Evidence-based Class II treatment

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Virginia - 2014

#### Topics for today

- Levels of Evidence Cochrane Reviews
- Very early treatment (5-8) should we?
- Early treatment (9-12)
- □ Class II Sliding extraction mechanics
- Anchorage TPA's, TAD's
- Class II non-extraction timing of treatment
- □ Class II non-extraction treatment options

# Since ADDDO Pandis 2011;140:4466-7: Since Bis Bis Bis Cohort Case control Case reries Case reries Case reries Bis Interais studies Invitro studies

#### Cochrane - prominent front teeth

- Orthodontic treatment for prominent upper front teeth in children
- Harrison JE, O'Brien KD, Worthington HV
- Authors' conclusions
- The evidence suggests that providing early orthodontic treatment for children with prominent upper front teeth is no more effective than providing one course of orthodontic treatment when the child is in early adolescence.

#### Cochrane - Class II div 2 Tx

- Orthodontic treatment for deep bite and retroclined upper front teeth in children
- Millett DT, Cunningham SJ, O'Brien KD et al.
- Authors' conclusions
- It is not possible to provide any evidence-based guidance to recommend or discourage any type of orthodontic treatment to correct Class II division 2 malocclusion in children.

#### Conclusions about best evidence?

- The overall level and quality of evidence for many of our procedures is low
- Low level evidence does not mean it is 'wrong' however the risk of bias is higher which can over or under-estimate the result or in some cases give the incorrect answer

#### **Evidence-Based Clinical Orthodontics**

- Eds: Peter Miles, Dan & Don Rinchuse
- Tizziano Baccetti
- William Brantley
- Ali Darendeliler, Lam Cheng
- Ted Eliades, Nick Pandis
- Sanjivan Kandasamy
- Eric Liou, James Noble
- Peter Ngan, Tim Tremont
- Jack Sheridan



## Very early treatment (ages 5 - 8)

#### **Eruption Guidance Appliances**

Occlus-o-Guide

■ Nite-Guide

■ T4K – soft

Myobrace



#### **Eruption Guidance Appliance**

- Methenitou S et al. J Pedod 1990; 14:219-30.
- 43 subjects, avg age 6.17 years,
- Nightly wear over 13 mths
- Overbite reduced 2 mm
- Overjet reduced 1.6 mm

#### Trainer appliance (MRC)

- Usumez et al. Angle 2004;74:605-609
- 20 patients vs. 20 controls
- Age 9.6 yrs, Tx over 13.1 mths
- Lower incisors tipped forward 4°, upper incisors tipped back 2.7°, no skeletal effect

#### **Eruption Guidance Appliance**

- Keski-Nisula et al. AJODO 2008;133:254-60.
- 167 subjects of 243 (selection bias)
- 31% were not included
- Age= 5.1yo, 2-3 appliances used in each patient

#### **Eruption Guidance Appliance**

- Avg Active Tx time = 3.3 yrs
- Nett difference in overjet = 2.4mm
- Nett difference in overbite = 2.0mm



#### More on the EGA

- Janson. AJODO 2007;131:717-28.
- 39 subjects with EGA, age ~8.8 y.o., Tx 3.6 yrs
- This was from an initial sample of 60 subjects which was reduced down (~35%) and further reduced down by cases requiring extractions, retreatment or poor compliance

#### Effects of 3.6 yrs of EGA

Overjet improved by	2mm	- with Tx
Overjet relapsed by	-0.5mm	- after Tx
Nett Overjet change		
Overbite improved by	1.9mm	- with Tx
Overbite relapsed by	-1.4mm	- after Tx
Nett Overbite change		
Crowding improved by	2.3mm	- with Tx
Crowding relapsed by	-2.1mm	- after Tx
Nett crowding change		

#### T4K and EGA Results?

~2mm

- Overjet reduced
- Overbite reduced ~2mm
- Crowding reduced ~2mm
- The changes were not stable and relapsed toward baseline
- Treatment ranged from 13-36 months
- For such a long treatment time and a modest result would you use them?

## Early treatment (ages 9 – 11)

#### Cochrane - prominent front teeth

- Orthodontic treatment for prominent upper front teeth in children
- Harrison JE, O'Brien KD, Worthington HV
- Authors' conclusions
- The evidence suggests that providing early orthodontic treatment for children with prominent upper front teeth is no more effective than providing one course of orthodontic treatment when the child is in early adolescence.

#### Timing of Class II treatment

- If UK and UNC studies find no difference between early and late adolescence then why treat early?
- They were designed to evaluate if early treatment was beneficial or advantageous over later treatment for patient's with overjet >7 mm
  - Patient/parent demand (informed)
  - Psychosocial benefit
  - Trauma benefit

#### Psychosocial benefit

Factor	Twin Block	Control	Р
Appearance	9.3	8.0	0.005
Anxiety	10.8	9.3	0.005
Popularity	9.9	8.3	0.005
Happiness	8.9	8.2	0.005
Total	63.6	59.0	0.005

#### Results of UK study - Trauma

- Half the trauma had occurred <u>before</u> orthodontic treatment was started
- Treatment did not have an effect on the incidence of trauma to the incisors (p=0.36)
- 8% early Tx vs. 14% late Tx



#### Results of UNC study - Trauma

- New incisor trauma in Phase 1
  - Headgear 4 in 50 = 8%
  - Functional 3 in 52 = 6%
  - Control 9 in 61 = 15%
- New incisor trauma in Phase 2
  - Headgear 4 in 46 = 9%
  - Functional 5 in 42 = 12%
  - Control 12 in 51 = 24%



#### Results of UNC study - Trauma

- Should we treat very early (~age 7) to reduce incisor trauma?
- The estimated Cost vs. Risk of trauma was calculated and higher in the control group BUT
  - Most injuries were minor
  - The expected extra cost of early treatment in a 2phase strategy is significantly more
- Choice will be affected by a family's values and the relative risk they are willing to bear

#### Univ of Florida study

- After the 1<sup>st</sup> phase the incidence of trauma was 7-8% higher than the early treatment group (p=0.13)
- Consistent finding amongst all 3 trials suggesting it is a real difference (more power)
- Higher incidence in boys

#### Florida study – incisor trauma

- Effect of early Class II treatment on the incidence of incisor trauma.
- Chen et al. AJODO 2011;140:e155-e160.
- 3 groups
  - Headgear/biteplane
  - Bionator
  - Control, age ~9.6 yo
- 80% were enamel only, 19% involved dentine, 1% had pulpal involvement

#### Relative risk of trauma

- If you delay treatment to age 12-13 vs. treat at 9-10, what is the relative increased risk of trauma?
- UK and UNC studies show 7-8% elevated risk
- Florida study shows 19% dentine, 1% pulpal
- Therefore:
  - 80% of 8% =  $\sim$ 6.4% risk of enamel chip
  - 19% of  $8\% = \sim 1.5\%$  risk of dentine involvement
  - 1% of 8% =  $\sim 0.08\%$  risk of pulpal involvement
- Informed choice and risk assessment

#### Expansion stimulates jaw growth



#### Expansion stimulates growth?

- Guest, McNamara et al. AJO 2010;138:582-91
- 50 Class II subjects with RME. Some also had partial braces or a lower Schwarz expander.
- Compared with literature control group
- "The protocol ... can help to improve the Class II malocclusion as a side-effect."
- "The results of this study show that the improvements are far more pervasive than anticipated."

#### Expansion stimulates growth?



#### Expansion stimulates growth?

- Historical control so less valid comparison
- No blinding so risk of bias



#### Systematic review

- Lagravere et al. Angle 2005;75:1046–1052
- No significant alterations in A-P were found in any of the studies reviewed.
- After the posttreatment and postretention, the maxilla and mandible of the treated groups presented no statistical or clinical significance.

#### **Expansion in Class II**

- Angle Orthod. 2011;81:298–303
- Farronato et al.
- In Class II patients ... The ANB decreased, statistically improving the skeletal classification.
- 8.8 yo expansion observed 6mths? unclear?
- Avg 1.81° decrease in ANB
- Occlusal change was <u>Not</u> measured

#### Expansion stimulates growth?

- Volk et al. AJODO 2010;137:310-5
- Small retrospective study of 13 Class II subjects who underwent expansion and then observation
- 7 of the 13 subjects underwent improvement
- **5** of the remaining subjects actually got worse
- The authors concluded their results do not support the 'foot in the shoe' theory and that maxillary expansion does not predictably improve Class II dental relationships.

#### Plates vs. Fixed expanders

- Expansion of maxillary aches with crossbite: Systematic review of RCT's in the last 12 years.
- Zuccati et al. Eur J Orth 2013:35:29-37.
- Plates were unsuccessful in 30% of patients due to poor cooperation.
- Expansion arches were as good as quad-helix

#### Plates vs. Fixed expanders

- Early correction of posterior crossbites a cost minimisation analysis
- Petren et al. Eur J Orth 2013:35:14-21
- Quad-helix was the most cost effective compared with a removable plate mainly due to poor compliance with plates.
- Petren et al. AJODO 2003;133:790.e7-e13

#### **RPE** with anterior arms



#### Early treatment - should we?

- Do the findings of the UNC and UK studies indicate we should not do early treatment?
- Their purpose was to assess whether early Tx in OJ > 7 mm resulted in enhanced mandibular growth and simplified future treatment
- This is not to say that early treatment is not indicated for some individuals – but which ones?

#### UK study 2 phase

- Early Tx for Cl2 Div 1 malocclusion with the Twin-block appliance: .....a multi-center RCT
- O'Brien et al. AJODO 2009;135:573-579
- ~15% of the early Tx group did not proceed with a 2<sup>nd</sup> phase. This could be due to
  - A successful outcome or close-enough and no other Tx needed
  - Burnt out and did not want further Tx
  - But.. Cost is not a factor as provided free of charge

#### Twin-block RCT

- Incremental versus maximum bite advancement during Twin-block therapy: A randomized controlled clinical trial
- Banks, ..., O'Brien. AJODO 2004;126:583-8
- 203 subjects aged 10-14 randomly assigned to full advancement vs. Incremental advancement

#### Twin-block RCT

- 70 81% compliance rate in this study
- UK Twin-block study had 84% compliance
- Harradine. Clin Orthod Res 2000;3:202-9. had 83% compliance rate with TB
- Patients aged ≤ 12.3 years were 3 times more likely to complete treatment
- Operator influenced a) compliance and b) treatment duration

#### Florida study

- Effectiveness of early treatment of Class II malocclusion
- Wheeler et al. AJODO 2002;121:9-17.
- Percentage of treatment goal achieved:
  - Bionator = 83%
  - Headgear = 100%
  - Control = 14%
- Slightly more relapse in the headgear group

#### Measure compliance/progress

Maximum protrusion





## Adolescent treatment (ages 12 – 16)

#### **Class II extraction treatment**



#### Survey of extractions

#### JCO 2008 - USA

	2008	2002	1996	1990	1986
Treated at least one extraction case	94.9%	95.3%	92.1%	87.7%	95.0%
Percentage of active cases (median)	18.0	20.0	22.0	25.0	34.9

- Australian Orthodontic Journal 2013
- **23**%

#### Class II - extraction vs. non

- Class II treatment efficiency in maxillary premolar extraction and nonextraction protocols
- G Janson et al. AJODFO 2007;1<u>32:490-498</u>

#### The 2-maxillary-premolar-extraction protocol has greater treatment efficiency than the nonextraction protocol of complete Class II malocclusion.

#### Hold space in Class 2 treatment

- Orthodontic treatment time in 2- and 4premolar-extraction protocols
- G Janson, et al. AJODFO 2006;129:666-671
- Treatment time will be shorter and the occlusal results more predictable with a 2-premolarextraction protocol compared with 4 premolar extractions.

#### Lower incisor stability?

- Alignment stability in Class II malocclusion treated with 2- and 4-premolar extraction protocols
- G Janson et al. AJODFO 2006;130:189-195
- Treatment of Class II malocclusion with extraction of either 2 maxillary premolars or 4 premolars provides the same mandibular anterior-tooth alignment stability.

#### Serial extraction?

- Efficiency of serial extraction and late premolar extraction cases treated with fixed appliances
- O'Shaughnessy et al. AJODO 2011;139:510-16
- Retrospective chart review identified 51 SE patients and 49 LPE patients treated with fixed appliances. Number of appointments, length of time, and estimated total chair time were determined prior to the placement of fixed appliances and during fixed appliance treatment.

#### Serial extraction?

- SE and LPE resulted in similar final outcomes.
- SE reduced active treatment time
- but significant observation time preceded Tx

	Pre-Active Tx		SE JPE
Months of Treatment	42.5	28.6 13 24.6	
Number of Visits	11.8	22.3 24.0	]
Chair-time (minutes)	220	695 760	_



#### Serial extraction – 20 mths, 2 visits



#### Advantages of serial extraction

- Shorter active treatment time
- Potentially reduced risk of WSL/Decalcification
- Potentially reduced risk of root resorption
- Detentially reduced reliance upon compliance

#### **Closing extraction spaces**



Start





#### Consistency of lacebacks

- Magnitude and reproducibility of forces generated by clinicians during laceback placement.
- Khambay, McHugh, Millett.
- J Orthod. 2006;33:270-275.
- In vitro, there was a large inter-operator variation in the forces produced. The forces by clinicians ranged from 0 to 11.1 N (1.1kg).

#### Upper canine lacebacks

- A randomized clinical trial to compare the effectiveness of canine lacebacks with reference to canine tip.
- Usmani, O'Brien et al. J Orthod 2002;29:281–286
- The effect of canine lacebacks on preventing an increase in upper incisor proclination at the start of treatment is in the order of 1 mm and their effect on mesial molar movement is insignificant.
- Canines lacebacks are similarly effective for patients with mesially inclined, upright or distally angulated upper canines.

#### Lower canine lacebacks

- The effectiveness of laceback ligatures: A randomized controlled clinical trial
- R. Irvine, S. Power, and F. McDonald. J Orthod. 2004; 31: 303 - 311.
- The use of laceback ligatures conveys no difference in the antero-posterior or vertical position of the lower labial segment.
- The use of laceback ligatures creates a statistically and clinically significant increase in the loss of posterior anchorage (0.83mm).

#### Laceback systematic review

- The effectiveness of laceback ligatures during initial orthodontic alignment: a systematic review and meta-analysis
- Fleming, Johal, Pandis.
- According to the GRADE assessment, the overall quality of evidence was high. There is no evidence to support the use of lacebacks for the control of the sagittal position of the incisors during initial orthodontic alignment.

#### Sliding mechanics



#### Canine vs. en masse retraction?

- A Randomized Prospective Trial Comparing Two Retraction Techniques on Anchorage
- Xu T-M, Hu W, Zhang XY, Baumrind S. IADR Brisbane 2006;Abstract #1947.
- 64 maximum anchorage cases were randomly assigned to an en masse group and a two-step group before start of the treatment.
- Standard MBT appliance was used for all the cases. 63 cases completed treatment.
- Computerized cephalometric measurements focused on molar anchorage and incisor retraction in the upper jaw.

#### Canine vs. en masse retraction?

- En masse group:
- Mx 1 retracted 6.2mm, Mx 6 cusp forward 2.8mm
  Two-step group:
  - Mx 1 retracted 5.3mm, Mx 6 cusp forward 3.1mm
- **Treatment times:** 
  - En masse =  $30.2\pm9.4$  months
  - Two-step =  $31.6 \pm 9.4$  months
- Conclusion: Retracting canines prior to incisor retraction does not necessarily save more molar anchorage in the sagittal plane than retraction of 6 anterior teeth together.

#### Canine vs. en masse retraction?

- En masse retraction and two-step retraction of maxillary anterior teeth in adult class I women: A comparison of anchorage loss
- Heo W et al. Angle Orthod. 2007;77:973-8
- 30 Women 2 groups of 15 matched cases
- Approximately 4 mm of the retraction of the upper incisal edges resulted from 1 mm of anchorage loss in the upper molars in both groups.
- Conclusion: No significant differences existed in the degree of anchorage loss.

#### Time for retraction

Group 1 = En masse 1SD (68%) 0.6 - 1.3 yrs
 Group 2 = Two-step 1SD (68%) 0.6 - 2.0 yrs

Gr	oup 1	Group 2			
x	SD	x	SD	Significance	
0.93	0.36	1.31	0.71	NS	
<sup>a</sup> Independent <i>t</i> -test. NS indicates not significant.					
(N = 30)					



#### **En-Masse sliding mechanics**

- P Miles. Self-ligating vs conventional twin brackets during en-masse space closure with sliding mechanics. *AJODO* 2007;132:223-5
- Split mouth study comparing SmartClip with CB using en-masse retraction on a posted 0.016"x0.022" ss wire in 0.018" slot with SS ligatures used on CB
- Results: no difference in the rate of space closure (CB = 1.2mm/mth, SC 1.1mm/mth, p=0.86)

#### **Canine retraction**

- S Burrow. Canine retraction rate with selfligating brackets vs conventional edgewise brackets. *Angle Orthod* 2010;80:626-633.
- Split mouth study on 43 subjects comparing SmartClip & Damon3 with a CB during canine retraction on a 0.018" ss wire in 0.022" slot using 150g springs
- Results: Statistically significant difference in the rate of retraction (SC p<0.0043; D3 p<0.0001)</p>
- CB = 1.2mm, SC = 1.1mm, D3 = 0.9mm/mth



#### Burstone on retraction

- Burstone CJ. The segmented arch approach to space closure. Am J Orthod 1982;82:361–378.
- Separating the retraction of canines from that of the incisors makes little sense because all six teeth can be retracted at once with relatively low forces
- The only patients for whom separate canine retraction is appropriate are those with anterior crowding as a result of archlength problems.



#### Sectional retraction







#### Tipping vs. bodily retraction

- Duration & anchorage management of canine retraction with bodily versus tipping mechanics
- Shpack N et al. Angle Orthod 2008;78:95-100
- 14 subjects, 22 slot, split mouth, xtn Mx 4's
- Bodily retraction was faster than tipping due to less time root uprighting.
- Anchorage loss was similar for both groups (17-20% or 1.2-1.4mm)
- Nance did not provide absolute anchorage

#### Fastest way to close spaces?

- Samuels RHA, Rudge SJ, Mair LH. A comparison of the rate of space closure using a nickel-titanium spring and an elastic module: a clinical study. *Am J Orthod Dentofac Orthop.* 1993;103:464-467
- Samuels RHA, Rudge SJ, Mair LH. A clinical study of space closure with nickel-titanium closed coil springs and an elastic module. *Am J Orthod Dentofac Orthop.* 1998;114:73-79
- C. Nightingale, SP. Jones. A clinical investigation of force delivery systems for orthodontic space closure. J Orthod 2003;30:229-36

#### Space closure

- A randomized clinical trial to compare three methods of orthodontic space closure
- Dixon V, Read MJF, O'Brien KD, Worthington HV, Mandall NA. *J Orthod.* 2002;29:31-36.
- Ligatures vs. Chain vs. NiTi springs
- Ligatures, chain replaced every visit
- Lig = 0.35mm/mth\*, PC = 0.58, NiTi = 0.81\*

#### What is clinically significant?

- Consider closing a 6mm space
- Lig at 0.35mm/mth =~17.1 mths
- Chain at 0.58 mm/mth  $= \sim 10.3$  mths
- Spring at 0.81 mm/mth = -7.4 mths
- What do you consider clinically significant?
- If using extended appointment intervals to avoid reactivations which could be relied upon more?

#### Canine retraction rate

- Rate reported by A. Bagden (unpublished) using 0.018" with 16ss
  - Damon bkts 1.8mm/mth
  - Alexander bkts 1.4mm/mth
- Rate reported by Bokas & Woods (*Aust Orth J*, 2006;22:39-4) using conventional 0.018" twin brackets with 16x16ss, reactivated @ 4 wks
  - 1.9mm/mth with springs 1.7mm/mth with chain

#### Alexander/Lang bracket



#### **Canine retraction**

- S Burrow. Canine retraction rate with selfligating brackets versus conventional edgewise brackets. *Angle* 2009: Accepted
- Split mouth study on 43 subjects comparing SmartClip & Damon3 with a CB during canine retraction on a 0.018" ss wire in 0.022" slot using 150g springs
- Results: Statistically significant difference in the rate of retraction (SC p<0.0043; D3 p<0.0001)</p>
- CB = 1.2mm, SC = 1.1mm, D3 = 0.9mm/mth



#### Ligation distal to extractions?



#### Ligatures, modules, SL brackets?

- Wong et al. J Orth 2013;40:155-162.
- Does the bracket-ligature combination affect the amount of orthodontic space closure..... RCT
- 45 subjects with 1<sup>st</sup> Bi's xtn 0.022" slot
  - Conventional elastomeric modules
  - SuperSlick 'low-friction' elastomeric ligatures
     Damon 3MX<sup>®</sup>
- No difference in rate of closure (p=0.72)
- 1mm per 28 days but a lot of variation

#### Anchorage



#### TPA's enhance anchorage?

- Effects of transpalatal arch on molar movement produced by mesial force: A finite element simulation.
- Y Kojima, H Fukui. AJODFO 2008;134:335-6.
- The TPA had no effect on the initial movement and almost no effect preserving anchorage. The TPA merely prevented rotational and transverse movements of the anchor teeth.

#### More on TPAs in xtn cases

- Effect of the transpalatal arch during extraction treatment.
- Zablocki HL, McNamara JA, Franchi L, Baccetti T. AJODFO. 2008;133:852-60.
- No significant effect on either the AP or vertical position of the maxillary 1<sup>st</sup> molars during xtn Tx.

#### Miniscrews/TADs



#### **Cochrane library**

- Skeggs RM, Benson PE, Dyer F. Reinforcement of anchorage during orthodontic brace treatment with implants or other surgical methods. Cochrane Database of Systematic Reviews 2007, Issue 3. Art. No.: CD005098. DOI: 10.1002/14651858.CD005098.pub2.
- There is limited evidence that osseointegrated palatal implants are an acceptable means of reinforcing anchorage

#### TPAs vs. TADs as anchorage

- Anchorage capacity of osseointegrated and conventional anchorage systems: A randomized controlled trial.
- Feldmann I, Bondemark L. AJODO. 2008;133:339.e19-339.e28
- Leveling/aligning onplant/implant and headgear groups were stable, but the transpalatal bar group had anchorage loss (mean, 1.0 mm; P <.001).</li>
- Space-closure phase onplant/implant groups stable, whereas the headgear and transpalatal bar groups had anchorage loss (means, 1.6 and 1.0 mm, respectively; P <.001).</li>

#### Canine retraction with TADs

- Comparison and measurement of the amount of anchorage loss of the molars with and without the use of implant anchorage during canine retraction.
- Thiruvenkatachari et al. AJODO 2006;129:551-4
- Mean anchorage losses were:
  - Maxilla = **1.6** mm
  - Mandible = 1.7 mm
- No anchorage loss occurred on the implant side.

#### TADs vs. Tweed

- Treatment effects and anchorage potential of sliding mechanics with titanium screws compared with the Tweed-Merrifield technique.
- Park H, Yoon D, Park C, Jeoung S. AJODO. 2008;133:593-600.
- **TAD** group treatment time 4mths less
- Less anchorage loss in TAD group
- **1.5**mm retraction of A-point in TAD group
- **\square** 87% success rate of TADs over 25.6  $\pm$  5.5mths

#### Headgear vs. TADs

 Comparison of treatment outcomes between skeletal anchorage and extraoral anchorage in adults with maxillary dentoalveolar protrusion

- Yao C et al. AJODO 2008;134:615-624
- The skeletal anchorage group had greater anterior tooth retraction (8.17 vs 6.73 mm) and less maxillary molar mesialization (0.88 vs 2.07 mm) than did the headgear group, with a shorter treatment duration (29.81 vs 32.29 months).
- Difference = 1.42 mm greater retraction

#### TADs vs. other anchorage

- Treatment effects of mini-implants for en-masse retraction of anterior teeth in bialveolar dental protrusion patients: A RCT.
- Upadhyay M et al. AJODO 2008;134:18-29
- TADs achieved absolute anchorage and greater levels of skeletal and dental change than conventional anchorage (eg. HG, TPA, 2<sup>nd</sup> molars, differential moments)
- 93% success rate of TADs

#### Headgear vs. TADs

- Palatal implants are a good alternative to headgear: A randomized trial.
- Sandler et al. AJODO. 2008;133:51-7
- The use of palatal implants to reinforce anchorage was as effective as extraoral anchorage with headgear.
- Hawthorne effect?

#### Headgear vs. TADs

- Comparison of the zygoma anchorage system with cervical headgear in buccal segment distalization
- Kaya et al. Eur JO. 2009; 31:417–424
- The use of zygomatic plate anchorage was as effective as extraoral anchorage with headgear.
- Both groups ~5mm molar correction in 9 mths

#### Invisalign



#### Accelerated Tx

- Miles, Smith, Weyant, Rinchuse.
- Aust Orth J 2012;28:213-8.
- The effects of a vibrational appliance on tooth movement and patient discomfort: a prospective randomised clinical trial.
- 66 non-extraction subjects randomly assigned to Tooth Masseuse vs. No appliance



#### Accelerated Tx

- Instructed to use appliance for 20 mins per day
- Impressions of lower teeth taken at 0, 5, 8 and 10 wks and irregularity index measured (blinded)
- Irregularity reduced 65% expt and 69% control
- Despite randomisation there were 5 outliers with higher irregularity all in the appliance group

#### 1-way ANOVA - outliers removed







#### Acceledent study - Texas

- Subject selection and exclusion criteria unclear
- Only 5 subjects ended up in the alignment study appliance group
- Space closure measured from TAD's which could potentially drift
- Not blinded so high risk for bias
- No reliability measurement, measured directly in mouth

#### Partial braces to reduce spaces



- Partial braces 7 months
- <sup>1</sup>/4" 3.5oz Cl2 els 12 hrs with lower retainer



#### Invisalign study intruding laterals



#### Maxillary 2's intrusion

- Aim: To determine if the use of an ovoid auxiliary on maxillary 2's prevents unwanted intrusion during Invisalign treatment
- Method: 30 subjects randomly assigned to having ovoid attachments or not. If the Align technician had placed auxiliaries on the 2's then the patient was excluded.
- Assess clinically whether buttons or refinement involving extrusions was required or not

#### Maxillary 2's intrusion

- Results: 28 subjects completed the study (14 in each group)
- 4 subjects required buttons for extrusion
- All 4 in the NO attachment group (4/14 = 29%)
- Wilcoxon test p = 0.02

#### Class II non-extraction Tx



#### Kevin's Blog

- Kevinobrienorthoblog.com
- http://orthoartmeetsscience.blogspot.com.au

### Cochrane - Class II div 2 Tx

- Orthodontic treatment for deep bite and retroclined upper front teeth in children
- Millett DT, Cunningham SJ, O'Brien KD et al.
- Authors' conclusions
- It is not possible to provide any evidence-based guidance to recommend or discourage any type of orthodontic treatment to correct Class II division 2 malocclusion in children.

#### Cochrane - prominent front teeth

- Orthodontic treatment for prominent upper front teeth in children
- Harrison JE, O'Brien KD, Worthington HV
- Authors' conclusions
- The evidence suggests that providing early orthodontic treatment for children with prominent upper front teeth is no more effective than providing one course of orthodontic treatment when the child is in early adolescence.

#### **Review of distalisation**

- Development And Use Of A Taxonomy To Carry Out A Systematic Review Of The Literature On Methods Described To Effect Distal Movement Of Maxillary Molars.
- G.J. Atherton, A.M. Glenny, K. O'Brien
- J Orthod 2002;29:211-216
- The authors concluded that no more than 2-2.5mm of distal maxillary molar movement could be achieved and the quality of evidence for any method of moving maxillary molars distally was not high
- Therefore only ~1/3 unit Class II cases

#### Molar distalisation

- Upper removable appliance or Jones Jig for distalizing first molars? A randomized clinical trial
- Paul LD, O'Brien KD, Mandall NA. Orthod Craniofac Res 2002;5:238-242
- There were no statistically significant differences between the two treatment methods for any of the outcome measures (P > 0.05).
- Distal movement by both was 1.2-1.3 mm.

#### Headgear vs. Nance/coils

- Extraoral vs Intraoral Appliance for Distal Movement of Maxillary First Molars: A RCT.
- Bondemark & Karlsson. Angle 2005;75:699–706
- Mean distal molar movement:
  - Nance/coil = **3.0** mm
  - Headgear = 1.7 mm
- Mean incisor flaring
  - Nance/coil = 0.9 mm
  - Headgear = -0.9 mm

#### Headgear vs. Nance/coils

■ Final result = molar movement – anchorage loss

- Nance/coil = **3.0** 0.9 = 2.1mm
- Headgear = **1.7** -0.9 = 2.6mm

#### Pendulum vs. headgear

- Comparison of the effects produced by headgear and pendulum appliances followed by fixed orthodontic treatment
- Angelieri F, de Almeida RR, Janson G et al.
- **Eur J Orthod 2008;30:572-9**
- Retrospective study but no significant pre-Tx differences between the groups
- Greater restriction 1.5mm of maxillary growth in the CHG group (P<0.05) and 3° more flaring of lower incisors in the Pendulum group (P<0.05)</li>

#### Pendulum vs. extractions

- Comparative efficiency of Class II malocclusion treatment with the pendulum appliance or two maxillary premolar extractions and edgewire appliances
- Pinzan-Vercelino CRM, Janson G et al.
- Eur J Orthod 2009;31:333-340
- Retrospective study with Pendulum appliances in less severe Cl II and extractions in full Cl II
  - Pendulum Tx time = 45.7 mths
  - Extraction Tx time = 23.0 mths

#### Cochrane review of distalisers

- Jambi S, Thiruvenkatachari B, O'Brien KD, Walsh T.
- Orthodontic treatment for distalising upper first molars in children and adolescents.
- Cochrane Database of Systematic Reviews 2013



#### Meta-analysis – Incisors distalise







#### TAD anchored distalisers?

- Likely gain additional anchorage of 1.5-2mm
- Sectional reduces time in full fixed so less hygiene and OIRR risk and less impact on QOL
- Additional time to distalise prior to placement of full fixed appliances
- If we have to distalise that far, extract 2 x Bi's?







#### Orthadontic Functi Appliances

## Fixed Functional Appliances

"Orthodontic Functional Appliances" Ed: Prof R. Lee and P. Fleming

#### Timing of treatment

- Initially many felt that functional appliance therapy should be initiated at ~9-10 yo
- UK and UNC studies showed early treatment made no difference in the final outcome
- Others have suggested timing to peek growth spurt for the greatest skeletal effect (~12-13)

#### Timing of treatment

CVM – Cervical Vertebral Maturation method

- Based on Don Lamparski's thesis from U Pitt
- Revised by Baccetti, Franchi, McNamara



#### CVM method

- The age closest to this stage varies greatly, from 8½ 11y 5m in girls and 10-14 in boys
- This large variability makes it more difficult to determine the ideal timing for treatment for an individual, and multiple radiographs may be required to determine this

#### Is the CVM method reliable?

- AJODO 2009;136:478.e1-478.e7
- **1**0 orthodontists assessing radiographs
- Inter-observer agreement <50%
- Intra-observer agreement = 62%
- A study evaluating the pattern of mandibular growth and CVM concluded that it cannot predict the onset of peak mandibular growth AJODO 2011;139:e455–e461

#### Herbst and CVM

- A Herbst used at the ideal time according to the CVM method resulted in 1.9mm advancement of Pogonion AJODO 2009;135:698.e1–698.e10
- A Herbst used in non-growing adult patients resulted in a 1.3mm advancement of Pogonion AJODO 2004;126:140–152
- Is it worth 0.6mm?

#### Inter-arch fixed 'functionals'

- Bremen J, Pancherz H. Efficiency of early and late Class II division 1 treatment. Am J Orthod Dentofacial Orthop 2002;121:31-7.
- Treatment in the permanent dentition was more efficient than in early or late mixed dentition.

#### Does it hold up long term?

Long term prospective clinical trials (O'Brien et al. 2003; Tulloch et al. 2004) find any initial growth acceleration does not hold up long term.

#### Herbst vs. elastics

- Class II correction in patients treated with Cl2 elastics and with fixed functional appliances: ....
- Nelson et al. AJODO 2000;118:142-9.
- 18 Begg/elastics for 1.3 years
- 18 Herbst only for 0.5 years
- Skeletal improvement in Herbst 2mm better
- OJ improvement in Begg was 2mm better
- Skeletal contribution 4% in Begg, 51% in Herbst

#### Herbst vs. Elastics - long term?

- A long-term follow-up study of Class II malocclusion correction after treatment with Cl2 elastics or fixed functional appliances
- Nelson et al. AJODO 2007;132:499-503.
- 15 from each group returned ~6-8 years later
- During the total observation period many of the changes reversed and the differences did not last
- The final outcome may be similar regardless

#### What is a functional appliance?

- "One that engages both dental arches and acts principally by holding the mandible away from its normal resting position" (Isaacson et al. 1990)
- "An appliance aimed at modifying growth" (Proffit 2007)

#### Fixed functional appliances

The more appropriate description is fixed Class II correctors but the current convention is FFA

#### Popularity of FFA - USA

	2008	2002	1996	1990	1986
Activator	0.3%	0.8%	1.7%	2.8%	4.0%
Bionator	1.3	4.9	6.1	12.8	13.1
Bite plates	11.9	18.1	27.9	23.1	14.3
Class II Corrector	4.5	3.6	NA	NA	NA
Distal Jet	2.9	2.1	NA	NA	NA
Dynamax	0.4	0.0	0.0	0.1	NA
Forsus	17.4	2.2	NA	NA	NA
Fränkel	1.7	1.5	3.0	5.1	5.9
Herbst	$\frown$				
Banded	9.2	7.6	4.5	4.0	0.9
Bonded	0.8	1.5	2.3	2.1	1.6
Crowns	19.2	22.6	11.0	NA	NA
Removable	0.5	1.3	3.0	3.3	1.3
Fixed-removable	1.2	1.9	NA	NA	NA
Hilgers Pendulum	6.1	12.9	10.0	NA	NA
Invisalign	20.3	11.0	NA	NA	NA
Jasper Jumper	1.2	4.7	5.3	4.2	NA
Jones Jig	0.1	0.4	NA	NA	NA
Magnets	0.0	0.0	0.2	NA	NA
Mandibular Corrector	0.0	0.1	1.4	1.7	2.8
Mandibular Protrusion	0.1	0.3	0.7	NA	NA
MARA	5.8	3.1	NA	NA	NA
Sagittal	2.5	4.0	8.1	8.3	7.5
Schwarz plates	5.2	8.9	13.0	10.6	5.9
Twin Block	3.8	4.4	NA	NA	NA
Other	4.6	4.6	4.7	3.9	1.2

#### Popularity of FFA - Australia

APPLIANCE	2013
<ul> <li>Twin Block</li> </ul>	70%
Pendulum, Distal-jet	11%
Herbst	33%
<ul> <li>Forsus, Jasper Jumper</li> </ul>	61%
□ MARA	0%

#### Popularity of FFA - USA



- Twin Block
- Pendulum
- Distal-jet
- Herbst
- Jasper Jumper
- Forsus
- MARA

 1-0011	
2002	2008
4.4%	3.8%
12.9%	6.1%
2.1% →	2.9%
34.9% ←	30.9%
4.7%	1.2%
2.2%	17.4%
3.1% →	5.8%

#### Summary of Class II correctors

- Upper Molar Distalization: A Critical Analysis
- Orthod Craniofac Res 2002;5:114-26. Sfondrini et al.
- Review The only appliance suitable for high angle cases was high-pull headgear, due to the intrusive effect on the maxillary molars.
- Appliances using palatal anchorage (e.g. Pendulum, Distal-Jet) all led to loss of maxillary anterior anchorage, and so are more suited to Class II malocclusions with normally inclined or retroclined maxillary anteriors.

#### Hyperdivergent facial types

- It has been stated that hyperdivergent types are contraindicated for functional appliances as they are more likely to exhibit an unfavourable growth pattern during treatment due to posterior mandibular growth rotation
- Tulley 1972; Ruf & Pancherz 1997.

#### Herbst vertical effects

- Based on this premise, it has been suggested that the Herbst appliance is more suited to deep bite cases with retroclined lower incisors (Sfondrini et al. 2002; Baccetti et al. 2009)
- The Herbst has even been contraindicated in patients with a high mandibular plane angle and excess lower facial height (McSherry & Bradley 2000).

#### Herbst vertical effects

- Hansen et al. 1997.
- When examining the mandibular plane angle in 24 Class II division 1 subjects, Herbst therapy was found to increase the mandibular plane angle only slightly (0.4°) which during the 6 months post-Herbst reduced back to baseline.
- Over the ensuing 5 years the mandibular plane angle actually reduced further for a final reduction of 2.2°.

#### Herbst vertical effects

- Ruf & Pancherz 1996
- When assessing the vertical affects of the Herbst in 10-14 year-olds both from treatment, shortly after (6 months), and long term (4.5-5 years) it was found to have minimal effect during Herbst treatment while post-treatment, a continuous decrease occurred.

#### Herbst vertical effects

No statistically significant differences were found between hypodivergent, normodivergent, and hyperdivergent subjects although a large amount of variation was noted.

#### Herbst vertical effects

- Ruf & Pancherz 1997.
- When examining Hyper- and hypo-divergent Class II subjects aged 11 to 14 years, skeletal and dental changes were independent upon the vertical facial type.

#### Herbst vertical effects

- Windmiller 1993
- When using an acrylic splint Herbst, although the lower anterior face height increased 2.4 mm, both the Y-axis and mandibular plane angle remained essentially the same.
- Thus, the overall vertical skeletal pattern did not change which is in agreement with others (Martin & Pancherz 2009).

#### Herbst vertical effects conclusion

It therefore seems that functional appliance therapy with the Herbst appliance is equally effective and vertically neutral regardless of the pre-treatment vertical jaw base relationship.

#### **Risk of recession?**

- Does orthodontic proclination of lower incisors in children and adolescents cause gingival recession?
- Ruf S, Hansen K, Pancherz H. AJODO 1998; 114:100–106.
- Only 3% of mandibular incisors developed recession after the use of Herbst appliance.
- They concluded that no interrelationship was found between the amount of incisor proclination and gingival recession.

#### **Risk of recession?**

- Correlation between mandibular central incisor proclination and gingival recession during fixed appliance therapy
- Djeu G et al. Angle Orthod 2002; 72:238-245
- Previous reports on irreversible gingival recession during fixed therapy = 1.3-10%
- This study found 12 % with gingival recession.
- No correlation between mandibular incisor proclination during treatment and gingival recession or change in clinical crown length.

#### **Risk of recession?**

- Melsen & Allais AJODO 2005;127:552-561
- No orthodontic variable was associated with recession.
- They concluded that thin gingival biotype, visual plaque, and inflammation are useful predictors of gingival recession.

#### What is biotype?

- Claffey & Shanley (J Clin Periodontol 1986)
- **•** Thin tissue biotype gingival thickness  $\leq$  1.5mm
- Kan et al. J Periodontol 2003;74:557-562)
- The outline of a periodontal probe (PCP-UNC 15) can be seen through the gingival margin then it is a Thin Biotype

#### **Risk of recession?**

- Yared et al. AJODO 2006;130:6.e1-6.e8
- In adult patients greater proclination >95° and especially free gingival margin thickness (biotype) had the greatest association with the risk of recession.

#### Systematic review of recession

- Aziz, Flores-Mir. Aust Orth J 2011;27:33-39
- No association between labial movement of mandibular incisors and gingival recession.
- Important factors that may predispose to gingival recession were
  - reduced thickness of the gingival margin (biotype)
  - narrow mandibular symphysis
  - inadequate plaque control
  - aggressive tooth brushing.

#### Risk of recession?

- Handelman. Angle 1996;66:95-109.
- Thinner labial cortical bone demonstrated in untreated hyperdivergent facial types.
- Enhos et al. Angle 2012;82:868-874.
- Slightly higher occurrence of dehiscences in hyperdivergent facial types.

#### Putting it all together

- There is therefore a potentially elevated risk of recession when advancing lower incisors in hyperdivergent facial types.
- Care should be exercised in maintaining excellent oral hygiene and particular care and monitoring in those with a thin tissue biotype and/or a hyperdivergent facial type.

#### Jasper Jumper vs. Activator/HG

- Comparative Evaluation of a New Removable Jasper Jumper Functional Appliance vs. an Activator-Headgear Combination.
- Sari et al. Angle Orthod 2003;73:286–293
- Increase in total facial height was greater in the activator group than in the JJ group. Vertical growth inhibition of lower incisors was greater in the JJ group.
- JJ seemed more suitable for high-angle cases, particularly with maxillary excess and some mandibular deficiency.

#### Fixed functional vectors



#### Consider the desired response





#### Allow eruption



#### Forsus and Jasper Jumper

- Forsus Nitinol Flat Spring and Jasper Jumper Corrections of Class II division 1 Malocclusions.
- Karacay S et al. Angle Orthod 2006;76:666–672.
- Both the appliances were effective in the treatment of Class II malocclusion
- Both appliances cause significant incisor and molar movements, and these dentoalveolar changes are more effective than the skeletal changes in attaining Class I molar relationship.

#### Forsus success

- Effectiveness of comprehensive fixed appliance Tx used with the Forsus FRD in Cl2 patients
- Franchi, Alvetro et al. Angle 2011;81:678-683
- 32 subjects compared with matched control
- 87.5% success rate with Tx over 2.4 yrs ( $\pm$  0.4)
- Overjet reduced ~5.5mm, molar relationship 3.4mm, lower incisors flared ~5°

#### Forsus FRD vs. elastics

- Class II Non-Extraction Patients Treated with the Forsus Fatigue Resistant Device Versus Intermaxillary Elastics.
- Jones G et al. Angle Orthod 2008;78:332–338.
- With the exception of lower molar mesial movements and total molar correction, which were significantly (P < .05) greater in the Forsus group, there were no statistically significant group differences in the treatment changes. (retro/matched)

## Forsus side effect



## Not wearing your elastics?



#### Forsus faux pas

- Ulcers, lateral open bites, breakages
- This is not reported in most studies and should be so we can compare ITT (Intention To Treat = real world) and PP (Per Protocol – ideal)



#### Non-extraction anchorage

- Possible hierarchy for <u>non</u>-extraction anchorage (minimise lower flaring)
  - Minimum = Elastics/Forsus
  - Moderate = Headgear or TAD
  - Maximum = TAD anchored appliance or Extraction



#### TAD anchored FFA

- Angle Orthod. 2014;84:76–87. Aslan et al.
- 16 patients (13.7 yo) were treated with FRDMS, whereas 17 subjects (14.6 yo) were treated with only FRD
- Tx times avg FRDMS 6.5 mths & FRD 5.5 mths
- No skeletal effect but labial tipping of mandibular incisors was significantly greater in the FRD group than in the FRDMS group

#### **TAD** Forsus

- Not randomised so a risk of selection bias
- Not blinded when tracing so a risk of bias
- FRD group 10-12 mths older so potential for less growth
- FRD group 1 mth less possibly due to greater dental movement - we correct until we achieve what we want
- If less dental movement then we have to wait longer to achieve the desired change

#### **TAD** Forsus

- Skeletal changes tend to relapse long term in e.g. Herbst studies
  - VanLaecken et al. 2006
  - Pancherz & Anehus-Pancherz 1993
  - Wieslander 1993
- Need long term follow-up study to evaluate the final extent of the changes and any differences

Table 7. The Mean Differences (T2-T1) and 95% Confidence Intervals of Significance Values of the Differences Between FRDMS (1), FRD (2), and Co				
	1	95% CI	2	95% CI
U6-VRL, mm	n -2.11 ± 1.66	(-2.92, -1.08	) -1.45 ± 0.83	(-1.88, -1.02)
U6-HRL, mm	$1  0.00 \pm 1.28$	(-0.54, 0.80)	$-0.63 \pm 1.20$	(-1.25, -0.01)
U6/HRL, °	$-2.53 \pm 4.66$	(-3.88, 0.28)	$-3.92 \pm 3.34$	(-5.64, -2.20)
L6-VRL, mm	1.39 ± 1.83	(0.28, 1.96)	1.95 ± 1.33	(1.27, 2.64)
L6-MP, mm	1.43 ± 1.40	(0.55, 2.03)	$1.53 \pm 1.46$	(0.78, 2.28)
L6/MP, °	0.30 ± 2.91	(-1.37, 0.90)	$3.24 \pm 3.19$	(1.59, 4.88)
U1-VRL, mm	n -3.16 ± 1.90	(-4.26, -2.08	) -1.79 ± 1.90	(-2.77, -0.81)
U1-HRL, mm	n 2.01 ± 1.79	(0.92, 2.95)	0.77 ± 0.91	(0.30, 1.24)
U1/HRL, °	$-8.94 \pm 5.70$	(-11.78, -5.42	$)-2.68 \pm 4.43$	(-4.95, -0.40)
L1-VRL, mm	1.09 ± 1.76	(0.09, 1.44)	2.34 ± 1.68	(1.47, 3.20)
L1-MP, mm	-0.73 ± 1.41	(-1.48, 0.12)	$-1.45 \pm 1.27$	(-2.11, -0.80)
L1/MP, °	3.61 ± 5.07	(0.46, 5.52)	9.29 ± 3.81	(7.33, 11.25)
SN/OP, °	3.66 ± 3.24	(1.67, 5.30)	3.78 ± 3.33	(2.06, 5.49)
U1/L1, °	3.72 ± 6.51	(0.03, 7.50)	$-6.09 \pm 4.42$	(-8.36, -3.82)
OJ, mm	$-4.28 \pm 2.15$	(-4.87, -2.99)	$-4.08 \pm 2.02$	(-5.12, -3.03)
OB, mm	$-1.53 \pm 1.19$	(-2.01, -0.78)	$-2.68 \pm 1.52$	(-3.46, -1.90)
Molar Rel,	$-3.50 \pm 2.06$	(-3.92, -2.32)	$-3.39 \pm 1.72$	(-4.28, -2.51)
mm				

#### **Incisor movements**

- 1.1mm vs. 2.3mm labial movement
- L1 to MP 3.6° vs. 9.3°
- 1.2mm labial movement and 6° tipping could be related to tracing error/bias?
- Most TAD studies find ~1.5mm difference to other forms of anchorage
- Perhaps tie ligature to premolars to reduce risk of 'screwing it up'









#### Functional appliances vs. braces



#### Functional design

- Bite plane to disclude
- Distal force applied to the upper dentition
- Mesial force on lower jaw applied to the dentition
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### Functional design

- Bite wedges
- Distal force applied to the upper dentition
- Mesial force on lower jaw applied to the dentition
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### Bite wedges to protect brackets

- Composite bite wedges to help reduce breakages
- In a normal occlusion use on the palatal of the upper central incisors
- Open bites and larger overjets, place on the buccal cusps of the lower molars



#### Functional design

- Bite wedges
- Distal force applied to the upper dentition
- Mesial force on lower jaw applied to the dentition
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### **Functional design**

- Bite wedges
- TAD, Headgear, Forsus, Elastics, etc.
- Mesial force on lower jaw applied to the dentition
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### **Functional design**

- Bite wedges
- TAD, Headgear, Forsus, etc.
- Mesial force on lower jaw applied to the dentition
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### **Functional design**

- Bite wedges
- **TAD**, Headgear, Forsus, etc.
- Elastics, Forsus, etc.
- Additional adjustments
  - E.g. Bow to retract anteriors
  - Expansion e.g. Screw vs. Screens/shields
  - Selective eruption

#### **Fixed** appliances

- Bite wedges
- **TAD**, Headgear, Forsus, etc.
- Elastics, Forsus, etc.

#### Additional adjustments

- E.g. Bow to retract anteriors
- Expansion e.g. Screw vs. Screens/shields
- Selective eruption

#### Fixed appliances as functionals



#### Upcoming book on functionals

- Orthodontic Functional Appliances
- Editors: Prof. Bob Lee & Padhraig Fleming
- Wiley/Blackwell
- Peter Miles: Fixed Functional Appliances

Efficiency (Molar mm/year)

#### Summation

- Treatment times and molar effects are similar
- However, this does not factor in the number of appointments, appointment duration, or appliance cost which influence the cost effectiveness
- Ideally this would be the subject of future high quality RCT's

#### Compare with removable FA

The overall molar change, treatment time and efficiency (mm/yr) was no more or less effective using a continuous 2-stage approach with a Herbst (Franchi et al. 1999, Schaefer et al. 2004) or MARA (Azizollahi 2012) followed immediately by preadjusted edgewise appliances than using a single phase with a Jasper Jumper, Forsus FRD, Herbst (Al-Jewair et al. 2012) or MARA (Al-Jewair et al. 2012, Ghislanzoni et al. 2013).

#### Compare with removable FA

This contrasts with the UNC clinical trial (Tulloch *et al.* 2004) of removable functional appliances and headgear which found the overall treatment time to be significantly longer with the 2-phase approach.

#### Possible explanations?

- The efficiency in terms of mm/month change of the Bionator has been suggested to be less than the Herbst (Cozza *et al.* 2006).
- Another study comparing the MARA, Bionator, Herbst and Twin-block followed by preadjusted edgewise appliances also found treatment involving the Bionator to be slower by ~7 months or 17% (Siara-Olds *et al.* 2010).

#### Possible explanations?

- The delay between phases in the UNC trial allows some possible loss of the molar correction which then needs to be recovered?
- Shorter treatment times using fixed functionals (Herbst, MARA) compared with the Bionator used in the UNC trial suggest the Bionator may be less efficient.



#### Twin-Block vs. Herbst

When comparing the Twin-block with the Herbst in a RCT when both were followed by preadjusted edgewise appliances, it was found that the time saved with the Herbst was mostly lost in the preadjusted edgewise appliances phase of treatment (O'Brien *et al.* AJODO 2003;124:128-37).

#### Twin-Block vs. Herbst

- Treatment with the Herbst appliance resulted in a lower failure-to-complete rate for the functional appliance phase of treatment (12.9%) than did treatment with Twin-block (33.6%)
- Author's conclusion:
- Because of the high cooperation rates of patients using the Herbst appliance it could be the appliance of choice for treating adolescents with Class II Division 1 malocclusion.

#### Twin-Block vs. Herbst

- Previous studies show a 15-50% lack of compliance (2003 O'Brien) most being 20-30% with TB in RCT's
- Herbst design used by O'Brien was cast Co-Cr prone to debonding & expensive to make/repair



#### **Appliance choice**

- Dan Rinchuse (Seton Hill Univ) "Patients have
- a right to autonomy and input into their treatment provided that it does no harm."
- Involve the patient/family in choosing an option
- Explain the Pros and Cons of various appliances and mechanics as this may influence their choice
- Some may rate comfort over cost, time over facial change, is an appliance suited to their goals, personality and diligence – ask them!