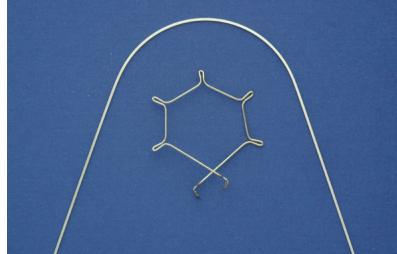
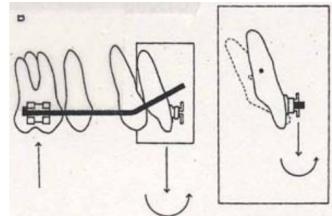


Adjustment of individual tooth position	
<ul style="list-style-type: none"> - Some final adjustments are necessary to compensate for the individual tooth anatomy and mistakes in bracket positioning. - Poorly positioned bracket → usually it is more time-efficient to rebond the bracket rather than place compensating bends in the archwires (esp. if the inclination is not correct). - Use a flexible wire after rebonding a bracket. Rectangular wire = too stiff in bending for tooth positioning. - Minor in-out and up-down adjustments (to correct canine interdigitation / level out marginal ridges) can be obtained by placing mild step bends in a flexible full-dimension wire (next to the last wire in a sequence). Steps must be repeated in the final wire for torque adjustment. - NiTi archwires: Not recommended for torque expression → no effective torsional properties. - The position of a step bend is not critical. No difference whether a step bend is in the center of the interbracket span or offset to either side. 	
Midline discrepancies	<ul style="list-style-type: none"> - Reflect how the posterior teeth fit together. - Esthetically it is undesirable to displace the mx midline to meet a displaced mn midline. - Skeletal asymmetry: An orthodontic correction is maybe impossible. → Consider camouflage vs. surgery. - Elastic force: <ul style="list-style-type: none"> • Asymmetric cl.II/III elastic force: More effective if used bilaterally with heavier force on one side than placed only unilateral. • Diagonal elastics anterior only for small discrepancies. (otherwise risk for an occlusal cant due to elastic side effects) - Place coordinated steps in the archwires to shift the teeth of one arch more than the other. - A mn shift can occur if a slight discrepancy in the transversal position of posterior teeth is present → use a force system to correct the transversal relationship. (coordination of the dental arches, posterior cross-elastics)
Tooth size discrepancies	<ul style="list-style-type: none"> - Othmann, 2007: 2-mm tooth size discrepancy noted from Bolton analysis is the threshold for clinical significance. - A small space distal 2+2 can be functional & esthetically acceptable. - <u>Stripping:</u> <ul style="list-style-type: none"> • To compensate for excessive tooth size. • If part of the original tx plan, it should be done initially. • Defer final stripping until the finishing stage → direct observation of the occlusal relationship is possible before the final tooth size adjustments are done. • Apply topical fluoride immediately after stripping. - <u>Composite resin built-ups for small incisors:</u> <ul style="list-style-type: none"> • The root position must be correct before any restorations are done. • Precise finishing is easier if the built-up is done during the finishing stage. • If it is done after the appliance removal, any gingival inflammation should be healed. • Delay laminate restorations safter the end of orthodontic tx. (bonding can damage their surface) - <u>Mask small deficiencies by altering incisor position</u> <ul style="list-style-type: none"> • Torque: <ul style="list-style-type: none"> ○ Incisors slightly more upright makes them take up less room relative to the lower arch. ○ Slightly excessive torque can partially compensate for small upper incisors. • Slightly tip teeth. • Finish tx with mildly excessive OB/OJ.
Root paralleling	<ul style="list-style-type: none"> - Take an OPG towards the end of the 2nd stage of tx, to check for root positioning errors and root resorption. - <u>Begg technique:</u> <ul style="list-style-type: none"> • Auxiliary springs placed into the vertical slot of the Begg bracket (ribbon wise) and hooked beneath the archwire. • Crowns must be tied together across extraction sites, since root-paralleling forces are also crown separating forces. • Can be employed with the edgewise appliance if it includes a vertical slot behind the edgewise bracket.

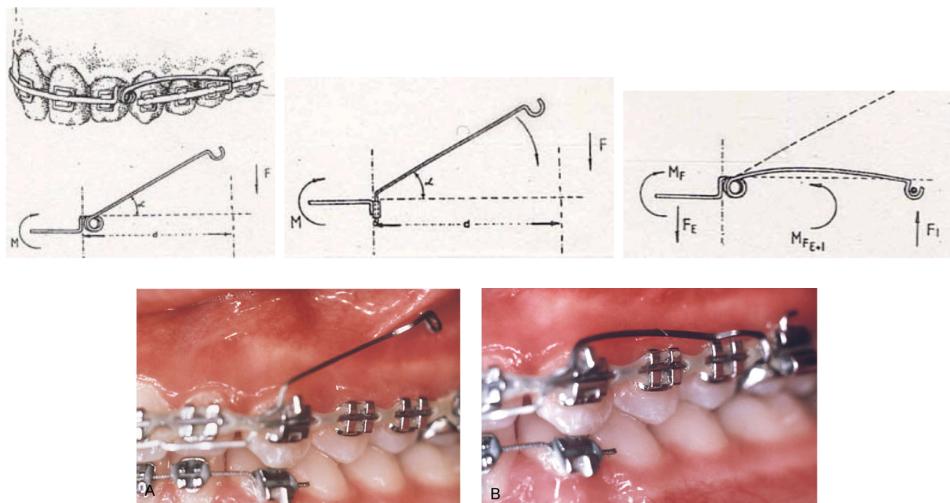


	<p>- 18 slot appliance:</p> <ul style="list-style-type: none"> • Finishing archwires: 17x22 ss or 17x25 ss. • The wires generate the necessary root paralleling moments + the wires are flexible enough to engage into narrow brackets. • If greater tipping is present, more flexible full-dimension rectangular archwires are needed: 17x25 TMA or 17x25 M-NiTi. <p>- 22 slot appliance:</p> <ul style="list-style-type: none"> • Usually less need for root paralleling than with the 18 slot. • Finishing arch: 21x25 TMA. Ss is too stiff. • If sign. root positioning is needed: 21x25 M-NiTi before TMA. <p>- Appropriate stiffness and relatively small deflection wire characteristics are more important in the finishing stage than the range.</p> <p>- If a severe tipped tooth is present and a longer range of action is needed: → Rectangular A-NiTi is indicated initially or an auxiliary Burston root uprighting spring if the brackets have a vertical slot (similar to an R-loop welded on the base arch which bypasses the tooth with need for correction)</p> <p>- Prevent crown separation during root paralleling:</p> <ul style="list-style-type: none"> • Tie all the teeth together or • Tie the entire archwire back against the molars. • Maxillary spaces are likely to open between the incisors in non-ex & ex cases if a full-dimension rectangular wire is placed. 
<p>Torque:</p> <p>- Lingual root torque of incisors</p>	<p>- Crowns are pushed labially with a torqueing force to move the roots lingually → Anchorage is needed to maintain the OJ when the upper incisors are torqued lingually → Class II elastics.</p> <p>- Piggyback arch:</p> <ul style="list-style-type: none"> • = Auxiliary arch to provide torque by creating a couple with a moment arm of 4-5 mm. • Bent into a tight circle initially: → Exerts a force against the roots of the teeth when it is partially straightened out to normal arch form and hooked behind the first premolars. The vertical parts point towards the occlusion and lie in the interdental space. The horizontal parts contact the labial surface of the incisors near the gingival margins  <p>- 18 slot appliance:</p> <ul style="list-style-type: none"> • 17x25 ss • Assumed that the rectangular archwires for finishing fits tightly into the bracket slot. <p>- 22 slot appliance:</p> <ul style="list-style-type: none"> • Full dimension M-NiTi or beta-Ti archwires for torquing incisors. The best finishing wire is usually 21x25 beta-Ti. Alternative: The stiffest braided ss 21x25 wire (braided ss wires are available in various stiffnesses). • Solid 21x25 ss is too stiff and results in high forces and a short range of action. • Some prescriptions have extra built in torque to compensate for rectangular finishing archwires that have more clearance. • Full torque expression is never achieved with undersized wires without extreme bracket prescriptions or placing major twist bends in the wires. (even then it is difficult to obtain adequate torque)

- Torquing arch:
- Indicated if all four incisors need torque.
 - Wire from the molar auxiliary tube to the incisors with a V-bend, so that the incisor segment receives a greater moment.
 - **Isacsoon 1993: 16x22 ss with 1.5 helices or TMA.**
(similar to an intrusion base arch, but with the V-bend more anterior closer to the incisor segment)



- Burston torquing arch:
- Long lever arm:
 - **Full-dimension ss (21x25)** that fits only into the brackets 1+1 or 21+12.
(Note: Bantleon, 1988: 17x25 TMA or ss, 18 slot)
 - Passive form: Posterior arm is up in the buccal vestibule.
 - Activated form: Hooked beneath the base arch archwire mesial to the first molars.
 - **Full dimensional rectangular stabilizing segments from the canines to the 1st molars.**
 - **Auxiliary wire 17x25 TMA from the molar:** -
Huckepack on premolars and canine brackets - step down to rest against the labial surface incisal to the brackets of the teeth which are going to be torqued. Must be tied back.
→ Prevents elongation and proclination of the incisors.



- Factors determining the amount of torque, which will be expressed by any rectangular archwire in a rectangular slot:
- Torsional stiffness of the wire.
 - Inclination of the bracket slot in relation to the archwire.
 - Tightness of the fit between the archwire and the brackets.

Semetz, 1993

TABLE 17.1 Effective Torque

From Semetz. *Kieferorthop Mitteil.* 1993;7:13–26.

Wire Size	Play (Degrees)	BRACKET TORQUE ANGLE (DEGREES)		
		10	22	30
		EFFECTIVE TORQUE		
18-Slot Bracket				
16 × 16	10.9	0.0	11.1	19.1
16 × 22	9.3	0.7	12.7	20.7
17 × 25	4.1	5.9	17.9	25.9
18 × 18	1.5	8.5	20.5	28.5
18 × 25	1.0	9.0	21.0	29.0
22-Slot Bracket				
16 × 22	21.9	0	0.1	8.1
17 × 25	15.5	0	6.5	13.5
19 × 25	9.6	0.4	12.4	20.4
21 × 25	4.1	5.9	17.9	25.9
21.5 × 28	1.8	8.2	20.2	28.2

Based on nominal wire and/or slot sizes; actual play is likely to be greater.

Torque: - Buccal root torque of premolars and molars	<ul style="list-style-type: none"> - Change bracket prescription to decrease or eliminate negative torque for mx canines and premolars. - <i>Zachrisson, 2002:</i> Reduced lingual crown torque gives the appearance a broader smile without the risk of relapse accompanying arch expansion. - Uprighting premolars elongates their lingual cusps: → Can lead to occlusal interferences, which are difficult for the patient to tolerate. → Reduction of the height of lingual cusps indicated.
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Correction of the vertical incisor relationship	
Excessive OB	<ul style="list-style-type: none"> - Evaluation of: <ul style="list-style-type: none"> • Vertical relationship between the mx lip and the mx incisors. • Anterior face height. → Defines if the anterior or posterior teeth should be corrected by extrusion or intrusion. - <u>Intrusion of mx incisors:</u> <ul style="list-style-type: none"> • If a rectangular finishing arch is in place, cut it distal 2+2 and install an auxiliary intrusion arch. • A stabilizing TPA is maybe needed to control the transverse relationship and prevent excessive distal tipping of the molars. - <u>Elongation of posterior teeth:</u> <ul style="list-style-type: none"> • Step bends in a flexible archwire are satisfactory.
Anterior open bite	<ul style="list-style-type: none"> - Evaluation of: <ul style="list-style-type: none"> • Vertical relationship between the mx lip and mx incisors. • Anterior face height. → Defines if the anterior or posterior teeth should be corrected by extrusion or intrusion. - Skeletal anchorage = Most effective approach for intrusion of posterior teeth. - If an open bite is due to an excessively leveled lower arch: <ul style="list-style-type: none"> • Elongate the lower, but not the upper incisors by installing a slight curve of Spee. • Put steps in an appropriately flexible lower archwire, while maintaining a stiffer upper wire supplemented with light vertical elastics. - Cl.II/III elastics have a bite opening effect which can be reduced by triangulation of the elastics. <div style="text-align: center; margin-top: 10px;">  </div> <ul style="list-style-type: none"> - Elongation of lower incisors to close a moderate anterior open bite: = Quite stable. - Elongation of upper incisors: = Less stable, compromises facial esthetics if it makes them too prominent.

Final “settling” of teeth	
<ul style="list-style-type: none"> - For a full-dimensional rectangular archwire it is not uncommon to hold some teeth slightly out of the occlusion. 	
Methods for settling	<ul style="list-style-type: none"> - <u>Light archwires:</u> Replace the rectangular archwires at the end of tx with light round archwires that provide some freedom for movement of the teeth. (16 mil in the 18-slot appliance, 16-18 mil in the 22-slot appliance) <ul style="list-style-type: none"> • The light final arches must include any 1st & 2nd order bends used in the rectangular finishing arches. • Combination with light vertical elastics to bring the teeth together is possible (usually not necessary) i.e. vertical triangles. • Let the wires only a few weeks in place. • Cave: Precise control of the anterior teeth is lost. - <u>Vertical elastics:</u> Remove the posterior segments of the archwires and use laced posterior vertical elastics for 1-2 weeks. <ul style="list-style-type: none"> • Cave: control of the posterior teeth is lost: → Contraindicated in patients with major rotations or posterior crossbites. - <u>Positioner:</u> Tooth positioner after debonding.
Control of rebound and posturing	<ul style="list-style-type: none"> - Rebound = Due only to tooth movement, 1-2 mm phenomenon. - Posturing = 4-5 mm relapse possible. - Teeth tend to go back towards their initial position after class II/III correction, especially if elastics have been used. → Slightly overcorrect the occlusal relationship. - Guidelines for finishing tx with interarch elastics: <ul style="list-style-type: none"> • Decrease the force while light elastics are continued full time for another appointment when an appropriate degree of overcorrection has been achieved. • At that point, discontinue interarch elastics 4-8 w before the appliances are removed. • If the occlusion is stable, the teeth should be brought into a solid occlusion relationship without heavy archwires present.
Removal of bands and bonded attachments	<ul style="list-style-type: none"> - <u>Bands:</u> <ul style="list-style-type: none"> • Break the cement, remove any rest by scaling. • Upper jaw: 1st lingual , then buccal. • Lower jaw: 1st buccal, then lingual. - <u>Metal brackets:</u> <ul style="list-style-type: none"> • Fracture between the bracket & resin (= usual failure site) or within the resin bonding material. • Bend the base of the bracket to prevent enamel damage. - <u>Ceramic brackets:</u> <ul style="list-style-type: none"> • Little ability to deform: → Shearing stress applied to the bracket to remove it can create alarmingly high forces. • Modify the interface between the bracket & bonding resin to increase the chance that the failure occurs at this level. • Use heat to soften the bonding resin: → Brackets can be removed with lower force. • Modify the bracket so that it breaks predictably when the debonding force is applied. • Enamel damage at debonding is more likely with ceramic than metal brackets. - 4% of patients have major enamel damage from bracket debonding. - Remove the rest of the resin with a 12-fluted carbide at moderate speed. - Apply topical fluoride after debonding, because the fluoride rich outer enamel layers are probably lost, even with a careful approach. - Remove the rest of ceramic brackets with a diamond bur.

TABLE 17.2 Enamel Presence on Debonded Brackets

Summarized from Cochrane NJ, Lo TW, Adams GG, Schneider PM. *Am J Orthod Dentofac Orthop.* 2017;152:312–319.

	METAL BRACKETS	CERAMIC BRACKETS		
		Two-Step Etch-and-Bond n = 150	Two-Step Etch-and-Bond n = 144	Self-Etching Primer n = 126
% Presence of enamel	13.3	30.2	38.2	19.7
% Bracket fracture	0	26.2	6.2	12.1
<i>RMGIC</i> , Resin-modified glass ionomer cement.				

Positioners for finishing

- Indications:
 - Gingival condition with more than the usual degree of inflammation and swelling at the end of active orthodontic tx.
→ Gingival massage supports the healing process.
 - Open bite tendency so that settling by mild depression rather than elongation of posterior teeth is needed.
- Most effective if placed immediately after removal of the fixed appliance.
- Tooth movement tends to decline rapidly a few days after debonding:
→ Apply the positioner directly after debonding, wear it full time the first 2 days and afterward at least 4h during the day + during sleep.
- Positioner produces any changes it is capable of within 2-3 w.
→ After that, it serves more as a retainer than a finishing device (bad retainer function!).
- Fabrication:
 - Remove the archwires 4-6 w before the planned removal of the appliance.
 - Use a facebow transfer to mount the casts.
 - All erupted teeth should be included to prevent supereruption.
 - Bands & brackets are trimmed away, any band space is closed.
 - Tth are individually positioned with high precision in the lab.
 - Positioners are formed of an elastic material with the characteristic to move the teeth slightly to their final positions as the patient bites into it.
- Advantages:
 - Fixed appliance can be removed somewhat more quickly.
 - It massages the gingiva apart from repositioning the teeth.
→ Gingival stimulation is an excellent way to promote rapid return to normal gingival contours.
- Disadvantages:
 - Expensive.
 - Tends to increase OB more compared to settling with vertical elastics.
 - Does not maintain the position of rotated teeth well.
 - Good cooperation is essential.

Special finishing procedures to avoid relapse	
Control of unfavorable growth	<ul style="list-style-type: none"> - Requires a continuation of active tx after the fixed appliance has been removed: <ul style="list-style-type: none"> • Continued EO force in conjunction with orthodontic retainers. • Use a functional appliance rather than a conventional retainer after the completion of fixed appliance tx.
Control of rebound after tooth movement	<ul style="list-style-type: none"> - A major reason for retention is holding the teeth until soft tissue remodeling can take place. - Even with the best remodeling, some rebound from the application of orthodontic forces occurs. 2 strategies to deal with it: <ul style="list-style-type: none"> - 1. Overtreatment: <ul style="list-style-type: none"> • Only a small degree of overtx is compatible with precise finishing. • Class II/III: <ul style="list-style-type: none"> ◦ Overcorrect 1-2 mm. ◦ Elastic wear can be reinstated to obtain a complete correction if there is excessive rebound. • Crossbite correction: Overcorrect minimum 1-2 mm. • Crowded and irregular teeth: <ul style="list-style-type: none"> ◦ Often not stable. ◦ Overcorrect it in the 1st stage of tx and stabilize it for some months. ◦ No overcorrection in the rectangular finishing archwires. • Rotation corrections: <ul style="list-style-type: none"> ◦ Perform overcorrection and maintain it as long as possible by adjusting the wings of single bracket or by maintaining a rotation wedge in place with twin brackets. Position of rotation wedge = incisal & cervical wings of the side of the tooth which should be lingual rotated. Elastic tie only on the other wings without the rotational wedge. ◦ Later periodontal procedures are often necessary to improve stability. - 2. Adjunctive periodontal surgery: <ul style="list-style-type: none"> • The network of elastic supracrestal gingival fibers is a major cause for rebound: → Relapse is greatly reduced by sectioning these fibers and allow healing while the teeth are held in proper position. • Circumferential supracrestal fibrotomy CSF: (<i>Edwards, 1988</i>) <ol style="list-style-type: none"> 1. Local anesthetic. 2. Insert the sharp point of a fine blade into the gingival sulcus down to the crest of alveolar bone. 3. Cuts are made interproximal on each side of a rotated tooth and along the labial and lingual gingival margins unless they are quite thin. 4. No periodontal pack necessary, only minor discomfort after the procedure. <p>Alternative: Use a lase instead of a blade.</p> • Papilla dividing procedure (alternative approach): <ol style="list-style-type: none"> 1. Incision in the center of each gingival papilla, sparing the margin but separating the papilla from just below the margin to 1-2 mm below the height of the bone buccal & lingual. <p>→ This approach should reduce the possibility of vertical attachment loss after surgery (no evidence).</p>



Micro-esthetic procedures in finishing	
Recontouring the gingiva to improve tooth proportions and display	<ul style="list-style-type: none"> - Height-width ratios of the teeth are greatly affected by the extent to which the gingiva covers the upper part of the crown. - Soft tissues considerations should be dealt first with, before reshaping the teeth. - Provide enough time for healing. - Soft tissue recontouring allows ideal vertical placement of brackets. - Remove any excess of soft tissue with laser after checking the probing depth.
Reshape the teeth for enhanced esthetics	<ul style="list-style-type: none"> - Enameloplasty should be deferred until initial alignment has been achieved and rotations corrected = end of the finishing stage of tx. (Rotations influence the perception of the width.) - Important elements: <ul style="list-style-type: none"> • Ideal ratios of tooth dimensions • Tooth shape and contours • Ideal width-length relation 1+1: 0.8 (average length 1+1 = 11.7 mm) - Connector length between 1+1: Ideal 50% of their length. - Temporary restorations so that all teeth have approximately the correct size makes finishing easier.

Proffit Chapter 18:

Retention

Why is retention necessary?
<ul style="list-style-type: none">- Orthodontic tx results are potentially unstable.- Factors influencing long-term results: (<i>Ormiston, 2005 / Joondeph, 2017</i>)<ul style="list-style-type: none">o Gendero Post-tx growtho Type of malocclusiono Magnitude of the pre-tx irregularityo Quality of the orthodontic tx- Reasons why retention is necessary:<ul style="list-style-type: none">• The gingiva and periodontal tissues are affected by orthodontic tooth movement and require time for reorganization when the appliances are removed.• The teeth will be in an inherently unstable position after the tx. → Soft tissue pressure constantly produces a relapse tendency.• Changes produced by growth may alter the orthodontic tx results.- Gradual removal of the orthodontic appliance is of no value → relapse or permanent retention is necessary.- Retention cannot be stopped before growth is completed.
Reorganization of periodontal and gingival tissues
<ul style="list-style-type: none">- The periodontal ligament space widens and collagen fiber bundles are disrupted during orthodontic tx.- Restoration of the normal periodontal architecture does not occur as long as a tooth is strongly splinted to its neighbors (i.e. a rigid archwire).- Bone bending as each tooth is displaced slightly relative to its neighbors when the patient chews, is necessary for recovery from the splinting effect of a fixed appliance.- If the teeth can respond individually to the forces of mastication, reorganization of the periodontal ligament occurs over 3-4 m.- Small but prolonged imbalances in tongue-lip-cheek pressure or pressure from the gingival fibers are resisted by active stabilization due to PDL metabolism (same force-generating mechanism that produces eruption). → The disruption of the PDL produced by orthodontic tooth movement eliminates this active stabilization. (but has probably little effect on stabilization against occlusal forces). → Directly after orthodontic tx, teeth are maybe unstable against occlusal and soft tissue pressure, which can be resisted later.
<p>The major causes of relapse after orthodontic treatment are elastic recoil of gingival fibers, which can cause intra-arch irregularity; cheek/lip/tongue pressures, which can affect both tooth alignment and occlusal relationships; and differential jaw growth, which can change occlusal relationships. Gingival fibers and soft tissue pressures are especially potent in the first few months after treatment ends, before PDL reorganization has been completed. Unfavorable growth is the major contributor to long-term changes in occlusal relationships.</p> <ul style="list-style-type: none">- Reorganization of the collagenous and the elastic fibers occurs more slowly than of the PDL itself:<ul style="list-style-type: none">• Collagenous fiber network completes its reorganization within 4-6 m. (<i>Reitan, 1959</i>)• Elastic supracrestal fibers remodel slowly and can still exert forces capable to displace a tooth 1 y after removal of the orthodontic appliance. (<i>Reitan, 1959</i>)- Severe rotations: Section of the supracrestal fibers around teeth initially or before the appliance removal is recommended. (high relapse tendency due to the elastic fibers)

Principles of retention against intraarch instability

- The teeth will tend to move back in the original directions because of elastic recoil of gingival fibers and unbalanced tongue-lip forces.
- Full time retention is required in the first 3-4 m after removal of the orthodontic appliances.
 - Patients will wear retainers about 12 h if instructed to wear them full time, but this is enough.
 - Ask for more, to be sure you get what you want.
- To promote reorganization of the PDL, the teeth should be free to flex individually during mastication, as the alveolar bone bends in response to heavy occlusal loads during mastication.
- Retention should be continued for at least 12 m if the teeth were quite irregular before tx, due to the slow response of gingival fibers. The time of wearing the retention appliance can be reduced after 3-4 m.
- After 12 m, it should be possible to discontinue retention in non-growing patients. Gradual discontinuation helps to test the stability.
- In the absence of growth, the teeth should be stable by 1-2 y after tx, if they will ever be.
- Some patients who are not growing require permanent retention to maintain teeth in an unstable position with higher soft tissue pressure than the force provided by active stabilization.
- Growing patients usually need retention until growth has reduced to the low levels of adult life.

Occlusal changes related to growth	
<ul style="list-style-type: none"> - Skeletal problems in all 3 planes tend to recur if growth continues (the original growth pattern continues). - Behrents, 1984: Very slow growth continues throughout adult life (vertical > anterior-posterior > transversal). 	
Retention after class II corrections	<ul style="list-style-type: none"> - Relapse = Combination of tooth movement and differential growth. - Overcorrect the occlusal relationship 1-2 mm anterior-posterior. → Changes caused by adjustments in tooth position are likely to occur after tx, esp. if class II elastics were used. - Don't move lower incisors > 2 mm forward. → Lip pressures will upright them if no permanent retention is applied → crowding. - The more severe the initial cl.II occlusion and the younger the patient at the end of active tx, the more likely the need for a retention appliance. - <u>Appliances:</u> <ul style="list-style-type: none"> • HG on 6+6 2/4 + retainer to hold the alignment. • Functional appliance of an activator-bionator type to hold tooth positions and the occlusal relationship. <ul style="list-style-type: none"> ◦ Construction bite without any mn advancement if there is no excessive OJ. ◦ In a deep bite patient, the acrylic over the lower posterior teeth can be trimmed away, so that these teeth can erupt slightly while the other teeth are tightly controlled.
Retention after class III corrections	<ul style="list-style-type: none"> - Continuing growth of the mandible is very likely to occur and difficult to control. - Surgical correction often is the only solution, if growth has expressed itself for patients with normal or excessive lower face height. - Mild cases: <ul style="list-style-type: none"> ◦ Chin cup tends to rotate the mandible downward. → Growth is expressed more vertically and less horizontally. ◦ Positioner to maintain the dental relationship.
Retention after deep bite corrections	<ul style="list-style-type: none"> - Control of the vertical overlap of incisors is required for most patients. - Cave: Vertical growth continues until late teens → long retention period needed. - <u>Appliances:</u> <ul style="list-style-type: none"> • Removable upper retainer: The lower incisors encounter the baseplate if they begin to slip vertically behind the upper incisors. The retainer does not separate the posterior teeth.
Retention after anterior open bite corrections	<ul style="list-style-type: none"> - Anterior open bite can occur by depression of the incisors or elongation of the molars - Stop active habits: Thumb sucking... - Tongue-thrust swallowing: No evidence to be a reason for relapse of open bites. - Elongation of upper molars = Mostly the reason for the relapse of an open bite if no habits are present. → The molar eruption must be controlled! - Cave: Vertical growth continues until the late teens → long retention needed. - <u>Appliances:</u> <ul style="list-style-type: none"> • Bite blocks (modified Hawley retainer) between the posterior teeth to create some mm jaw separation → soft tissue is stretched = force opposing eruption. • High pull HG • Vacuum formed retainer with thickened plastic over the posterior surfaces? (no good data exists)
Retention of lower incisor alignment	<ul style="list-style-type: none"> - Forward-downward growth of the mandible / posterior rotation of the mandible: → Lower incisors are carried into the lip. → Distal tipping force generated (esp. cl.III, open bite). - Retainer for retention until growth of the mandible decreases to adult levels. - Pressure from 3th molars as a reason for incisor crowding is incorrect. - Evidence is contradictory if the post-tx crowding can be predicted from characteristics of the original malocclusion or variables associated with tx. → To be sure, place fixed retainers in every patient.
Timing of retention: Summary	<ul style="list-style-type: none"> - Retention is needed for ALL patients. - First 3-4 m: Removable retainers 4/4 except for eating or fixed retainers that are flexible enough to allow displacement of individual teeth during mastication. (unless periodontal bone loss or other special circumstances require permanent splinting) - Continuation of the retainer on a part-time basis for 12 m to allow time for remodeling of gingival tissues. - Continue part time wear of retainers, if significant growth remains. - In case of skeletal problems pre-tx: Functional appliance or EO-force part time needed.

Removable retainers	
<ul style="list-style-type: none"> - Serve for intra-arch or inter-arch stability and are useful in patients with growth problems. - If permanent retention is needed → Prefer fixed retention. 	
Hawley retainers	<ul style="list-style-type: none"> - Adam clasp on the first molars. - Outer bow with adjustment loops usually from canine to canine. - Covers the palate → potential bite plan to control an increased pre-tx OB. - Difficult to keep extraction spaces closed with the standard model. <p>- <u>For extraction cases:</u></p> <ul style="list-style-type: none"> • Bow soldered to the buccal section of the Adams clasps. (A) → Activation of the bow helps to hold the extraction sites closed. • Wrap around outer bow soldered to C-Clasp on the 2nd molars: (C) → No interference as the wire crosses the occlusion. → Cave: Bow quite flexible due to the long span. <p>- <u>Control of buccally positioned canines:</u> (B) A wire to an anterior bow (that crosses distal the lateral incisors) and which extends across the canines.</p> <ul style="list-style-type: none"> - A clear outer bow (D) fits more tightly than a metal wire and is better esthetically. → Cave: No adjustments are possible. - Slightly trimming the acrylic lingual to the posterior teeth so that an eruption path exist is an important clinical adjustment. - Wires from clasps crossing the occlusal table can disrupt the tooth relationship: → If the occlusion is tight, chose a circumferential clasp on the terminal molar.
Wraparound (clip) retainers	<ul style="list-style-type: none"> - Plastic bar (usually wire reinforced) along the labial and lingual surfaces of the teeth. - Indication: Prevent spaces from reopening. <p>- Advantages:</p> <ul style="list-style-type: none"> • Esthetic. • Spaces are impeded from reopening. • Prevents re-rotations. • Can be used to realign irregular incisors in a mild crowding situation. • For a mn retainer, the Hawley bow is less effective than a wire reinforced acrylic bar that tightly contacts the lower incisors. <p>- Disadvantages:</p> <ul style="list-style-type: none"> • Not very comfortable. • No individual tooth movements for reconstruction of the PDL are possible if a full-arch retainer is applied. → Fullarch retainer is indicated only for splinting if a periodontal breakdown is present) • Undercuts lingual to the lower molars make it difficult for posterior extensions. • If applied in the upper arch, contact of the lower incisors can become a problem. • May not effective in maintaining OB correction.

	<p>- Moore retainer:</p> <ul style="list-style-type: none"> o = Canine-to-canine wraparound retainer extended distally on the lingual side only to the central grooves of the first molar o Indicated in lower extraction cases.
Clear (vacuum-formed) retainers	<ul style="list-style-type: none"> - Invisible. - <i>Tynelius, 2010 & 2015:</i> No difference regarding the effectiveness to maintain the alignment between vacuum-formed retainers and bonded wire retainers, but excellent compliance is needed. - Disadvantages: <ul style="list-style-type: none"> • Thickness of the material over the occlusal surface on the teeth can become a problem <ul style="list-style-type: none"> o Separation of the posterior teeth may develop. o <i>Mai, 2014:</i> <ul style="list-style-type: none"> ▪ Posterior occlusion is better at 6 m after debonding with a Hawley retainer than a vacuum-formed retainer for just the mx arch. No difference however at a long-term recall. ▪ Better occlusion with mx vacuum-formed retainer and mn fixed retainer than with a mx and mn vacuum-formed retainer. o → Small holes can be made in the occlusal surface of the retainer at the points of occlusal contacts. • Does not help to control a deep bite. • Tend to crack and discolor after a few months (~9 m). • Use of the final aligner in an Invisalign sequence as a retainer is not as effective as use of another vacuum formed retainer, because a thinner and less durable material is used.
Positioners as retainers	<ul style="list-style-type: none"> - Indication: <ul style="list-style-type: none"> o Open bite patients. o Cl.III patients → Mn is rotated somewhat downward and backward. o If used as a finishing device before. - Not advised as routine retainer: <ul style="list-style-type: none"> • Bulky → difficult to wear full time. • Retention of incisor irregularities and rotations is not as well as with standard retainers. • OB tends to increase. - Maintains the occlusal relationship and intra-arch tooth positions. - Less effective in controlling growth than a functional appliance or a HG worn 2/4. - Articular mounting in difficult cases is necessary when posterior teeth are separated 2-4 mm.

Fixed retainers	
Indications	<ul style="list-style-type: none"> - Normally used when inter-arch instability is anticipated and prolonged retention is planned. - Enough movement of the mn incisors to promote maturation of the supporting bone is important. - <u>1. Maintenance of lower incisor position during late growth:</u> <ul style="list-style-type: none"> • Canine to canine bonded: 28 or 30 ss <ul style="list-style-type: none"> ◦ Rests against the lingual surfaces of the incisors above the cingulum to prevent them from lingual moving. ◦ The wire must be heavy enough to resist distortions. ◦ Place a loop at the end of the wire to improve retention. ◦ <i>Booth, 2008:</i> No periodontal problems in 20 y observation time. 61% survival. • Bonded on all teeth: 17.5 braided steel <ul style="list-style-type: none"> ◦ Indicated if severe rotations were present. ◦ If the span of the wire is reduced, a more flexible wire should be used. ◦ Controls are necessary: Bond failure is unlikely to be noticed by the patient + risk for decalcifications. ◦ <i>Al-Nimri, 2009:</i> Plaque build-up ↑ for a mn multistranded wire vs. a heavier round wire bonded to canines only, but effectiveness to maintain alignment ↑ - <u>2. Diastema maintenance:</u> <ul style="list-style-type: none"> • Tendency for space opening between 1+1 even with frenectomy. • Wire can be configured to avoid tooth contact or facilitate flossing and can incorporate stops to prevent deepening of the bite. - <u>3. Maintenance of a pontic or implant space:</u> <ul style="list-style-type: none"> • Implants should be placed as soon as possible after the orthodontic tx is completed. → The integration of the implant occurs simultaneously with the initial stages of retention. • Heavy wire bonded to the adjacent teeth: <ul style="list-style-type: none"> ◦ The longer the span, the heavier the wire should be. ◦ Bringing the wire down out of occlusion, decreases the chance that it will be displaced by occlusal forces. • Replacement teeth in the anterior part can be attached to a removable retainer. Prefer a bonded bridge if retention is required for a longer period. - <u>4. Keeping extractions spaces closed in adults:</u> <ul style="list-style-type: none"> • Fixed retainer on the facial surface of posterior teeth indicated, esp. if skeletal anchorage has been used.

Inadvertent tooth movement with fixed lingual retainers	<ul style="list-style-type: none"> - Loss of lower incisor alignment is more likely when wires break: → Breakage increases the likelihood that the wire is distorted at the same time and leads to activation of the wire. - Downward deflection of the wire could occur if bond failures of the incisors occur, but the canines remain bonded. - Displacement of the crowns is as likely as inadvertent torque forces. - Inadvertent torque forces may cause fenestration of the labial or lingual cortical alveolar bone. - Dead soft wire was suggested to be safer than flexible twist wire, but no evidence is available to support this.
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Active retainers	
Realignment of irregular incisors	<ul style="list-style-type: none"> - Indication = Realignment of irregular incisors. - The shapes of the incisors' crowns can contribute to a re-crowding (<i>Shah, 2003</i>), but in most cases mn growth that tips the incisors lingually causes the problem. - <u>Stripping:</u> <ul style="list-style-type: none"> • Often necessary before realignment of the incisors so that the crowns do not tip labially into an unstable position. • Reduces the amount of space required for alignment. • Flattens the contact areas → more stability in the corresponding region. (<i>Note: not believed at the ZMK</i>) • <i>Zachrisson, 2007:</i> Long-term periodontal health is not affected by the increase of root proximity. • <i>Zachrisson, 2011:</i> IPR has no adverse effect on the long-term stability of the teeth. • Lower incisors can be reduced up to 0.5 mm on each side. <i>Gillings et al. 1961:</i> <ul style="list-style-type: none"> • Mean thickness of mesial-incisal area: 0.62 mm (0.42 0.82 mm) • Mean thickness of distal-incisal area: 0.64 mm (0.44 0.84 mm) - <u>Appliances:</u> <ul style="list-style-type: none"> ○ A short series of aligners ○ Canine to canine clip: only for small/modest crowding situations <ol style="list-style-type: none"> 1. IPR 2. Realign the teeth in laboratory → clip on appliance ○ A fixed appliance is necessary if more crowding is present. 
Correction of occlusal discrepancies: Modified functional appliances	<ul style="list-style-type: none"> - Permanent retention is necessary after correction. - Indication = Management of Cl.II or cl.III relapse tendencies. - Can be used in teenagers but are of no value in adults. - Not > 3 mm of occlusal correction is possible. - Differential antero-posterior growth is not necessary to correct small occlusal discrepancies → Tooth movement is adequate. Some vertical growth however is required to prevent downward and backward rotation of the mandible. - Cl.II: Correction is achieved by restraining the eruption of the posterior maxillary teeth and directing the erupting mandibular teeth anteriorly. - Functional appliance used as a passive retainer: <ul style="list-style-type: none"> ○ Objective: Control growth. ○ Tooth movement is largely an undesirable side effect. - Functional appliance used as an active retainer: <ul style="list-style-type: none"> ○ Expected primarily to move teeth. ○ No significant skeletal changes are anticipated.

Discussion with Dr. Gkantidis 09.05.2017

- *Little, 1995:*
Observational study from 21-35 y:
80% of patients have incisor crowding after orthodontic treatment without retention.
- First 6 m after orthodontic tx = most crucial time for retention.
- 1-2 y after tx it is no longer retention, but prevention of normal tooth movement.
- Lower incisors: High risk for relapse.
- Upper incisors: Low risk for relapse but positioned in the high important esthetic region.
- Use essix retainers in both jaws for retention of an anterior open bite.
→ Same bite closing effect like a positioner.

Proffit Chapter 19:

Special Consideration in Treatment for Adults

Adjunctive versus comprehensive treatment	
Differences in treating adult patients	<ul style="list-style-type: none"> - USA: 30% of orthodontic patients = adults. - Other types of dental tx, apart from orthodontics, are nearly always required compared to children. - Prevalence of orthodontic problems increase with age. - Used dentition. - Absence of growth: <ul style="list-style-type: none"> → No uncertainties about growth direction, but no growth modification is possible. → The whole tx must be done with tooth movement, restorative dentistry or orthognathic surgery.
Rules to consider	<ul style="list-style-type: none"> - Involve all the dentists who will play a role in the tx planning. - Diagnostic setup → = Diagnostic and communication tool for the patient. - Ideal dental occlusion and facial appearance are not necessary an appropriate tx goal: <ul style="list-style-type: none"> → Costs & risks / benefits to the patient. → Differentiate between a realistic tx focused on the patient's problem and an ideal tx aimed at perfection. - Adults younger than 35 y: Goal = Improve the quality of life. - Adults in their 40s/50s: Goal = Maintain what they have. Orthodontics is often an adjunctive procedure to larger periodontal or restorative goals. - More clinical time necessary for explanations. - Adults experience more pain / are less tolerant. <ul style="list-style-type: none"> → Medication for pain control is important. - Disease control is more often necessary.
Adjunctive treatment	<ul style="list-style-type: none"> - = Tooth movement carried out to facilitate other dental procedures, like to control disease / restore function and/or enhance appearance. - Involves usually only a part of the dentition. - Lasts usually a few months. - Long-term retention is usually supplied by the restorations. - Should be carried out within the context of a general dental practice. - Patients are typically in their 40s/50s.
Comprehensive treatment	<ul style="list-style-type: none"> = Same like for adolescents. Aim = produce the best combination of dental and facial appearance, dental occlusion and stability result to maximize the patient's benefit. - Duration > 1 y. - Often demand for esthetically enhanced appliances. - Should be provided by an orthodontic specialist. - Patients are often <35 y / 20s.

Principles of adjunctive treatment	
Goals of adjunctive tx	<ul style="list-style-type: none"> - Improve periodontal health by eliminating plaque-harboring areas and improving the alveolar ridge contour adjacent to the teeth. - Establish favorable crown-to-root-ratios and the position of the teeth so that occlusal forces are transmitted along the long axes of the teeth. - Facilitate restorative tx by positioning the teeth so that more ideal and conservative techniques can be used & optimal esthetics obtained. <p><u>Procedures:</u></p> <ul style="list-style-type: none"> - Repositioning of teeth that have drifted after extractions or bone loss, so that more ideal fixed or removable partial dentures can be fabricated or implants placed. - Alignment of anterior teeth for esthetic restorations or splinting while maintaining good interproximal bone contour and embrasure form. - Correction of crossbites if they compromise jaw function. - Forced eruption of badly broken-down teeth to expose sound root structure to place crowns or to level bone margins and regenerate alveolar bone.
Not part of adjunctive tx	<ul style="list-style-type: none"> - TMJ problems. - Intrusion of teeth because of technical difficulties and the possibility of periodontal complications. - Adults with periodontal involvement / bone loss & extruded incisors: Best treated by reduction of crown height. - Crowding > 3-4 mm should not be solved with IPR of the anterior teeth. → Better to perform IPR also posterior and correct the alignment with a full appliance.
Principles of adjunctive tx	<ul style="list-style-type: none"> - Restorative dentist usually is the principal one. - Diagnostic records needed for tx planning differ from those of children: <ul style="list-style-type: none"> o Individual intraoral radiographs to supplement the panoramic radiograph (required by the ABO except, if only a partial fixed appliance is planned). o Pre-tx lateral cephalometric view is usually not required for adjunctive orthodontics with a partial fixed appliance. o Articulator-mounted casts are often necessary. - Often need for fixed appliances or a sequence of aligners. (problem management is for most cases not possible with removable appliances). - Skeletal anchorage makes tx often more effective and efficient.
Characteristics of the orthodontic appliance	<ul style="list-style-type: none"> - 22-slot edgewise appliance with twin brackets recommended or clear aligners. - A fixed appliance is needed if root movement is planned for patients with reduced alveolar bone height to achieve the large moments required. - Brackets are placed in an ideal position only on the teeth indented to move. The remaining teeth can be bracketed and incorporated in the anchor system so that the archwire slots are closely aligned. → Anchorage segment of the wire can be engaged passively in the brackets with little bending. - Clear aligners: <ul style="list-style-type: none"> • Better esthetic → compliance ↑ • Control of the root position / correction of rotations & extrusion of teeth is difficult.
Timing and sequences	<ol style="list-style-type: none"> 1. Comprehensive tx plan 2. Disease control 3. Establishment of the occlusion 4. Definitive periodontal / restorative tx 5. Maintenance <ul style="list-style-type: none"> - Restorations requiring detailed occlusal anatomy should not be placed until any adjunctive orthodontic tx has been completed. - Surgical pocket elimination and osseous surgery can be delayed after the end of orthodontic tx because soft tissue and bony recontouring occurs during orthodontic tooth movement. - <i>Thilander, 1996:</i> Orthodontic tooth movement superimposed on bad periodontal health can provoke a rapid & irreversible breakdown of the periodontal support. - <i>Ogihara, 2010:</i> Orthodontic tx with both normal and compromised periodontal tissues can be completed without loss of attachment if there is good periodontal tx both initially and during tooth movement.