

Is the Physiological Mobility of the Teeth Disturbed Because Of the Retainer- Comparative Study between the Different Retainers

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Abstract: In Orthodontics The Stability Of The Achieved Result Remains A Fundamental Issue Of Concern And Debate. Tirk Has Said "The Result Of Orthodontic Therapy – Good, Bad Or Indifferent Is Only Evident Many Years Out Of Retention" . Maintaining Teeth In Their Corrected Positions After Orthodontic Treatment Has Been And Continues To Be A Challenge . Usually A Retention Phase Is Required After Active Orthodontic Tooth Movement To Hold Teeth In Its Ideal Aesthetic And Functional Relation And Prevent The Teeth To Return To Their Former Position. Fixed Appliance Therapy Often Lasts Several Years. Gladness About Debonding Is Great And The Patient Consider The Occasion As The End Of Treatment Many Times. Patients As Well As Their Parents Often Underestimate The Importance Of The Following Retention Period And How Quickly Negligences In This Part Of Treatment Result In Recidivisms. Fixed Retainer Guarantee A Good Long-Term Stability At Least As Long As They Are In Situ. The Reliable Attachment Of Lingual Retainers With Modern Bonding Procedures Made Them A Popular Retention Method. To Test Their Influence On Tooth Mobility Or Damping Quality The Presented Study Was Performed With A Dynamic Test Procedure (Periotest).

Keywords: Fixed Orthodontic Retainer, Retention, Retainers, Relapse, Stability.

I. Introduction

Retention After Orthodontic Treatment Has Been Recommended By Several Authors And Researchers. It Can Be Stated As Holding The Teeth In Optimal Esthetic And Functional Positions. A Proper Retention Regimen To Prevent Relapse After The End Of An Orthodontic Treatment Is Frequently Overlooked By Orthodontists. Adequate Retention Is Needed To Let PDL And Supracrestal Fibers Reorganize, To Allow Remodeling Of The Alveolar Bone And To Manage Differential Growth Of The Jaws, While Managing Soft Tissue Pressure [1]. The Extent Of The Changes Happening After The End Of Active Treatment Is Not Predictable [2]. These Changes May Be Partly Dependent On The Type Of Malocclusion And The Type Of The Mechano-Therapy Used [3]. Removable Retainers Were Usually Prescribed For The Lower Arch After The End Of Fixed Orthodontic Treatment.[1] Greater Research Emphasis Has Been Placed On Relapse Of Mandibular Anterior Crowding And Little Emphasis Has Been Given To Investigating The Maxillary Crowding Relapse And Parameters That May Be Helpful In Predicting Its Long-Term Stability.[4] Alignment Stability Of Mandibular Incisors Is Less Than That Of The Maxillary Anterior Teeth. Factors Such As Pretreatment Crowding Severity And Gingival Fibers Traction Are Considered Risk Factors For Maxillary Incisors Crowding Relapse. However, There Is An Association Between A Prolonged Period Of Retention And Greater Stability Of Maxillary Teeth Alignment. Maxillary Incisors Tend To Rotate In The Direction Of Their Initial Positions, Despite Buccolingual Relapse Being Unpredictable. Furthermore, Palatal Contacts Between Maxillary And Mandibular Incisors Preclude Lingual Movement Of The Maxillary Teeth And Any Vestibular Movement Is Probably Determined By The Lips Position And Function.[1,2,3,4] Many Factors Influence Long Term Stability Of Orthodontic Treatment Results. A Number Of Studies Show A Correlation Of Insufficiently Corrected Malocclusion Or Further Physiologic Growth With Recidivisms. Further Factors Which Can Promote Recidivisms Are Tooth Morphology Itself And Inauspicious Occlusal Loadvectors. These Might Occur When Incisors Are Protruded Extensively To Prevent Extractions In Crowding Cases. Typically, Recidivisms Become Obvious For The Patient In A Esthetically Disturbing Crowding Of The Lower Anteriors. To Prevent This Crowding, Fixed Lingual Retainers Are Applied. [5,6]. Indication For A Bonded Retainer And The Risk Of Recidivisms Can Be Minimized When General Principles Of Orthodontic Treatment Are Followed. A Widening Of The Canine Distance Or Disregarding Original Archform Are Treatment Mistakes Just As An Insufficient Correction Of Rotated Teeth. Fibrotomies Or Reduction Of The Mesio-Distal Tooth Width Of Anteriors Which Transforms Contact Points Into Contact Areas Can Add To The Stability In These Patients.[7] The Indication For Bonding A Fixed Retainer Should Be Limited To The Following Situations Despite The Very Good Experiences With It ;

- Borderline Tipped Anteriors

- After Aligning Previously Severely Crowded Teeth
- Limited Overbite
- Large Spaces Like A Medial Diastema Prior To Treatment
- Extensive Rotations Prior To Treatment
- Extraction Of A Lower Anterior Tooth
- Class III Patients
- Retruded Anteriors With Deep Bite And Class I Skeletal Relationship[1-7]

In The Appropriate Situation Duration Of Retention Should Last Many Years And Especially In Adults Even Longer Or Permanent. In Class III Cases One Should Take Care To Retain Up To Complete Termination Of Growth. Different Authors Suggest Retention Until The Eruption Of Wisdom Teeth Or Retain In Males Into The Mid Thirties, In Females Until The Beginning Of The Third Decade Of Live.[8]

Different Materials And Methods Are Offered For Lingual Retainers. The Choice Of Wire Quality Of The Retainer And How Many Teeth Are Be Incorporated Have To Be Individually Selected. Zachrisson Described Three Generations Of Lower Canine To Canine Retainers. Retainers Of The First Generation [9] Were Made Of Round Blue-Elgiloy-Draht (0,032“ –0,036“) With Loops At Each End. 1983 The Wire Was Replaced With A Twisted Flexible (0,032“) One. With The Twisted Wire A Sufficient Retention Was Achieved Which Made The Loops At The Ends Unnecessary And The Fixation Easier [10]. More Plaque Accumulation And A Reduced Wearing Comfort Were The Disadvantages Of The Twisted Round Wire. The 1995 Described Retainer Of The Third Generation Was Made Of A Solid Stainless Steel Wire (0,030“ –0,032“) [10] Which Was Bent On A Plaster Cast Exactly To The Lingual Surfaces Of The Lower Anteriors. To Increase Retention Of The Composite, The Ends Of The Wire Were Sandblasted.[9,10]



Figure 1: Periotest-Appliance Appliance Which Was Used In This Study

A Disadvantage Of Fixed Retainers Worth Discussing Is Their Restriction Of Physiologic Tooth Mobility [11,12]. Tooth Mobility Decreases With Increasing Age But Also With Longer Periods Without Function. Several Studies Were Conducted On Tooth Mobility During Orthodontic Treatment [13] Some Of Them With Histologies [14-17]. After The End Of Orthodontic Treatment Tooth Mobility Decreased To Norm-Values [18]. Retention Appliances, Especially Fixed Lingual Retainers Should Not Be Impeding. Thus, The Question Arises Whether Tooth Mobility Is Reduced Below Physiologic Values With Lingual Retainers. Besides Reliable Recidivism Prophylaxis, Easy And Fast Production And Application, Ability For Interdental Hygiene, The Ensurance Of Sufficient Tooth Mobility Is One Of The Basic Requirements Of A Fixed Lingual Retainer. Schwarze [12] Studied The Last Aspect With 10 Different Retainer Designs. With Static And Dynamic Measurements Of Mobility It Could Be Shown That Even With Twisted Wires Of Relatively Small Diameter (0,0155“) And 6 Points Of Fixation, Tooth Mobility Was Impeded. The Retainer Showed The Largest Effect In Areas Of Low Strain. Inter-Individual Differences Could Be Explained With The Shape Of Approximal Contacts, Different Tooth Widths, As Well As Position And Size Of The Fixation [12]. Measurements Were Done With The „ Periotest-Appliance“ (Siemens Medical Systems Inc., Charlotte, NC) Immediately After Insertion Of The Retainer.[11-17]



Figure 2: The Handpiece Of The Periotest-Appliance Positioned To An Anterior Tooth. During Measurements The Handpiece Has To Be Hold Perpendicular To The Long-Axis Of The Tooth At The Middle Of The Crown. An Acoustic Computer Signal Shows Inacceptable Deviations.

Methods To Measure Tooth Mobility Are Either Static Or Dynamic. In The Static Method A Defined Moment Of Force Is Applied On A Certain Area Of The Tooth And Its Movement Is Then Measured. The Dynamic Method Is Used To Obtain Information Of The Biophysical Properties Of The Tooth In Its Alveolus With Regard To Different Forces. To Get Reproducible Values It Was Attempted To Built Appliances Which Allow Measurements Of Tooth Mobility Without Great Effort. Such Appliances Were Developed As Early As 1939 [19]. Mühlemann [13] Reported In 1960 About 10-Year Experiences With The „Periodontometer“ To Study Tooth Mobility. Reproducibility And Handling Were Subjects Of Improvement Though. In 1962 Körber [20] Introduced A Touchless Procedure To Measure Tooth Mobility For The First Time. Burstone Described In 1978 [21] A Method To Measure Tooth Mobility With Holographics. This Method Was Superior To Previous Concept With Regard To Precision But Was Not Practicable Because Of The Amount Of Technical Equipment. Desmodontometry, Introduced In 1987 By Niedermeier [22-25], Was A Precursor Of The Periotest-Appliance Appliance Which Was Used In This Study (**FIG 1**). Measurement Is Made With A Pneumatic Driven Head Which Also Registers The Movement Of The Tooth. Niedermeier [22] Found A Dynamically Measured Physiologic Tooth Mobility Of 0.065mm At 1.5N In Horizontal Direction (**FIG 2**).



Figure 3: Canine To Canine Lingual Retainer Fixed To 2 Teeth.

Sand-Blasting The Ends Of The Retainer (E.G. Microetcher). (A) Prior (B) After Sand-Blasting. (C) Retainer Fixed To Two Teeth.

Objective

Because Of The Widespread Use Of Fixed Retainers It Is Was The Purpose Of This Study To Examine The Influence Of Canine To Canine Retainers Fixed To Either 2 Or 6 Teeth On Damping Properties Of The Periodontium And With That In A Broder Sense On Tooth Mobility (**FIG 3, FIG 4**). A Control Group Was Made Up Of Patients With Removable Retainers Only.

Methods

To Study The Different Kinds Of Retainers (2 Or 6 Fixations) And Their Influence On Physiologic Tooth Mobility Three Study Groups Were Created: Two Groups (A And B) Where A Fixed Retainer Was Inserted At The End Of Active Treatment With Fixed Appliances And A Corresponding Control-Group Without Fixed Retainer.

- Treatment Group A: Treated Patients Where Retention Was Achieved Wit A Canine To Canine Retainer Made Of Half-Round Wire Fixed At The Canines Only (N = 20) (**FIG 3**).
- Treatment Group B: Treated Patients Where Retention Was Achieved Wit A Canine To Canine Retainer Made Of Twist-Flex Wire (0.0175in) Fixed At All 6 Anterior Teeth (N = 20) (**FIG 4**).
- Control Group C: Treated Patients Where Removable Unimaxillar Appliances Only Were Used For Retention (N = 20) (**FIG 5**).



Figure 4: Canine To Canine Lingual Retainer Fixed To 6 Teeth; Retainer Made Of Twisted Flexible Wire.

All Groups Showed Similar Age And Gender Distribution (Table 1). Measurement Of Tooth Mobility Was Conducted By One Examiner With The Periotest-Appliance [26] Approximately 6 Months After Insertion Of The Fixed Retainer Or Immediately After Insertion Of The Removable Retainer. To Control Variability Every Fourth Patient Was Measured By A Second Examiner

During The Same Session. Variations Were Within The Variance Found By The Manufacturer (± 1 Periotest Value = PTV).



Figure 5: Treated Patients Where Removable Unimaxillary Appliances Only Were Used For Retention

The Resulting Value At The End Of Each Measurement (PTV) Represents A Biophysical Variable. This Value Is Partly Dependent Upon Tooth Mobility But More Upon The Damping Properties Of The Periodontium. Pathological And/Or Functional Changes Of The Periodontium Including The Alveolar Bone Can Be Quantitatively Determined Very Exactly Long Before They Are Visible On A Radiograph. Measurements Are Conducted By Percussion Of The Tooth (16 Times With A Frequency Of 4Hz) By A Electromagnetically Driven Electronically Controlled Tip Of A Handpiece. For A Correct Measurement The Handpiece Has To Be Placed Perpendicular To The Long Axis Of The Tooth (Fig. 1). Area Of Measurement Is The Middle Of The Anatomic Crown. As Soon As The Tapp Of The Device Hits The Tooth Ist Velocity Is Reduced. The More Stable The Periodontium The Greater The Damping, The Greater The Deceleration. Contact Time Of The Tip With The Tooth Is Measured. The Scale Of Measureable Values Ranges From -8 To +50. Miller Assigned These Values Mobility Grades Established By The „Deutschen Arbeitsgemeinschaft Für Periodontiumologie“ (ARPA) [9]. **Table 1** Shows This Correlation:

Table 1: The Scale Of Measureable Values Ranges Of Mobility Grades

	Mobility	PTV
Clinical Not Mobile	0	-8 To +9
Sensible Mobile	I	10 To 20
Visible Mobile	II	20 To 29
Mobile By Touch Of Lip Or Tongue	III	30 To 50

For Interpretation Of The Measured Tooth Mobility Two Groups Were Established: Canines (33 And 43) Were Compared Versus Anteriors (32, 31, 41 And 42). The Study Groups A And B As Well As The Control Group Were Statistically Compared With Respect To The Periotest Values As A Measure For Tooth Mobility (Student's T-Test, Mann-Whitney-U-Test).

II. Results

Table 1 Shows The Results. Study Groups A And B Show A Reduced Tooth Mobility Compared To Group C. Tooth Mobility Of Incisors As Well As Canines Is Significantly Different Between The Two Lingual Retainer Groups And The Control Group ($P < 0.001$). Tooth Mobility Was Highest In The Control Group (Group C) For Incisors (6.97 ± 2.32) And Canines (3.00 ± 1.34) Lowest In Group B (2.3 ± 2.01 Respectively -2.02 ± 1.29). In The Retainer Group Fixed At Two Teeth (Group A) The Values For Incisors (5.73 ± 1.44) And Canines (1.88 ± 1.5) Were Two To Three Times As High As In The Group Where The Retainers Were Fixed At Six Teeth. Thus The Values Of Group A Were Between Those Of Group C And Group B.

Incisors And Canines Of Group A Show Tooth Mobility Reduction Of 20% (Canines 40%) Compared To Group C, The Corresponding Teeth Of Group B To Group C Even 70% (160%) (.Table 2) Average (MW) And Standard-Deviation(S) Of The Periotest-Values. Group A: Retainer Fixed To Two Teeth; Group B: Retainer Fixed To Six Teeth; Group C: Removable Retainers.

	Study-Group A (N = 20)		Study-Group B (N = 20)		Control-Group C (N = 20)		Significance (P)	
	MW	S	MW	S	MW	S	A Vs. B	C Vs. A/B
Incisors	5,73	1,44	2,3	2,01	6,97	2,32	<0,001	<0,001
Canines	1,88	1,50	-2,02	1,29	3,00	1,34	<0,001	<0,001
Age (Years)	15,2	1,2	15,4	1,3	15,7	1,6	-	-

III. Discussion

Incisors Alignment Relapse In Maxillary Arch Is Less Prevalent Than In Mandibular Arch, The Evaluation Of Possible Factors That May Influence Maxillary Tooth Alignment Stability Has Validity. Relapse Of Crowding In This Region May Also Results In Esthetic And Functional Occlusal Deficiencies. Mainly Due To Its Location, Maxillary Incisors Crowding Relapse Tends To Become More Visible And Therefore Promote Greater Esthetic Impacts Than Mandibular Irregularity.[27]

Sadowsky Et Al Evaluating Stability In Maxillary And Mandibular Dental Arches Of Patients Treated Without Extractions And Edgewise Mechanics, Observed No Significant Changes In The Intercanine And Inter-Premolars Widths, Five Years Post-Retention.[28]

In 2007, Katsaros Et Al. Examined The Unexpected Post-Treatment Changes In The Mandibular Anterior Region Associated With The Flexible Spiral Wire Retainer Bonded To 6 Teeth. For A 3 Year Period, Patients Were Screened For These Unexpected Changes During Their Regular Follow-Up Appointments. In Total, 21 Patients Were Found To Have Complications, Of Which 18 Patients Had A Torque Difference Between 2 Adjacent Mandibular Incisors And 2 Patients Had Increased Buccal Inclination Of A Mandibular Canine. Although The Authors Never Stated The Total Number Of Patients Screened, They Estimated Approximately 5% Of Patients With This Particular Type Of Retainer Experienced Either Of These Complications.[29]

In 2008, Booth Et Al. Set Out To Evaluate The Effectiveness And Gingival Health Effects Of Fixed Retainers Bonded To Canines And Followed-Up 20 Or More Years After Placement. This Was Another Retrospective Study Where 45 Of 60 Patients Still Had Their Retainers In Place. Of The 45 Patients, 1 Had An Irregularity Index Score > 2mm Whereas Of The 15 Patients Who Had Their Retainers Removed, 13 Had Scores > 3mm And 5 Had Scores > 4mm. These Results Convey That Fixed Retention (Bonded To Canines) Is Associated With Maintenance Of Alignment Of Mandibular Anterior Teeth If 3mm Is Acceptable For Relapse.[30]

In 2009, Kuijpers Et Al. Conducted A Retrospective Study Involving 222 Subjects, All Of Which Were Followed For 5 Years Post-Treatment. In The Maxilla, A Bonded Retainer On All 6 Teeth Or A Removable Retainer Was Used Whereas In The Mandible, A Bonded Lingual Retainer Either To All 6 Teeth Or Just The Canines Was Used. Along With The Degree Of Wear Of The Upper And Lower Incisors/Canines, The Upper And Lower Intercanine Width And The Lower Anterior Alignment (Irregularity Index) Were Measured. It Was Found That The Irregularity Index Decreased Significantly From Before Treatment To The End Of Treatment And Then Increased Significantly When Measured 5 Years Post-Treatment. With Respect To The Intercanine Distance, There Was A Significant Increase In Both The Maxilla And Mandible. Anterior Tooth Wear Increased Through All Phases And Was More Significant For Those With Maxillary Removable Retainers. Their Study Did Not Specifically Assess Whether One Method Of Retention Showed Less Incisor Irregularity.[31]

In 2007, Rowland Et Al. Implemented A Prospective Single-Center Randomized Controlled Trial To Investigate The Effectiveness Of Hawley And Vacuum-Formed (Aka. Essix) Retainers. A Total Of 396 Patients Were Randomly Given Either A Hawley Retainer Or A Vacuum-Formed Retainer, Though 155 In Each Group Were Eventually Analyzed. Dental Casts Of The Maxilla And Mandible At The Debonding Stage And 6 Months Into Retention Were Assessed For Rotations, Overjet, Overbite, Inter-Molar Widths, Intercanine Widths And Irregularity Index Of The Anterior Sextant. There Was A Significantly Greater Change In The Irregularity Index For The Hawley Retainer Compared To The Vacuum-Formed Retainer. They Concluded That Vacuum-Formed Retainers Are More Effective In Stabilizing The Maxillary And Mandibular Anterior Segments.[32]

Various Studies Have Shown That Fixed Retention Bonded Only To Canines Have Relapse, While Others Have Shown That Even Though Relapse Exists, It Is Not Significant Or Clinically Relevant. Other Studies Have Assessed Fixed Retention Including Incisors And Have Shown Both: Better Stability And More Movement Due To Its Technique Sensitivity. Only One Study Compared Fixed Retention With Removable Retention And Their Focus Was On Tooth Wear, Not Movement Of The Incisors. The Cochrane Collaboration Published A Report In 2009 Indicating That More Research Is Required In Comparing Different Types Of Retainers. Further, Most Studies Have Focused On Mandibular Anterior Alignment, While The Maxillary Anterior Alignment Has Been Studied To A Much Lesser Degree.[8,33]

Störmann And Ulrike 2002 In A Prospective Randomized Study, Compared 2 Types Of Fixed Mandibular Retainers With Respect To Detachment Rate, Relapse, Periodontal Problems, Oral Hygiene And Subjective Patient Discomfort. In Total, 103 Patients Had Either Canine-To-Canine (Bonded To 6 Teeth) Or Canine-And-Canine (Bonded To 2 Teeth). Using Little's Irregularity Index To Measure Relapse Over A Period Of 24 Months, It Was Found That Canine-To-Canine Retainers Had A Greater Degree Of Stability Whereas The Canine-And-Canine Retainers Were Associated With Frequent Relapse Of The Incisors Not Bonded.[34]

Renkema Et Al. Published A Large Retrospective Study That Explored The Effectiveness Of Lingual Retainers Bonded To Canines In Preventing Relapse Of Mandibular Incisors. Using The Dental Casts Of 235 Patients With Canine-And-Canine Mandibular Lingual Retainers, The Corresponding Irregularity Index Was Measured Before Treatment, After Treatment, 2 Years After Treatment And 5 Years After Treatment. It Was Found That The Irregularity Index Decreased Significantly From Before The Start Of Treatment To The End Of Treatment And Thereafter. In 60% Of Subjects, The Irregularity Index Was Stable During The Post-Treatment Period And In 40%, The Irregularity Index Exhibited A Slight Increase (0.4mm) During The Same Posttreatment Period.[35]

In 2006 Al-Omiri And Alhajja Published A Study Designed To Define The Factors That Affect Patient Satisfaction After Orthodontic Treatment. Their Sample Group Received Upper Hawley And Lower Bonded Retainers, Following Fixed Orthodontic Treatment. Dental Impact On Daily Living Questionnaires Identified That Personality And Satisfaction Were Correlated. Patients With High Neurotism Scores Were Associated With Lower Levels Of Satisfaction. Total Satisfaction Was Associated With Oral Comfort, Eating Capacities, And Pain Dimensions During Treatment. Interestingly They Found That Age, Sex And Pretreatment Orthodontic Treatment Need Had No Relationship With Patient Satisfaction. However Non-Extraction Patients Were More Dissatisfied With Their Dentition.[36]

Mollov Et Al Studied Patient Satisfaction At The End Of Active Orthodontic Treatment And After Retention Devices Had Been Removed. They Found That Most Patients (96%) Were Satisfied With The Orthodontic Treatment Rendered Both At The End Of Treatment And After A Post Retention Period. 88% Of The Patients They Surveyed Also Indicated That They Were Responsible For Maintaining The Alignment And Fit Of Their Teeth After Treatment Has Been Completed. They Found A Strong Correlation Between Those Who Indicated That They Were Not Responsible For The Retention Of Their Dentition Post-Treatment And Those Dissatisfied With Treatment Results. Patients With Essix Retainers Were More Satisfied Than Patients With Hawley Or Bonded Retainers.[37]

Millet Et Al Studied Bonded Retainers And Essix Retainers In The Mandibular Arch And Evaluated Outcome Measures Of Relapse In Alignment And Periodontal Health Of The Lower Incisors. Patients Preferred Bonded Retainers And The Clinicians Preferred Essix Retainers. Relapse Was Higher With Essix, Retainers Due To The Fact That They Were More Easily Lost Or Broken. They Also Found That The Group With The Bonded Retainers Had Mildly Increased Gingival Inflammation And Periodontal Pockets As Compared To The Group With The Essix Retainers. Neither Group Had An Increased Rate Of Decay In The Lower Incisor Region.[38]

Artun Et Al Compared One Removable Retainer And Different Types Of Bonded Retainers. After Following Patients For Three Years, There Was No Difference In The Survival Rates Of The Various Retainers. It Is Noted That The Sample Size Was Small And The Data Did Not Include Standard Deviations.[39]

Wong And Freer¹⁰ Found That Australian And New Zealand Orthodontists Most Often Used The Essix Appliance In The Maxilla And Canine To Canine Bonded Retainers In The Mandible. Multistranded Wires Were Most Often Used As Bonded Retainers, Followed By Stainless Steel Wires. The Position Of The Teeth Prior To Treatment Dictated The Type Of Retainer Prescribed. Of The Orthodontists Surveyed, Most Recommended A Retention Period Greater Than Two Years. There Was Some Variation In The Full-Time Followed By Part-Time Retention Protocols Prescribed By Australian And New Zealand Orthodontists. Some Practitioners Commonly Used Permanent Retention, While Others Demonstrated Minimal Use Of Long Term Retention. There Was No Identifiable Influencing Factor.[40]

Pratt Et Al Reported On A Study Investigating Patient Compliance With Short-Term And Long-Term Retention. They Looked At Age, Length Of Time Since Debonding, Sex, Retainer Type, Retention Protocols Prescribed, Regimens For Retainer Wear And Reasons For Non-Compliance. A Significant Finding Was That Patients Provided With Essix Retainers Were More Compliant With Wearing Them As Compared To Patients Given Hawley Retainers, From The Day That They Were Debonded To Two Years Post-Debond. After The Two Year Period, Compliance Increased In The Hawley Retainer Group. Overall, It Was Found That Long-Term Compliance Was Greater In The Hawley Retainer Group. Functional Wear Was Suggested As A Potential Cause Of The Decrease In Use Of The Essix Retainers Over Time. Esthetics Was Not Related To Compliance With Retainer Use. Females Were More Likely Than Males To Wear Their Retainers; And Younger Patients Demonstrated More Initial Compliance Than Older Patients Did; But This Decreased With Time. For Removable Appliances They Recommended The Initial Use Of Essix Retainers With A Transition To Hawley Retainers. However, Overall Compliance With Removable Retainers Was Low And Fixed Retention Was Recommended When Possible.[41]

Thus It Was The Aim Of This Study To Investigate The Decrease Of Tooth Mobility By Canine To Canine Retainers Fixed To 2 Or 6 Teeth. Since Tooth Mobility Was Increased Immediately After Debanding Due To Tooth Movements Immediately Up To This Point, Testing Of Tooth Mobility Was Postponed Until 6 Months After Insertion Of The Retainers Not To Influence The Measurements By The Increased Mobility. This

Time Period Was Considered Sufficient To Expect A Physiologic Situation Of The Periodontium After Preceding Orthodontic Tooth Movement. Restriction Of Tooth Mobility By Lingual Retainers Was Studied By Comparing Retainers With Either Two Or Six Teeth Used For Fixation And By Comparing These Groups With A Group With Removable Retainers Only. Since No Comparison With A Native Situation Was Attempted, It Does Not Matter Whether Re-Establishing Of The Pre-Orthodontic Situation With Its Respective Consequences On Tooth Mobility Was Influenced By The Removable Retainer.

The Dynamic Tooth Mobility Was Measured With The Periotest-Appliance. Differing From The Genuine Intention Of This Appliances Not Pathological Increased Tooth Mobility Was Measured But Rather A Reduced Mobility. Because Of The Size Of The Measure Head It Is Not Possible To Test The Tooth Mobility From Lingual. Thus The Measurement Of Buccal Periodontal Dependent Tooth Mobility Was Measured Under The Influence Of The Elastic Qualities Of The Retainer-Wire. One Would Expect That A Reduced Tooth Mobility Results By The Use Of The Semi-Round Wire. The Results Show Though, That Tooth Mobility Is Higher With The Rigid Wire Than With The Twistflex-Wire Fixed To Six Teeth. [9,10]

The Averaged Values Show That Tooth Mobility Is Reduced In The Sagittal Dimension But That It Is Within Physiologic Limits. The Values For The Control Group Were Also In The Physiologic Range. Retainers Fixed To Two Teeth Showed A Significant Smaller Reduction Of Tooth Mobility. One Has To Take Into Consideration Though That The Measurements Were Performed In Bucco-Lingual Direction. The Lingually Placed Retainer Has The Described Effect In This Direction; The Reduction Of Tooth Mobility In Lingo-Buccal Direction Can Be Expected To Be Less. For Long-Term Retention Retainers Fixed To Six Teeth Have The Greatest Effect On Reduction Of Tooth Mobility. In Addition, It Is Possible That Fixation To Every Tooth Also Has An Influence On Vertical Damping Of The Periodontium.[42]

How The Different Limitations Of Periodontal Damping React After Removal Of The Lingual Retainers And How The Following Stability Of The Treatment Result Is Influenced Could Not Be Investigated Since The Retainers Were Left In-Situ Following The Study Period.

Retainers Fixed To Two Teeth Have The Clinical Advantage That Failure Of A Fixation Is Perceived By The Patient Immediately. The Patient Can Then Remove The Retainer Without Great Effort And Reschedule An Appointment For Rebonding. Retainers Fixed To 6 Teeth Inherit The Danger That One Fixation Loosens Unnoticed By The Patient. Caries Might Develop At The Margin Between Tooth And Remaining Composite At The Retainer. No Fixation Of The Studied Retainers Loosened And Had To Be Reattached. Retention By Fixed Retainers Secures The Obtained Result To A Certain Extent Without The Compliance Of The Patient. The More Important Is A Perfect Oral Hygiene Of The Patient; Because Of The Proximity Of The Opening Of The Sublingual Gland Ductus Tartar Deposition Is Increased At The Lingual Surfaces Of The Lower Anteriors. Fixed Retainers Produce Additional Niches For Plaque- And Tartar-Deposition. The Possibility For Good Oral Hygiene Is Better With Retainers Fixed To Two Teeth. Fixation To Every Tooth Makes Interdental Hygiene Much More Complicated Since The Dental Floss Has To Be Thread Between Every Tooth Whereas Dental Floss Can Be Moved Along The Wire From One Approximal Area To The Other By The Patient Who Has A Retainer Fixed To Two Teeth Only. This Is Also Possible When The Retainer Touches Every Tooth As It Should Since There Is No Limitation Of Tooth Movement In The Labial Direction. In Addition Only Two Teeth Have To Be Acid Etched Which Is A Certain Preservation Of Tooth Substance. The Impairment Of The Patient By Lingual Retainers Has To Be Discussed Since They Are Placed Lingual Of The Anterior Teeth In The Area Of The Tip Of The Tongue. Retainers Fixed To Two Teeth Require A Larger Diameter To Obtain A Sufficient Stability And Thus Have Need More Space. Retainers With Six Fixations And A Twisted Wire Have A Smaller Diameter But The Amount Of Composite Relativates This Advantage. Further Research Is Necessary To Determine Which Type Of Retainer Masters Its Main Task To Stabilize The Result Best. Especially Situations Where Pre-Therapeutic Rotated Teeth Were Present Or After Vertical Repositioning Teeth A More Bodily Seizure Of The Affected Teeth Is Wanted.

There Are So Many Ways To Refine A Study Of Retention For The Future. It Would Be Best If It Were Prospective And Randomized In Nature, But Having Canines Fully Erupted In The Arch So That Pre-Treatment Measurements Could Be Done For Crowding, Would Be Ideal. Also Accounting For Extraction Of Premolars, Angulation Of Incisors, Type Of Malocclusion, Type Of Treatment Rendered, Duration Of Treatment, Timing Of Treatment, And Having A Measuring Device In The Removable Appliance For Amount Of Wear, Would Be A Great Asset.[35,3,38,40,41]

The Next Quarter Century May Witness The Much Needed Additional Of A More Scientific Dimension To The Retention Literature Such As Clinical Reports Of The Duration Of A Variety Of Retaining Appliances And The Observations And Opinions Advocated By Many Orthodontic Innovations And Clinical Scholars

IV. Conclusions

The Retention Stage Of Orthodontic Treatment Is Fairly Discussed In The Literature And Despite All Attention Deposited In This Area, It Still Is The Most Difficult Stage Of Orthodontic Treatment. One Would Expect That A Reduced Tooth Mobility Results By The Use Of The Semi-Round Wire. The Results Show Though, That Tooth Mobility Is Higher With The Rigid Wire Than With The Twistflex-Wire Fixed To Six Teeth.

The Averaged Values Show That Tooth Mobility Is Reduced In The Sagittal Dimension But That It Is Within Physiologic Limits. The Values For The Control Group Were Also In The Physiologic Range. Retainers Fixed To Two Teeth Showed A Significant Smaller Reduction Of Tooth Mobility. For Long-Term Retention Retainers Fixed To Six Teeth Have The Greatest Effect On Reduction Of Tooth Mobility. Retainers Fixed To Two Teeth Have The Clinical Advantage That Failure Of A Fixation Is Perceived By The Patient Immediately

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Legend

Figure 1: Periotest-Appliance Appliance Which Was Used In This Study

Figure 2: The Handpiece Of The Periotest-Appliance Positioned To An Anterior Tooth. During Measurements The Handpiece Has To Be Hold Perpendicular To The Long-Axis Of The Tooth At The Middle Of The Crown. An Acoustic Computer Signal Shows Inacceptable Deviations.

Figure 3: Canine To Canine Lingual Retainer Fixed To 2 Teeth.

Sand-Blasting The Ends Of The Retainer (E.G. Microetcher). (A) Prior (B) After Sand-Blasting. (C) Retainer Fixed To Two Teeth.

Figure 4: Canine To Canine Lingual Retainer Fixed To 6 Teeth; Retainer Made Of Twisted Flexible Wire.

Figure 4: Treated Patients Where Removable Unimaxillar Appliances Only Were Used For Retention