANGES OF THE SUPERIOR AND INFERIOR FIRST AND SECOND MOLAR DURING THE DISTALIZATION– COMPARATIVE ORTHOPANTOMOGRAPHIC STATISTICAL STUDY

INTRODUCTION

AIMS

MATERIALS AND METHOD

RESULTS

V.1. Descriptive analysis of the batch undergoing the distalization

V.2. The assessment of the linear and angular parameters analysed within the molar distalization, at moments T1 and T2.

V.3. The assessment of the linear and angular parameters analysed within the molar distalization, at moments T1 and T2 vs M2 eruption.

DISCUSSIONS

CONCLUSIONS

Chapter VI. CEPHALOMETRIC ANALYSIS PRE- AND POST-TREATMENT FOR ASSESSING MOLAR DISTALIZATION – COMPARATIVE STATISTICAL STUDY

INTRODUCTION

AIMS

MATERIALS AND METHOD

RESULTS

VI.1. EVOLUTION OF PRE- AND POST-TREATMENT CEPHALOMETRIC PARAMETERS IN THE EVALUATION OF MOLAR DISTALIZATION

VI.2. CHANGES OF THE PRE- AND POST-TREATMENT CEPHALOMETRIC PARAMETERS IN THE EVALUATION OF MOLAR DISTALIZATION

VI.3. CHANGES OF THE PRE- AND POST-TREATMENT CEPHALOMETRIC PARAMETERS IN THE EVALUATION OF MOLAR DISTALIZATION vs. M2 ERUPTION

DISCUSSIONS

CONCLUSIONS

Chapter VII. THE FINITE ELEMENT METHOD FOR ASSESSING THE DISTALIZATION OF THE SUPERIOR PERMANENT FIRST MOLAR

INTRODUCTION

AIMS

MATERIALS AND METHOD

BIOMECHANICAL ASPECTS OF THE DISTALIZATION OF M1 SUPERIOR – FINITE ELEMENT

METHOD ANALYSIS

VII.1. The study of the changes occurring in the distalization of the superior first molar following the variation of the magnitude of used forces

VII.2. Stress distribution according to the application point of the distalization force at the level of superior first molar (palatal/vestibular)

VII.3. Assess the Moment/Force report for the translation distalization of the superior first molar

Chapter VIII. MOLAR DISTALIZATION – DIAGNOSTIC AND THERAPEUTIC CONSIDERATIONS. *Clinical cases*

CLINICAL CASE 1

CLINICAL CASE 2

CLINICAL CASE 3

CLINICAL CASE 4

GENERAL CONSIDERATIONS ON THE STUDY

PRACTICAL APPLICATIONS OF THE STUDY

FINAL CONCLUSIONS

BIBLIOGRAPHY

LIST OF PAPERS PUBLISHED BEARING ON THE TOPIC OF THE DOCTORAL THESIS

INTRODUCTION

Molar distalization is often a challenge of the orthodontic treatment. The motivation to research this complex topic of contemporary orthodontic literature – “molar distalization” – is given by the need of a thorough analysis from point of view of possibilities, but also from point of view of its limits, as non-extraction therapeutic method. Nowadays, in several specialised studies, literature data indicates that the distalization of maxillary molars is a frequently used treatment method in cases of crowding cases associated to molar relationships of class II and class I skeletal relationships.

THESIS AIMS

- Establish the indications of molar distalization in relation to the type of skeletal or dental anomaly, namely to the space deficit on the dental arch;
- Indicate the limits of the molar distalization, taking into account the treatment's starting time, eruption stage of second molars and wisdom teeth, patient's cooperation, dental crowding and its location, used anchorage;
- Clinical and imaging evaluation of molar distalization, both on the maxillary, and on the mandible, by using the following appliances: headgear, palatal plate with one-way clasp, transpalatal arch, intraoral appliances with palatal spring with palatal clasp, fix braces with vestibular springs on ribbon arch, class II rubber bands, lingual plate with one-way clasp, lingual arch, lip-bumper and molar uprighting spring;
- Highlight the role of molar distalization in 2nd class mechanics, but also regain space on the dental arch;
- Imaging assessment of the effects of molar distalization, both at molar level, and at the level of anterior anchorage: type of obtained dental drifting, skeletal effects and facial aesthetics effects;
- Biomechanical evaluation of the type of molar drifting, during the distalization, depending on the force's application point, on its magnitude and on the design of the used appliance;

PERSONAL CONTRIBUTION

Chapter IV. THE NEED OF MOLAR DISTILIZATION. DESCRIPTIVE CLINICAL AND STATISTICAL STUDY

The longitudinal study conducted on 435 patients highlighted the following hierarchy of the intra-arch disharmonies, starting from the lowest frequency: superior dental crowding, inferior dental crowding, reduction of the arch's length by space compression, premature loss of deciduous teeth, medial position of the permanent first molar (M1), canine ectopia, lateral group medial position, macrodontia and M1 ectopia.

The space compression on the arch was due both to the caries of the deciduous teeth, and to their premature loss, and presented a more significant frequency as compared to the premature loss of the deciduous teeth; the most frequent deciduous tooth lost prematurely on the study batch was the second deciduous molar (m2t).

Patients treated by molar distalization represented 19.08% of the study batch, while the cases treated on a non-extraction basis (other than by molar distalization) represented

61.14% of the total of examined patients, and the cases treated via extraction means in permanent dentition represented 16.78% of the analysed batch.

The interpretation of the statistical data highlight significant correlations between the treatment via superior molar distalization and the mesial position of first permanent molar (M1), M1 ectopia and lateral group mesial position.

The statistical results reveal a significant correlation between the molar and lateral group distalization and the premature loss of deciduous teeth, but also between molar distalization and molar medial position, between molar and lateral group distalization and canine ectopia. The correlation analysis of the type of treatment as compared to overjet reveal that the maxillary molar distalization has a frequency similar to the cases of low and medium overjet, so that it can decrease in cases with excessive overjet; the correlation analysis of the type of treatment compared to the overbite reveal that molar distalization presented a higher frequency in cases of deep occlusions.

On the batch of patients benefiting from distalization, our research discovered a high frequency of molar distalization in case of class II/2 Angle malocclusions, followed by class I Angle and class II/1 Angle malocclusions.

The molar distalization on the maxillary arch was applied with a reduced frequency when the second permanent molar erupted. The statistical analysis on the distalization batch reveal that both the molar distalization, and the lateral group one are predominant in patients whose second molar has not erupted yet.

Based on the multi-varied analyses, we can state that the M1 medial position, the lateral group medial position, the frontal crowding and the type of treatment by distalization present a significant occurrence risk in the case of premature loss of deciduous teeth, while the M1 medial position, the canine ectopia, the type of treatment by distalization have a significant occurrence risk in case of caries of deciduous teeth.

Molar distalization, as non-extraction method, was used on 60.24% of the analysed cases, in order to regain space on the superior arch, on 42.16% of the cases in order to regain space on the inferior arch, and on 18.07% of the cases as integral part of the class II mechanics.

The average duration of the molar distalization was of approximate 9 months.

Molar distalization could not be considered an exclusive treatment method; regardless of the type of appliance used, most of the times it was followed by treatment with fixed poliaggregate appliance.

On approximately 25% of the patients who underwent treatment by distalization, no results could be achieved, the therapeutic failure being often caused by mono-dental molar distalization rather than lateral group distalization. As far as the treatment compliance is concerned, 17% of the total cases representing the batch D abandoned the case. The average age of the patients with treatment by superior molar distalization was 11.82, by inferior molar distalization 9.10 years and by bimaxillary molar distalization 9.68 years.

Our results allow us to consider that the earliest moment to start using molar distalization is around the age of 11, and for the lateral group distalization, it is the age of 10, and we can also notice that the treatment used in mixed dentition is predominant, as compared to the permanent one.

Compared to the type of dentition, we noticed that following the correlational analyses on the studied batch, the frequency in using superior molar distalization is little different between mixed and permanent dentition, as compared to the frequency in using inferior molar distalization, which decreases from mixed dentition to the permanent one.

Chapter V. ANGULATION CHANGES OF THE SUPERIOR AND INFERIOR FIRST AND SECOND MOLAR DURING THE DISTALIZATION– COMPARATIVE ORTHOPANTOMOGRAPHIC STATISTICAL STUDY

The average values of molar angulation are reduced after the distalization, both at maxillary level, and at mandible level, following molar distal tipping; The change of the molar post-distalization position is difficult to prove in this orthopantomographic study, due to the difficulty to distinguish between sagittal intra-arch dental drifting and the maxillary mandibular posterior increase.

Molar distalization is often used to correct an initially positive increased molar angulation; the drifting towards distal by tipping will lead to a correct mesial-distal inclination. Thus, the argument of the therapy used to regain space by distalization, aiming to bring the first permanent molar (M1) in a correct position;

The angulation of the first permanent molar (M1) plays an important part in functional occlusion; the reduction of the values of molar angulation may be an aim of the orthodontic treatment by distalization;

In class II anomalies, the mesial-palatal rotation is often met in M1 superior, together with a positive crown type; the distalization movement aims, under these circumstances, the mesial and vestibular rotation of the crown and its distal tipping, which will lead to a final physiological position;

The distalization M1 inferior is rather a molar recovery, in which an emphasized positive angulation is being corrected, which is responsible for premature contacts and occlusal interferences.

Chapter VI. CEPHALOMETRIC ANALYSIS PRE- AND POST-TREATMENT FOR ASSESSING MOLAR DISTALIZATION – COMPARATIVE STATISTICAL STUDY

For the patients with non-extraction treatment including molar distalization, the retrospective cephalometric analysis does not indicate changes in facial aesthetics. In the studied group no changes of the skeletal balance in the sagittal and vertical planes were found post-treatment.

The angular dental analysis shows that there is a statistically significant labioversion of the upper incisors, as well as a slight distal tipping of the permanent maxillary first molar, but this is not statistically significant.

The non-extraction treatment of cases including molar distalization causes incisor proclination to both arches, but a judicious selection of pre-treatment cases (with initially retruded maxillary incisors and mandibular incisors which still allow a slight protrusion) will lead to optimal post-treatment results. Post-treatment, a statistically significant increase in AxIsup-SN, AxIsup-NA, Axlinf-NB and IMPA angles and a statistically significant decrease in FMIA and Uli angles was shown.

The cephalometric analysis for the dental system, in the horizontal plane, shows that regardless of the chosen vertical reference line, the average incisor cephalometric values show the same statistically significant increases. The average value statistically insignificant for the sagittal displacement of the maxillary molar indicates that the upper M1 does not change its sagittal position in the upper maxilla between times T1 and T2.

The average values of the linear vertical dental parameters showed important changes only for the M2sup-PP distance, for which significant increases were found, because many of the analysed cases did not have the M2 erupted in the pre-treatment.

This type of non-extraction treatment was applied in cases with deep frontal occlusion at the onset of the treatment, so that at the end of the treatment the problems of the vertical

direction at the frontal level are corrected by reducing the overbite using a double mechanism: molar extrusion and incisor protrusion.

In the cases with M2 erupted, at the end of the treatment the lips are more protrusive, the thickness of the upper lip decreases and the angles Z and nasolabial are more reduced than in the cases where M2 has not erupted. The pre-and post-treatment comparative analysis of skeletal parameters in cases where molar distalization was performed, according to the stage of eruption of M2, does not reveal statistically significant changes for any of the analysed parameters. The eruption of M2 molar has, however, showed a significant influence on the post-treatment evolution of dental angular parameters: AxIsup-SN angle, AxIsup-NA angle, AxInf--NB angle, IMPA angle, FMIA angle and interincisal angle. The distance Isup-PTV shows statistically significant post-treatment increases in cases with M2 erupted, compared to those with M2 unerupted.

Chapter VII. THE FINITE ELEMENT METHOD FOR ASSESSING THE DISTALIZATION OF THE SUPERIOR PERMANENT FIRST MOLAR

The general tridimensional pattern which includes the tooth-periodontal ligament-alveolar bone was created according to the geometry, sizes and morphological data of M1 superior, taken from specialised textbooks, taking into account the following three main aspects:

- tooth geometry and periodontal structures;
- physical properties of the tooth,
- configuration of the orthodontic distalization force.

In order to build the tridimensional pattern tooth-periodontal ligament-alveolar bone, we considered that the three elements have linear elasticity and isotropic properties of the same quality. The study did not take into consideration the variations in bone density and trabeculation, the deformation of orthodontic rings, tubes, forces of circumoral tissue and occlusion forces.

Any distalization force with coronal application point will determine molar distalization with uncontrolled tipping, which translates into uneven periodontal stress.

As we grow up, the magnitude of the distalization force increases both in the tooth and in the periodontium (going up to its complete deformation at a magnitude of 5N) and even in the alveolar bone, aspect noticed at a magnitude of 5N only.

It seems that a force of magnitude 3N would be the most effective and biological one to displace the molar prim permanent superior by distalization.

The molar distal tipping generated by a palatal distalization force may be reduced by contracting the force arm when the application point of the force is closer to the molar's resistance centre.

Any distalization force applied on the vestibular side of the superior first permanent molar will determine effects on sagittal, transversal and vertical plane.

The distalization M1 will always, regardless of the type of appliance used, be accompanied by a coronal inclination movement towards distal, in the absence of the introduction of a counter-balancing anti-tipping moment in the system

Our research represents a mathematical demonstration of clinical and imaging observations, integrated in various literature studies, confirming the FEM's role in understanding biomechanical phenomena during molar distalization.

PRACTICAL APPLICATIONS OF THE STUDY

This study aimed to assess the problem of molar distalization within two great aspects of current orthodontic therapeutics: class II mechanics and treatment of the space crisis on the lateral areas of the arches. I consider that this research may bring new perspectives on the therapeutic approach of class II malocclusion, but also on space losses on the dental arch. Drafted based on clinical and paraclinical observations, statistic analysis and use of mathematic models, the thesis describes the molar distalization, both as constituent of the non-extraction orthodontic treatment, and as biomechanical, dynamic phenomenon, of tridimensional orthodontic dental drifting.

Concerning the clinical and therapeutic aspects approached in this research, it can be stated that our conclusions are similar to the current literature data, meaning the molar distalization indications, especially in class II slight anomalies and *class I anomalies with lateral secondary crowdings and molar mesial migrations*. Literature data currently converge to the idea that non-extraction treatment of class II malocclusions fall under class II dental with deep occlusion, class II skeletal with normal or hypo-divergent pattern and favourable aesthetics (J. Vaden, J. Dale, H. Klontz, 2006). “The treatment strategy in class II by conversion of the molar relation into class I at the beginning of the treatment depends on the ability to move the superior molars towards distal in a supra-corrected class I position. The procedure is not always simple, especially if the mechanotherapy of the molar distalization is totally dependent on the patient’s cooperation.”

The non-extraction treatment of class II malocclusions, therefore, uses as basic principle the distalization of the superior molars in order to transform the class II molar into class I, followed by retraction of premolars, canines and superior incisors(A. Gianelly, J. Bednar, V.Dietz, J. Koglin – cap. 14 in “*Biomechanics in Clinical Orthodontics*”- Ravindra Nanda, WB Saunders Co, 1996). We highlighted this therapeutic approach both in the presented statistical studies, and in the presented clinical cases. The extraction treatment of severe class II malocclusions is recommended in class II dental, skeletal, with normal or hyper-divergent pattern, perturbed aesthetics, crowding or severe superior and inferior protrusion (J. Vaden, J. Dale, H. Klontz – *Tweed Profile*, 2006). *In severe cases of class II, with perturbed aesthetics, hyper-divergence, crowding and protrusion, we used, after closing the spaces, an additional distalization of maxillary molars, which equals a critical anchorage, in order to supplement the incisive rebound and facilitate the sagittal correction of the anomaly.*

Concerning the correction of the space deficit by molar distalization, we observed that during the previous years, the presence of cases characterised by the premature loss of the temporary molars in mixed dentition is growing, the increased carioactivity and pulpar complications often requiring the extraction of the temporary teeth before their normal period of permutation. The thesis underlines the idea that conservative therapy in cases of premature loss of temporary molars in mixed dentition must, therefore, aim to regain space on the dental arch and then its maintenance.

The premature loss of temporary molars may be accompanied by changes on the frontal occlusion, such as overjet and overbite dimension, as well as on the relation of the interincisive median lines. Therefore, the premature loss of inferior temporary molars or of both temporary molars on one side and of only one on the other hemiarch, or of deciduous canines, especially inferior ones, we concluded that a discrepancy of the interincisive median lines occurs by deviation on the dental arch, desymmetrisations on sagittal plane of arches by different migrations, as amplexness of the molars one permanent superior or inferior, aspects which we could not correct during interceptive therapy on mixed dentition, by using easy and cheap means, such as one-way clasp plates.

We also concluded within the conducted population study, that there is an increased affectation among dental caries of children within mixed dentition. Aproximal caries on temporary or final teeth determine the loss of the contact points, and the mesialisation of the neighbouring teeth, leading to premature contacts, occlusal dysfunctions and consecutive dental malpositions; occlusal caries favour the extrusion of antagonic teeth, occlusion block, remote dental malpositions. From clinical point of view, consequences can be grouped as follows: change of the eruption of permanent teeth, either in the acceleration sense, or in its deceleration; reduction of the existing space by drifting in sagittal direction of the neighbouring teeth and extrusion of the antagonic ones; occlusal imbalance; interruption of the development of the alveolar bone and maxillaries.

I consider that this thesis also has a strong practical aspect for the dentist clinician, and for orthodontic practitioners, because it aimed to present molar distalization both from point of view of the possibilities, and of the method's limitations, based on clinical and statistical, and mathematical observations, but on the current literature data as well. All these elements can lead the practitioner towards a correct and complete orthodontic diagnostic of dento-maxillary anomalies, towards selecting an efficient distalization appliance and towards obtaining therapeutic results with as little side effects as possible.

The results presented in this thesis can contribute, besides those from literature, to making therapeutic decisions adequate to the cases with dental crowding or in the so different cases of class II malocclusions. The analysis of the clinical cases, the exploration method to create the orthodontic file, statistical analyses, orthopantomographic and cephalometric methods of molar distalization can be used as references in clinical activity and extended in the activity of scientific research.

FINAL CONCLUSIONS

1. Molar distalization represents an important constituent of non-extraction treatment in orthodontics.
2. The distalization of the maxillary posterior teeth is the most common method used to increase the length of the superior arch and to correct class II molars.
3. Molar distalization is recommended for space crisis located in the lateral region of the arch, where the space deficit is reduced and determined by the mesial migration of the first permanent molar.
4. The driftings of the molars one permanent superior and inferior take place after the premature loss of the neighbouring temporary teeth or within the molar eruption anomalies (ectopia), with its impact or expulsion of the deciduous second molar and consist of mesial inclination and rotation; the problem of space loss in mixed dentition must be solved, therefore, by regain and then maintenance.
5. The distalization of the molars one permanent superior can also be found as basic element in correcting class II malocclusions, both in non-extraction cases, and in sever, extraction cases, as additional measure to achieve space. Space achievement for the rebound of the maxillary arch is made by using two different mechanics, according to the anomaly's gravity.
6. Molar distalization is recommended for class II malocclusion with skeletal and dentoalveolar maxillary protrusion or when the dental extraction is not recommended for the maxillary (concave profile, hypo-divergent profile, lack of crowding on the mandible).
7. Class II non-extraction cases require as first treatment stage the distalization of the superior first molar; these cases are only seldom pure non-extraction cases, because the

distalization of the molars one maxillary can add a posterior space deficit to the eruption of the second molar and of the wisdom tooth.

8. Severe class II cases, with perturbed, hyper-divergent aesthetics, crowding and protrusion, require, after having closed spaces with an additional distalization on the maxillary molars, which equals to a critical anchorage.
9. Molar distalization can be made unilaterally as well, in order to correct a unilateral class II relation.
10. The moment of starting the treatment by molar distalization plays an important part, being known that molars get displaced more easily in late mixed dentition, before the eruption of molars two. The problem of the presence of the secondary molar and its influence on the distalization of the superior first molar remains controversial in the literature, much data currently indicating that the potential and distalization rate of the first molar decrease after the eruption of the second molar.
11. However, many types of molar distalization appliances have occurred, and there is currently no well-documented evidence on the efficiency of each molar distalization method.
12. Molar distalization without patient's cooperation can be made by using numerous appliances whose active constituents include NiTi, TMA springs, magnets or clasps and can be anchored dentally (conventional) or skeletally.
13. The solutions for a more bodily molar distalization seem to be the appliances that apply the force at palatal level, as close to the molar resistance centre as possible; out of these, we consider that the plates with one-way clasp, beyond the disadvantages represented by patient's cooperation, have the great advantage that by a proper design the force arm may decrease and, implicitly, the molar distal tipping moment, being, at the same, a cheap treatment solution.
14. The best solution to avoid the loss of anterior anchorage and for the bodily molar distalization seems to remain the headgear, which can lead, by adjusting the arms of the facial arch, both crown distalization, and consecutive root distalization.
15. Molar distalization is accompanied by loss of anchorage for dental anchorage appliances, which are most frequently used in practice. The loss of anchorage is manifested both at incisive level (vestibularisation, tipping, extrusion), and at the level of premolars one (mesialisation, tipping, extrusion).
16. Molar distal tipping is very low for a palatal force as compared to a distalization vestibular force, due to the fact the palatal application point is closer to the molar resistance centre.
17. Concerning the compliance of the patient with the treatment, we cannot absolutize this lack of necessity of patient cooperation, because, subsequently, the same patient will have to prove his treatment cooperation, by wearing other appliances. Therefore, the orthodontic doctor has to improve the motivation and cooperation of the patient.
18. The maxillary secondary molar, depending on its eruption stage, has a qualitative and quantitative impact on the distalization of the superior first molar;
19. The verification of the vertical direction during the class II mechanics used in non-extraction cases is essential to correct the sagittal direction. We can certainly state that the successful correction of the class II anomaly, meaning sagittal discrepancy, mandatorily requires a thorough verification of the vertical direction.
20. The verification of the vertical dimension is essential during the distalization of the superior molars and implies both control of the mandibular rotation, and control of the occlusion plane, whose angle may increase as side effect from using class II rubber bands or cervical headgear.

SELECTIVE BIBLIOGRAPHY

- Baccetti Tiziano, Lorenzo Franchi - A new appliance for molar distalization . *Ortho News* vol 1 nr 22 , ian – sept 2001 ;
- Boboc Lidia – *Tratamentul anomaliilor dento-maxilare prin tehnica Edgewise* – Ed Medicala , București , 2001;
- Bock Niko; Hans Pancherz - Herbst Treatment of Class II division 1 Malocclusions in Retrognathic and Prognathic Facial Types - A Cephalometric Long-term Retrospective Study - *The Angle Orthodontist*: Vol. 76, No. 6, pp. 930–941, 2005;
- Bolla Eugenio, Filippo Muratore, Aldo Carano, S. Jay Bowman - Evaluation of Maxillary Molar Distalization With the Distal Jet: A Comparison With Other Contemporary Methods - *The Angle Orthodontist*: Vol. 72, No. 5, pp. 481–494 , 2002;
- Bowman SJ. Modifications of the distal jet. *J Clin Orthod* 1998;32:549-56.
- Brickman David, P. K. Sinha , Ram S. Nanda – Evaluation of the Jones Jig appliance for distal molar movement - *Am J Orthod Dentofacial Orthop* 2000;118:526-534;
- Britto A. D., Isaacson R. – How Orthodontic Appliance Work - în Samir E. Bishara – *Textbook of Orthodontics* , cap15 - Ed. W. B. Saunders Comp. Philadelphia 2001;
- Burkhardt Donald R., James McNamara, Tiziano Bacetti – Maxillary molar distalization or mandibular enhancement: A cephalometric comparison of comprehensive orthodontic treatment including the pendulum and the Herbst appliances - *Am J Orthod Dentofacial Orthop* 2003;123:108-116;
- Burstone C J 2000 Application of bioengineering to clinical orthodontics. In: Graber T M, Vanarsdall R J (eds) *Orthodontics. Current principles and techniques*, 3rd edn. C V Mosby, St Louis, pp. 259 – 292
- Burstone CJ, Koenig HA. Force systems from an ideal arch. *Am J Orthod* 1974;65:270-89.
- Bussick Timothy J., James McNamara – Dentoalveolar and skeletal changes associated with the pendulum appliance - *Am J Orthod Dentofacial Orthop* 2000;117:333-343;
- Celestino E., D. Francioli – Classi II non estrattive: Il distalizzatore rapido – *Mondo Ortodontico*, 6/99, 469-474;
- Chung, K., Park, Y., KO, S. (2000). C-Space Regainer for Molar Distalization. *Eur. J. Orthod.* 34: 32-39.
- Frog Appliance – The Simplified Molar Distalizer – www.forestadent.com
- Gelgor IE, Buyukylmaz T, Karaman AI, Dolanmaz D, Kalayci A. Intraosseous screw-supported upper molar distalization. *Angle Orthod* 2004;74:836-48.
- Graber TM. Extraoral forces—facts and fallacies. *Am J Orthod* 1955;41:490-505.
- Henrikson, B. (1993). Treatment effects of the double loop distalizing arch wire in non extraction treatment. The European Begg Society of Orthodontics, 16th Congress, San Sebastian 19-24 May 1993.
- Hilgers JJ – The pendulum appliance for Class II noncompliance therapy – *J Clin Orthod* 1992;26:706-714;
- Hocevar R A 1981 Understanding, planning, and managing tooth moment: orthodontic force system theory. *American Journal of Orthodontics* 80 : 457 – 477
- Isaacson R, Worms FW, Speidel TM. Measurement of tooth movement. *Am J Orthod* 1976;70(3):290-303
- Kalra, V. (1995). The K-loop molar distalizing appliance. *J. Clin. Orthod.* 29: 298-301.
- Keleş Ahmet, Sayinsu Korkmaz – A new approach in maxillary molar distalization: intraoral bodily molar distalizer - *Am J Orthod Dentofacial Orthop* 2000;117:39-48;
- Kinzinger Gero S. M., Peter R. Diedrich - Biomechanics of a modified Pendulum appliance — theoretical considerations and *in vitro* analysis of the force systems *European Journal of Orthodontics* 29 (2007) 1–7
- Kinzinger Gero S. M.; Heiner Wehrbein; Peter R. Diedrich - Molar Distalization with a Modified Pendulum Appliance— In Vitro Analysis of the Force Systems and In Vivo Study in Children and Adolescents - *The Angle Orthodontist*: Vol. 75, No. 4, pp. 558–567 , 2004;
- Kinzinger GSM, Fritz UB, Sander FG, Diedrich PR. Efficiency of a pendulum appliance for molar distalization related to second and third molar eruption stage. *Am J Orthod Dentofacial Orthop* 2004;125:8-23.
- Klapper L. The super spring II: a new appliance for non - compliant class II patients. *J Clin Orthod*, Boulder, v. 23, p. 50-54, 1999.
- Korrodi Ritto A - Fixed Functional Appliances - A Classification - *The Orthodontic CYBER Journal* , 2007 ;
- Lindauer SJ, Rebelato J. Biomechanical considerations for orthodontic treatment of adults. *Dent Clin North Am* 1996; 40(4):811-36.
- Lindauer SJ. The basics of orthodontic mechanics. *Semin Orthod* 2001; 7(1):2-15.
- McNamara James – *Orthodontic and Orthopedic Treatment in the Mixed Dentition*, Needham Press , Ann Arbor, Mi 48113-0530;
- Mori S, Burr D B 1993 Increased intracortical remodeling following fatigue damage *Bone* 14 : 103 – 109
- Nanda R – *Biomechanics in Clinical Orthodontics* – W. B. Saunders Company, 1996;
- Nanda, S. K. The developmental basis of occlusion and malocclusion. Chicago:Quintessence, 1983.
- Ngantung V, Nanda RS, Bowman, SJ. Posttreatment evaluation of the distal jet appliance. *Am J Orthod Dentofacial Orthop*. 2001; 120:178–185.
- Nishii Y, Katada H, Yamaguchi H. Three-dimensional evaluation of the distal jet appliance. *World J Orthod* 2002;3:321-327
- Noble B 2005 Microdamage and apoptosis . *European Journal of Morphology* 42 : 91 – 98
- Noble B S, Stevens H , Loveridge N , Reeve J 1997 Identification of apoptotic changes in osteocytes in normal and pathological human bone . *Bone* 20 : 273 – 282

- Pancherz H. The mechanism of Class II correction in Herbst appliance treatment. A cephalometric investigation. *Am J Orthod.* 1982;82:104–113.
- Pieringer, M., Droschl, H., Permann, R. (1997). Distalization with a Nance appliance and coil springs. *J. Clin. Orthod.* 31: 321-326.
- Pilon JJ, Kuijpers-Jagtman AM, Maltha JC. Magnitude of orthodontic forces and rate of bodily tooth movement. An experimental study. *Am J Orthod Dentofacial Orthop.* 1996;110(1):16-23.
- Prato Rafael J. - Distalizator de molare superioare cu pistoncini de nichel-titanio. Informe de un caz Colombia Médica Vol. 38 N° 4, 2007 (Octubre-Diciembre)
- Quick AN, Harris AMP. Molar distalization with a modified distal jet appliance. *J Clin Orthod* 2000;34:419-23.
- Sayinsu Korkmaz, Fulya Isik, Ferdi Allaf, Tülin Arun – Unilateral molar distalization with a modified slider – *European Journal of Orthodontics* 28 (2006) 361-365;
- Smith RJ, Burstone CJ. Mechanics of tooth movement. *Am J Orthod Dentofacial Orthop* 1994;85:294-307.
- Taylor D , Lee T C 2003 Microdamage and mechanical behaviour: predicting failure and remodelling in compact bone . *Journal of Anatomy* 203 : 203 –211
- Turley PK, Kean C, Schnur J, Stefanac J, Gray J, Hemes J, Poon JC. Orthodontic force application to titanium endosseous implants. *Angle Orthod.* 1988;58:151–162.
- Ucem TT, Yüksel S. Effects of different vectors of forces applied by combined headgear. *Am J Orthod Dentofacial Orthop* 1998;113:3 316-23
- Veltri N. Espansione mascellare a 360 gradi. Sistematica dell'utilizzo di apparecchi fissi con vite per la correzione delle anomalie del mascellare superiore. *Bollettino di Informazioni Ortodontiche Leone* 1999; 63: 25-28.
- Wehrbein H, Diedrich P. Endosseous titanium implants during and after orthodontic load—an experimental study in the dog. *Clin Oral Implants Res.* 1993;4:76–82.
- Weiland Frank J., Hans Peter Bantleon – Treatment of Class II malocclusions with the Jasper Jumper appliance – a preliminary report - *Am J Orthod Dentofacial Orthop* 1995;108;341-350;
- Wieslander Lennart – Long-term effect of treatment with the headgear-Herbst appliance in the early mixed dentition. Stability or relapse? - *Am J Orthod Dentofacial Orthop* 1993;104;319-329;
- Yoshida N, Jost-Brinkmann P G, Koga Y, Mimaki N, Kobayashi K 2001 Experimental evaluation of initial tooth displacement, center of resistance, and center of rotation under the influence of an orthodontic force. *American Journal of Orthodontics and Dentofacial Orthopedics* 120 : 190 – 197

LIST OF PAPERS PUBLISHED BEARING ON THE TOPIC OF THE DOCTORAL THESIS

1. **"Finite Element Analysis for Upper Molar Distalization"** - Ioana Liliana Vătă, Irina Zetu, Mariana Păcurar - Romanian Journal of Oral Rehabilitation Vol. 4, No. 3, July - September 2012; pag.10-13; Rev.categ.B+, ISSN:2066-7000, www.rjor.ro
<http://journals.indexcopernicus.com/karta.php?action=masterlist&id=5930>
2. **"Stress distribution as a function of the point of force application on the upper first permanent molar during distalization"** - Liliana-Ioana Vătă, Sorana Rosu, Mariana Pacurar, Irina Zetu - International Journal of Medical Dentistry, Vol:16 Issue 3/2012: pag. 202-208, Rev.categ.B+, ISSN:2066-6063, www.ijmd.ro
<http://journals.indexcopernicus.com/karta.php?action=masterlist&id=4330>
3. **" Unilateral upper molar distalization in a severe case of class II malocclusion. Case presentation"**- Ioana Liliana Vătă, Mariana Păcurar - Romanian Journal of Oral Rehabilitation Vol. 4, No. 4, October-December 2012, pag 5 -10: sub tipar; Rev.categ.B+, ISSN:2066-7000, www.rjor.ro <http://journals.indexcopernicus.com/karta.php?action=masterlist&id=5930>