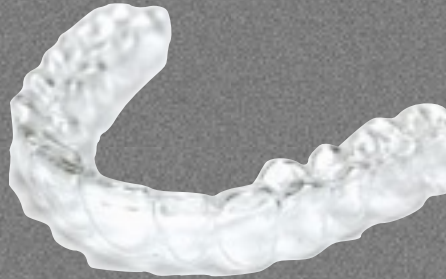


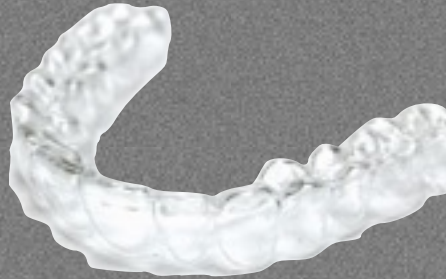
RETENTION: NOT LETTING GO?



PADHRAIG FLEMING



RETENTION: NOT LETTING GO?



PADHRAIG FLEMING



Barts and The London
School of Medicine and Dentistry

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TAURANGA 2019



Treatment Duration

Adult Orthodontics

Retention

Growing Wiser

Functional Appliances

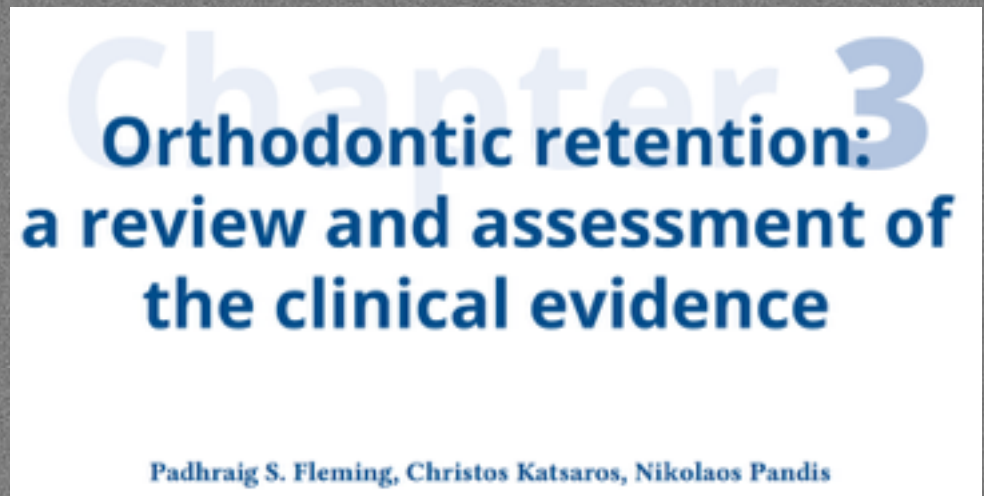
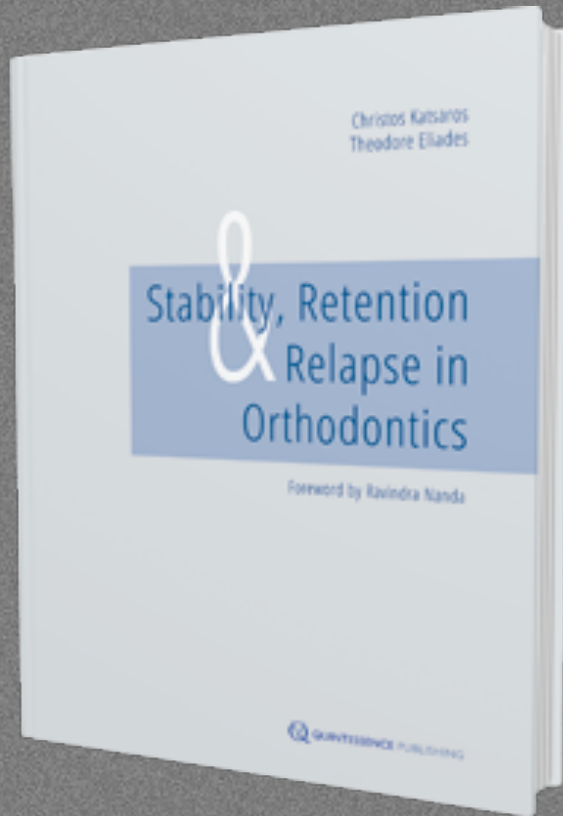
Orthodontic Research Practice



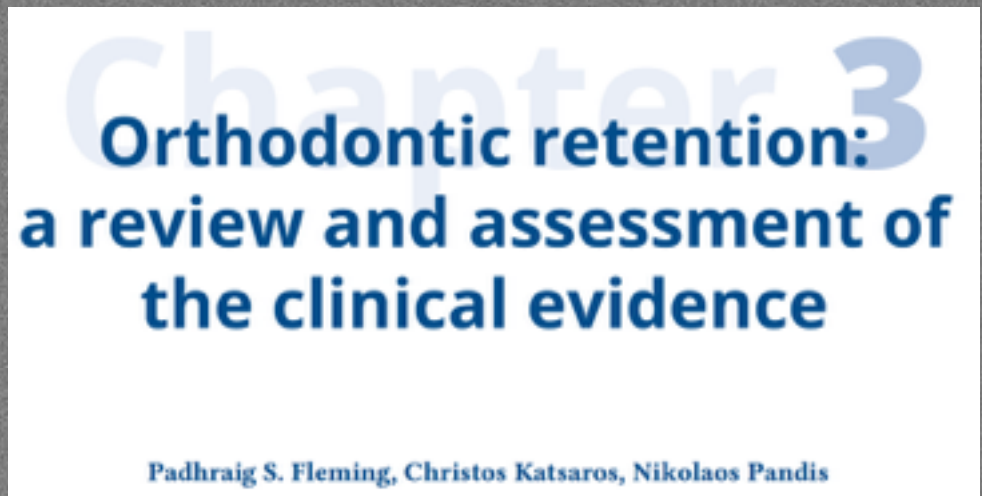
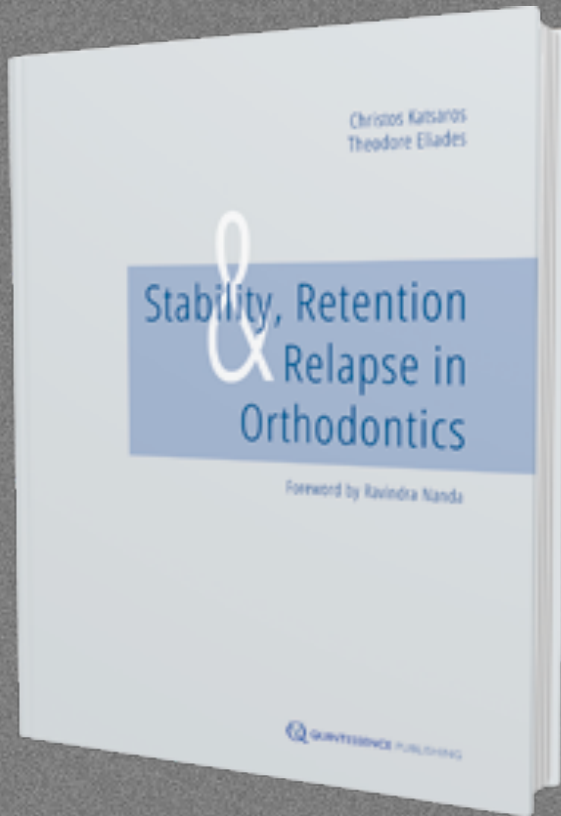
Development of a core outcome set for orthodontic trials using a mixed-methods approach: protocol for a multicentre study

Riki Yoshida^{1,2}, Kevin O'Brien³, Ama Jhal⁴, Zoe Markman⁵, Philip Benson⁶, Fiorella B. Colomo Salazar⁷ and Padraig S. Fleming²

RETENTION: NOT LETTING GO?



RETENTION



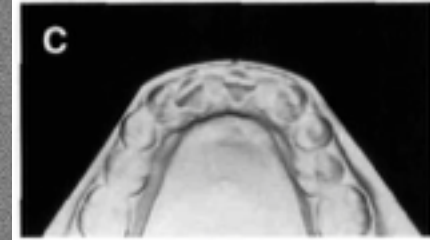
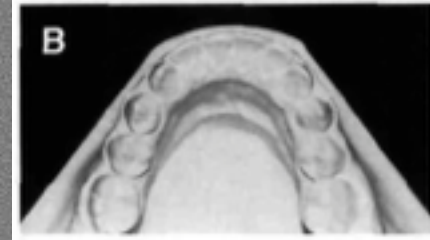
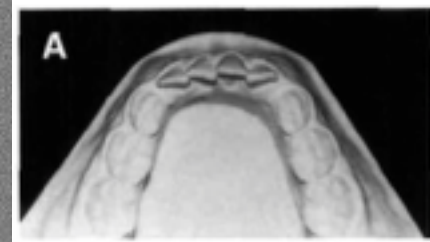
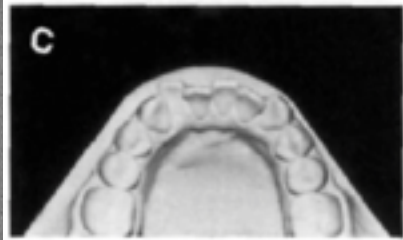
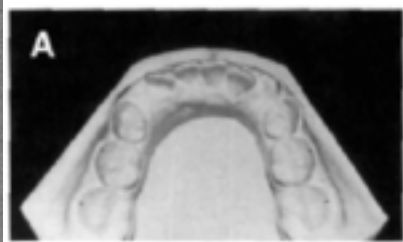
- THE MOST DIFFICULT PROBLEM IN ORTHODONTIA; IN FACT IT IS THE PROBLEM (OPPENHEIM, 1934)

RETENTION

Stability and Relapse of Mandibular Anterior Alignment: University of Washington Studies

Robert M. Little

For more than 40 years, research in the Department of Orthodontics, University of Washington (Seattle, WA) has focused on a growing collection of more than 800 sets of patient records to assess stability and relapse of orthodontic treatment. All patients had completed treatment a decade or more before the last set of data. Evaluation of treated premolar extraction patients, treated lower incisor extraction patients, treated nonextraction cases with generalized spacing, patients treated with arch enlargement strategies, and untreated normals showed similar physiologic changes: (1) Arch length decreases after orthodontic treatment. (2) Arch width measured across the mandibular canine teeth typically reduces posttreatment, whether or not the case was expanded during treatment. (3) Mandibular anterior crowding during the posttreatment phase is a continuing phenomenon well into the 20-to-40 years age bracket and likely beyond. (4) Third molar absence or presence, impacted or fully erupted, seems to have little effect on the occurrence or degree of relapse. (5) The degree of postretention anterior crowding is both unpredictable and variable and no pretreatment variables either from clinical findings, casts, or cephalometric radiographs before or after treatment seem to be useful predictors. (Semin Orthod 1999;5:191-204.)
Copyright © 1999 by W.B. Saunders Company



- POST-RETENTION: WORST-CASE?
- INSTRUCTIVE
- WE ARE BETTER NOW? SURELY?



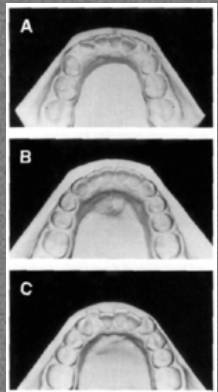
RETENTION

Untreated “Normal” Occlusions

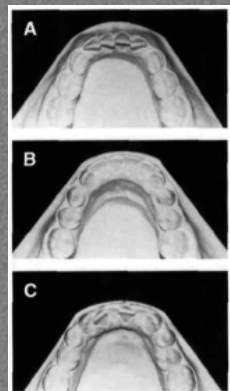
Purpose and rationale. (1) Describe the nature and extent of the dental and cephalometric changes seen during development from the mixed dentition into adulthood in untreated normals. (2) Analyze relationships between the variables measured in an effort to identify trends, predictors, and associations of clinical value. (3) Compare the dental and cephalometric changes seen in similar treated and untreated groups.

Materials and Methods. A sample of 65 “normal occlusion” patients, all with serial records, were evaluated using the same criteria as with the treated patients.^{1,2} Dental casts and cephalometric radiographs were assessed for the mixed dentition, early permanent dentition, and into early adulthood.

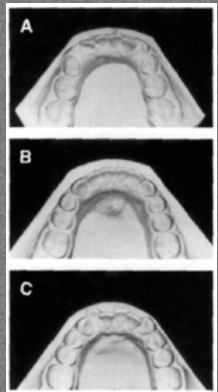
Results. (1) As with treated patients, arch length and arch width typically decreased with time. In a few patients, there was progression from near perfect alignment to mild or moderate crowding by early adulthood. (2) Females showed a greater tendency for arch constriction and crowding. (3) No single or multiple associations of clinical value were found when assessing stability or relapse versus cephalometric, dental cast or descriptive variables.



Maturational Change

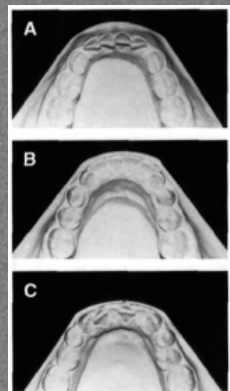


RETENTION

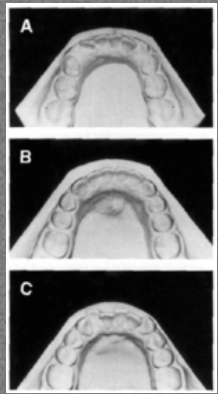


Premolar extraction. Removal of premolars to permit alignment of crowded teeth has been an accepted procedure for decades and continues as the most common treatment used for patients with crowded arches. Despite achieving suggested and accepted cephalometric norms, and despite adhering to usual clinical standards of arch form, overbite, etc, the **long-term maintenance of acceptable results is disappointing, with only 30% of the patients showing acceptable long-term results.** Indefinite use of removable or fixed retainers, perhaps for life, seems to be the only logical recourse. Unfortunately, the undesirable sequella of such a retention program is not yet known.

Relapse

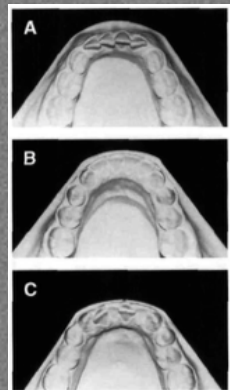


RETENTION

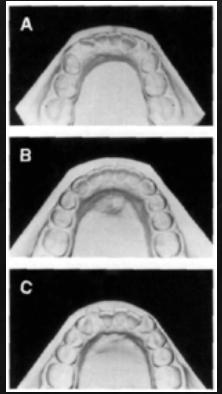
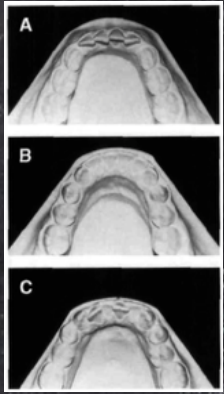


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Indefinite Retention



WANT NEED



RETENTION

MUST HAVE





RETENTION



LESSON # 1:

NATURE & EXTENT
OF POST-RETENTION CHANGE
ARE UNKNOWN

CLINICAL IMPLICATION:
PLAN ON LIFETIME
PERMANENT RETENTION





RETENTION



LESSON # 3:

EARLY STABILITY MAY BE A MIRAGE --
FOR MOST, IN A FEW YEARS THE
HONEYMOON WILL BE OVER

CLINICAL IMPLICATION:

LIFETIME PERMANENT RETENTION
IS THE ONLY WAY TO ENSURE
ALIGNMENT STABILITY





RETENTION



LESSON # 5

LABIAL AND LINGUAL RELAPSE
ARE UNPREDICTABLE

CLINICAL IMPLICATION:

MANDIBULAR ANTERIOR STABILITY
IS A RARE OCCURRENCE



LIFETIME PERMANENT RETENTION IS
THE ONLY RELIABLE METHOD TO ENSURE
LONG-TERM SUCCESS



RETENTION



LESSON # 9

A. RETENTION POSTPONES RELAPSE

B. RELAPSE IS PROGRESSIVE THROUGHOUT LIFE

C. RATE OF RELAPSE SLOWS WITH AGE

CLINICAL IMPLICATION:

LIFETIME PERMANENT
RETENTION TO ENSURE
LONG-TERM SUCCESS





RETENTION



LESSON # 8

ARCH DEVELOPMENT IS UNSTABLE
(THE MOST SEVERE RELAPSE
THAT WE HAVE STUDIED)

CLINICAL IMPLICATION:

PERMANENT RETENTION IS MANDATORY

GINGIVAL RECESSON AND DEHISCENCE
ARE POSSIBLE SEQUELLA

Extraction of premolars for orthodontic reasons on the decline? A cross-sectional survey of BOS members

Padhraig S. Fleming^a, Susan J. Cunningham^b, Philip E. Benson ^c, Preeti Jauhar^a and Declan Millett^d

Results: Two hundred and eight responses were obtained with 95.6% ($n = 199$) reporting reduced extraction prescription over the last 5–10 years. Overall, 29.9% and 35.5% felt that their threshold for extractions had increased by more than 2 mm in adolescents and adults, respectively. Facial ($n = 145$; 69.7%) and smile ($n = 127$; 61.1%) aesthetics, and increased use of inter-proximal reduction ($n = 102$; 49%) were the factors most frequently reported as having either a moderate or major influence on this trend. Based on ordinal logistical regression analyses, no significant relationship was found between threshold for extractions and work setting ($P = 0.675$; O.R. 0.51; 95% CI: 0.39, 1.85) or level of orthodontic experience ($P = 0.15$; O.R. 1.02; 95% CI: 0.15, 1.05), although a higher threshold for extractions was more likely among users of conventional than self-ligating brackets ($P = 0.001$; O.R. 4.74; 95% CI: 1.95, 11.5).

Conclusions: A reduced tendency to prescribe orthodontic extractions over the past 5–10 years among British Orthodontic Society members was identified. Comparative clinical research exploring the relative merits of extraction and non-extraction approaches could be timely.



EXTRACTIONS: U.K. PRACTICE

- Not due to TADs or SLBs
- Not reflected in increased use of bonded retention
- Patient- and market- driven
- But at what cost?

JOURNAL OF ORTHODONTICS
<https://doi.org/10.1080/14653125.2018.1517470>

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Check for updates

Extraction of premolars for orthodontic reasons on the decline? A cross-sectional survey of BOS members

Padhraig S. Fleming^a, Susan J. Cunningham^b, Philip E. Benson^c, Preeti Jauhar^a and Declan Millett^d



JCO ROUNDTABLE

Stability of Orthodontic Treatment Part 1

EUGENE L. GOTTLIEB, DDS, Moderator
MAURO COZZANI, DMD, MSD
JULIA F. DE HARFIN, DDS, PHD
ROBERT D. HELMHOLDT, DDS
LEE R. LOGAN, DDS, MS
DAVID W. WARREN, DDS



DR. GOTTLIEB What is the most frequent evidence of instability of results?

DR. WARREN The most frequent evidence that I see is a return of rotations of the anterior teeth.

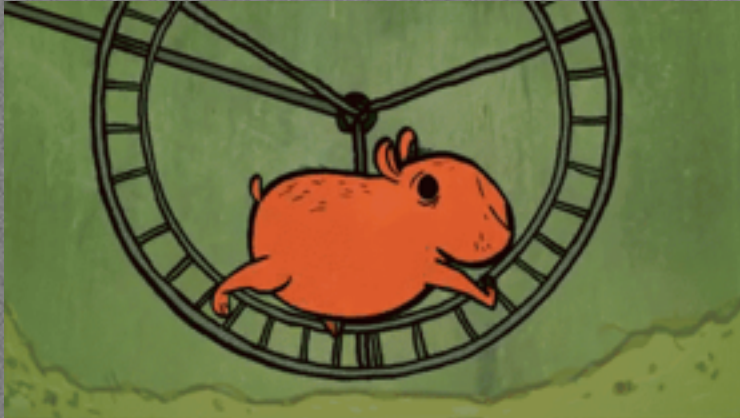
DR. COZZANI I'd say incisor crowding in the mandibular arch.

DR. LOGAN For me, the main one is rotations of mandibular anterior teeth. I would also list:

JCO ROUNDTABLE

Stability of Orthodontic Treatment Part 1

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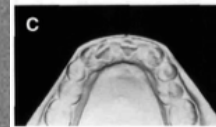
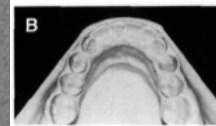
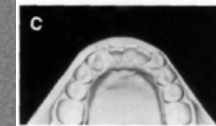
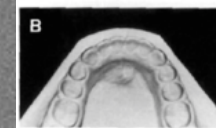
DR. LOGAN For me, the main one is rotations of mandibular anterior teeth. I would also list:

- Prognathic mandibular growth.
- Recurrence of a maxillary diastema.
- Recurrence of an open bite that has been closed with anterior vertical elastics.
- Lingually placed maxillary lateral incisors.
- Infraversion of lingually impacted maxillary canines that have had surgical treatment and erupted orthodontically.

In addition, Class II corrections achieved with elastics, Herbst appliances, or functional appliances, particularly in dolichocephalic cases, tend to be unstable, as do posterior crossbites corrected with removable appliances, archwires, or elastics. All adult mandibular bicuspid extraction sites tend to show some loss of contact, and maxillary first bicuspid extraction sites adjacent to small maxillary second bicuspids tend to re-open.

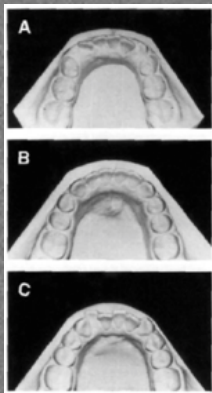
INSTABILITY: HIERARCHY

- 
- ALIGNMENT: IRREGULARITY AND SPACING
 - TRANSVERSE CHANGE
 - VERTICAL CHANGE: AOB
 - VERTICAL CHANGE: DEEP OVERBITE
 - ANTERO-POSTERIOR CHANGE

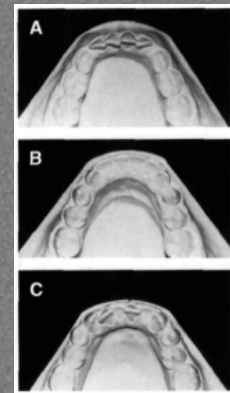


The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension

INSTABILITY: HIERARCHY



• PREDICTABLE ???



The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension

[William R Proffit](#),¹ [Timothy A Turvey](#),¹ and [Ceib Phillips](#)¹

DEEP OVERBITE

- INDEPENDENT: SAGITTAL CHANGE AND ALIGNMENT?
- KIM & LITTLE (1999):
 - START OVERJET AND GROWTH
 - POST-RETENTION
- SCHÜTZ-FRANSSON ET AL (2006):
 - 0.8MM INCREASE IN 11 YEARS
 - RETENTION



OVERJET

- FUNCTIONAL APPLIANCE THERAPY: TWIN-BLOCK
- HOW STABLE?
- FACTORS AFFECTING STABILITY



OVERJET

- OCCLUSAL INTERDIGITATION (PANCHERZ, 1982)
- DEVELOPED OCCLUSAL INTERDIGITATION INDEX
- EFFECT OF RETENTION REGIME

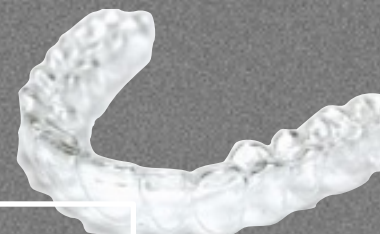


OVERJET

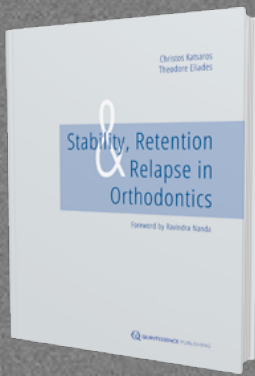
METHODS: A prospective cohort involving 64 participants treated with TBFA was undertaken over a 12-month period. Study models and lateral cephalometric radiographs were obtained to record overjet and molar relationship, PAR score, skeletal parameters and a new objective buccal segment interdigitation scoring system was developed. Multivariate logistical regression analysis was used to assess the stability of antero-posterior occlusal correction and the degree of buccal interdigitation, pre-treatment skeletal discrepancy and change in overjet during treatment

RESULTS: Mean overjet reduction of 6.22mm arose during treatment with the canine and molar relationships improving by 3.34mm and 2.67mm, respectively. In the 12 months post-treatment mean relapse of 0.67mm and 0.06mm in overjet and molar relationship, respectively, was observed with 25% having overjet relapse greater than 1mm. There is weak evidence that the treatment induced change in overjet is linked with overjet relapse. No significant relationship was observed, however, between antero-posterior stability and buccal segment interdigitation, pre-treatment skeletal discrepancy or prescribed retention regime.

CONCLUSIONS: Overall, acceptable levels of stability were observed, although appreciable relapse was noted in 25% of participants. Neither the degree of buccal segment interdigitation nor pre-treatment skeletal discrepancy were predictive of antero-posterior occlusal stability.



- 10% IN YEAR 1
- 25% >1MM OVERJET INCREASE: 12 MONTHS



RETENTION

Which type of retainer, fixed or removable, is more effective?

Which design of removable retainer is most effective?

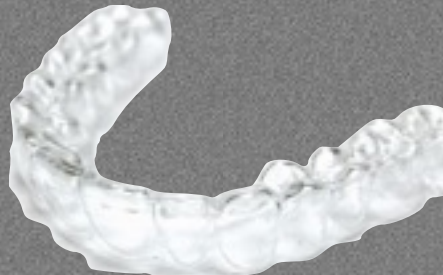
Which design and material has proven most effective for fixed retainers?

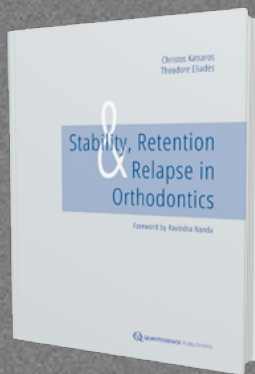
Is full-time wear of removable retainers preferable to part-time wear?

Are auxiliary procedures (eg, interproximal reduction or surgical adjuncts) of value or perhaps more effective than the use of retainers?

For how many months or years should removable retainers be worn?

What is the material safety of fixed and removable retainers?





RETENTION

Table 1 Fundamental questions of particular interest to clinicians regarding retention

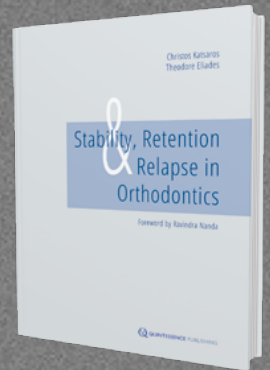
Objective measures of stability with various retention regimes	Design/setting of best evidence
Which type of retainer, fixed or removable, is more effective?	RCT
Which design of removable retainer is most effective?	RCT
Which design and material is proven most effective for fixed retainers?	RCT
Which material is proven most effective for fixed retainers?	RCT
Are auxiliary procedures (eg, interproximal reduction or surgical adjuncts) of value or perhaps more effective than the use of retainers?	RCT
Duration of retention	
Is full-time wear of removable retainers preferable to part-time wear?	RCT
For how many months or years should removable retainers be worn?	n/a
Patient preferences	
Which type of removable retainers do patients prefer?	RCT
Safety of retention	
What are the short- and long-term effects of removable and fixed retainers on the dentition and supporting structures?	Retrospective cohort studies
What is the material safety for fixed and removable retainers?	<i>In vitro</i> studies



RETENTION

Is full-time wear of removable retainers preferable to part-time wear?

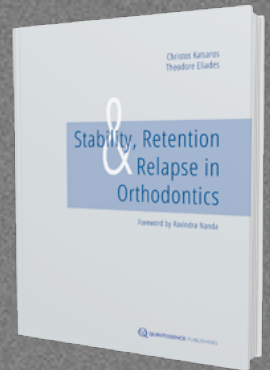
However, four RCTs have considered the relative merits of part-time and full-time wear of removable retainers, producing very consistent findings. Based on an analysis of 60 participants, Gill et al³⁵ concluded that there is little difference in mandibular labial segment stability with either full-time or night-only wear of Essix retainers over a 12-month period. Similar results were obtained in



RETENTION

Is full-time wear of removable retainers preferable to part-time wear?

On the basis of these four RCTs, it can be deduced that night-only wear may be sufficient. This approach also reduces the burden of retention wear, and may improve the longevity of retainers by reducing wear-induced degradation and limiting the potential for loss, improving their cost-effectiveness. This conclusion is further augment-



RETENTION

Is full-time wear of removable retainers preferable to part-time wear?

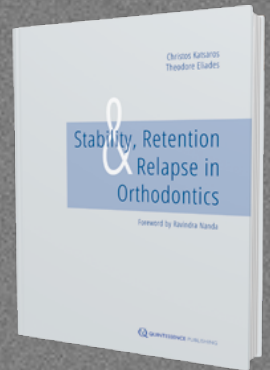


**Cochrane
Library**

Cochrane Database of Systematic Reviews

**Retention procedures for stabilising tooth position after
treatment with orthodontic braces (Review)**

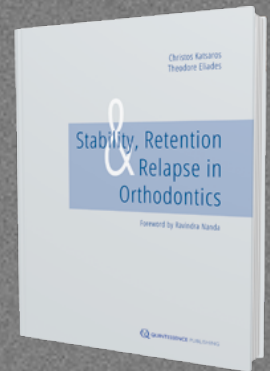
Littlewood SJ, Millett DT, Doubleday B, Bearn DR, Worthington HV



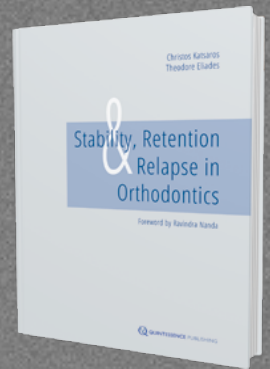
RETENTION

Which design of removable retainer is most effective?

A large randomized trial in the UK involving 397 patients compared both objective¹⁷ and economic and subjective¹⁸ considerations over a 6-month retention period in a single practice. Greater irregularity was observed in the anterior region with Hawley than with Essix retainers, with slightly more pronounced differences in the mandibular (0.56 mm) than the maxillary (0.25 mm) anterior region. In addition, Essix retainers were found to be more cost-effective than Hawley retainers, with patients also preferring Essix retainers.



RETENTION



Which type of retainer, fixed or removable, is more effective?

This question was addressed in an RCT in Sweden¹⁴ with a 12-month follow-up. No meaningful difference in relapse was found between three groups with a VFR in the maxilla and bonded canine-to-canine retainer in the mandible, Essix retainer in the maxilla combined with stripping of mandibular anterior interproximal surfaces, or a positioner in both arches. An allied concept was considered by Sari et al¹⁵ in a controlled trial comparing the number of occlusal contacts developing in a 12-month period with either bonded or Hawley retainers. The authors noted a greater proportion of contacts developing in the fixed-retainer group during the retention period, indicating that removable retainers may inhibit complete occlusal settling in the posterior dentition.

The relative merits of the combined use of fixed and removable retention was investigated by Xu et al¹⁶, although the comparison was confounded by

- RCTs PROBLEMATIC
- ATTRITION
- FOLLOW-UP
- ACTIVE PHASE OVER
- HOW LONG IS LONG ENOUGH?

DURATION OF FOLLOW-UP??? 18 MONTHS

CLINICAL TRIAL

RANDOMIZED CONTROLLED TRIAL



AJO-DO

Effects of fixed vs removable orthodontic retainers on stability and periodontal health: 4-year follow-up of a randomized controlled trial



Dalya Al-Moghrabi,^a Ama Johal,^b Niamh O'Rourke,^c Nikolaos Donos,^b Nikolaos Pandis,^d Cecilia Gonzales-Marin,^e and Padhraig S. Fleming^b

London, United Kingdom, Riyadh, Saudi Arabia, Bern, Switzerland, and Corfu, Greece

- To compare the stability of orthodontic outcomes with fixed and removable retainers over a period of at least 4 years
- To investigate periodontal outcomes with fixed versus removable retainers over this period

INTRODUCTION



- Prolonged retention is routinely prescribed
- Long-term impact of orthodontic retainers unclear

INTRODUCTION

Stability

SYSTEMATIC REVIEW



AJO-DO

Compliance with removable orthodontic appliances and adjuncts: A systematic review and meta-analysis

Dalya Al-Moghrabi,^a Fiorella Colonio Salazar,^b Nikolaos Pandis,^c and Padhraig S. Fleming^d

London, United Kingdom, Riyadh, Saudi Arabia, Bern, Switzerland and Corfu, Greece

Introduction: The primary aims of this systematic review were to assess objective levels of wear of removable orthodontic appliances and components vs both stipulated and self-reported levels. We also aimed to consider patient experiences and the effectiveness of interventions geared at enhancing compliance. **Methods:** Electronic databases and reference lists of relevant studies were searched with no language restriction (PROSPERO: CRD42016036059). Randomized and nonrandomized controlled trials, prospective cohort studies, case series, qualitative and mixed-methods studies objectively assessing compliance levels were identified. The quality of the studies was assessed using the Cochrane Collaboration's risk of bias tool, risk of bias in non-randomized studies of interventions (ROBINS-I), or mixed-methods appraisal tool based on their design. **Results:** Of 4269 records, 80 full texts were obtained, with 24 studies meeting the selection criteria. Of these, 11 were included in the quantitative synthesis. A weighted estimate of objectively assessed compliance levels in relation to stipulated wear time was calculated with the discrepancy highest in the headgear group (5.81 hours per day, 95% confidence interval, 4.98, 6.64) based on 6 studies. The mean discrepancy between self-reported and objectively assessed headgear wear was 5.02 hours per day (95% confidence interval, 3.64, 6.40). Compliance level was not directly related to appliance type ($P = 0.211$). Thematic synthesis was not undertaken because of the limited number of qualitative studies. **Conclusions:** Compliance with removable orthodontic appliances and adjuncts is suboptimal, and patients routinely overestimate duration of wear. Techniques for improving compliance have promise but require further evaluation in high-level research. (Am J Orthod Dentofacial Orthop 2017;152:17-32)



INTRODUCTION

Stability

- Acceptable levels of stability in the short-term (Forde et al., 2017; O'Rourke et al., 2016; Xiao-Cen et al., 2011)
 - Follow-up less than 2 years
 - Mean lower anterior irregularity <2mm



INTRODUCTION

Periodontal
outcomes

- No difference in periodontal health short-term (Storey et al., 2017)



INTRODUCTION

Stability

**Periodontal
health**

**Patient-
reported
outcomes**



Cochrane Database of Systematic Reviews

**Retention procedures for stabilising tooth position after
treatment with orthodontic braces (Review)**

Littlewood SJ, Millett DT, Doubleday B, Bearn DR, Worthington HV

AIMS

Primary aim

To compare the stability of orthodontic outcomes with fixed and removable retainers over a period of at least 4 years

Secondary aim

To investigate periodontal outcomes with fixed versus removable retainers over this period

MATERIALS AND METHODS


Study design

Follow-up of a randomised controlled trial



- n= 82
- Selection criteria
- Computer generated random numbers
- Allocation concealment
- Interventions
- Sample size calculation (Rowland et al., 2007)


MATERIALS AND METHODS

RANDOMIZED CONTROLLED TRIAL  AJO-DO

Effectiveness of bonded and vacuum-formed retainers: A prospective randomized controlled clinical trial

Niamh O'Rourke,^a Hussein Albeedh,^a Pratik Sharma,^b and Ama Johal^c
London, United Kingdom



RANDOMIZED CONTROLLED TRIAL  AJO-DO

Effects of fixed vs removable orthodontic retainers on stability and periodontal health: 4-year follow-up of a randomized controlled trial

Dalya Al-Moghrabi,^a Ama Johal,^b Niamh O'Rourke,^c Nikolaos Donos,^b Nikolaos Pantis,^d Cecilia Gonzales-Marin,^b and Padhraig S. Fleming^a
London, United Kingdom, Riyadh, Saudi Arabia, Bern, Switzerland, and Corfu, Greece

**18-month
follow-up**



**4-year
follow-up**

MATERIALS AND METHODS

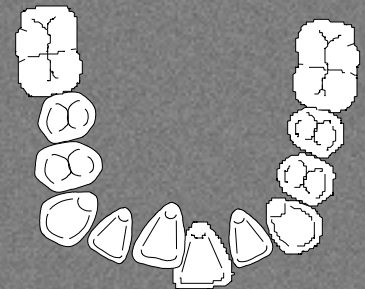
Study model measurements

Irregularity of the mandibular incisors

Inter-canine and inter-molar widths

Arch length

Extraction space opening



MATERIALS AND METHODS

Clinical measurements

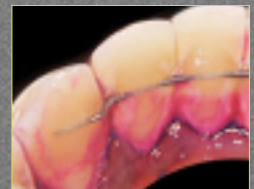
Gingival inflammation (MGI)

Calculus levels (CI)

Plaque levels (QHI)

Clinical attachment level

Bleeding on probing (present/absent)



RESULTS

Previous RCT (O'Rourke et al. 2016)

T0

Participants enrolled in the study (n= 82)

T1

Participants attended 6-month follow up
(n=74)

T2

Participants attended 12-month follow up
(n=59)

T3

Participants attended 18-month follow up
(n=48)

T4

Excluded (n= 40)
Unwilling to participate (n= 19)
Unable to contact (n= 16)
Moved or had work commitments (n= 5)

Present follow-up study

Fixed retainer group
n= 21

Vacuum-formed retainer group
n= 21

RESULTS

		Overall sample n= 42	Fixed retainer group n= 21	Vacuum-formed retainer group n= 21
Mean age in years (SD)		21.15 years (2.41)	21.54 years (3.06)	20.77 years (1.49)
Gender	Males	n= 10	n= 18	n= 7
	Females	n= 32	n= 18	n= 14
Mean years in retention (SD)		4.16 (0.35)	4.09 (0.25)	4.23 (0.42)
Treatment protocol	Extraction	n= 19	n= 9	n= 10
	Non-extraction	n= 23	n= 12	n= 11



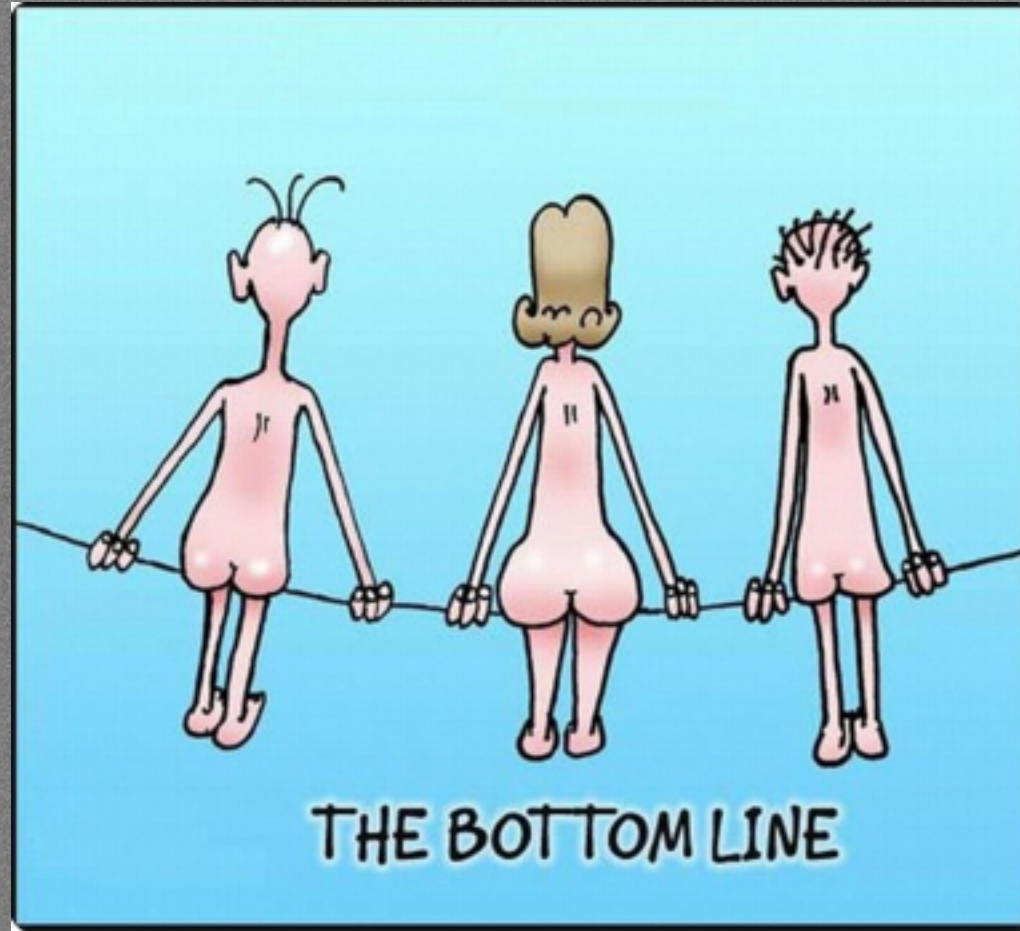
RESULTS: STABILITY



Outcome measures	Number of participants	Time point	Statistical measures	Fixed retainer group	Vacuum-formed retainer group	Coefficient	95 Confidence Interval	P-value
Irregularity index	FR group: n= 21	T4-T0	Median	0.85	2.37	1.64	0.30, 2.98	0.02*
	VFR: n= 21		IQR	0.91	2.26			
Inter canine-width	FR group: n= 21	T4-T0	Median	-0.28	-0.52	-0.26	-1.07, 0.55	0.52
	VFR group: n= 21		IQR	0.88	1.6			
Inter molar-width	FR group: n= 21	T4-T0	Median	0.15	-0.42	-0.40	-1.72, 0.93	0.55
	VFR group: n= 19		IQR	2.08	2.09			
Arch length	FR group: n= 21	T4-T0	Median	-3.63	-3.78	-0.01	-1.15, 1.14	0.99
	VFR group: n= 19		IQR	0.59	2.1			
Extraction site opening	FR group: n= 9	T4-T0	Median	1.23	1.65	0.16	-1.54, 1.86	0.84
	VFR group: n= 10		IQR	1.14	2.13			



CLINICAL IMPLICATIONS?

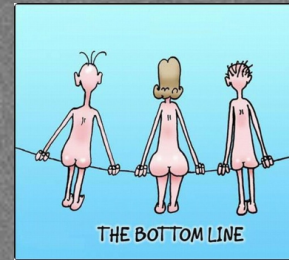
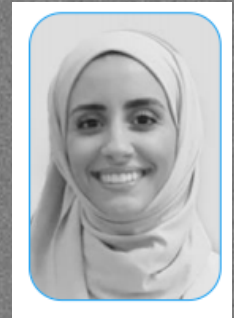




CLINICAL IMPLICATIONS?



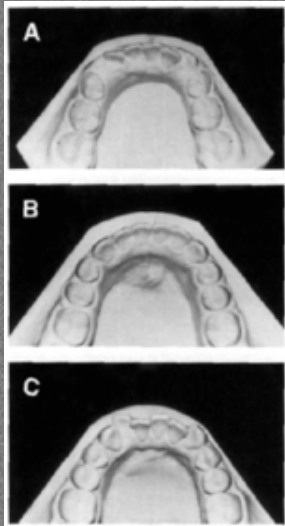
- SHOULD WE BE CONSIDERING MORE ROUTINE USE OF BONDED RATHER REMOVABLE RETENTION IF WE ARE TO PRODUCE THE BEST LONG-TERM TREATMENT OUTCOMES?



RETENTION: TAKING THE LONG VIEW



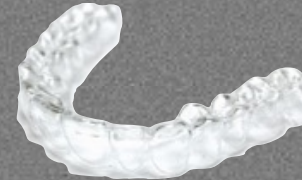
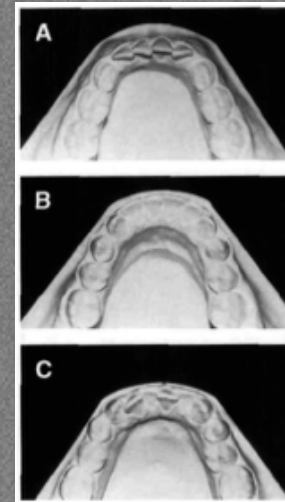
RESEARCH: CHANGING MY PRACTICE



Stability and Relapse of Mandibular Anterior Alignment: University of Washington Studies

Robert M. Little

For more than 40 years, research in the Department of Orthodontics, University of Washington (Seattle, WA) has focused on a growing collection of more than 800 sets of patient records to assess stability and relapse of orthodontic treatment. All patients had completed treatment a decade or more before the last set of data. Evaluation of treated premolar extraction patients, treated lower incisor extraction patients, treated nonextraction cases with generalized spacing, patients treated with arch enlargement strategies, and untreated normals showed similar physiologic changes: (1) Arch length decreases after orthodontic treatment. (2) Arch width measured across the mandibular canine teeth typically reduces posttreatment, whether or not the case was expanded during treatment. (3) Mandibular anterior crowding during the posttreatment phase is a continuing phenomenon well into the 20-to-40 years age bracket and likely beyond. (4) Third molar absence or presence, impacted or fully erupted, seems to have little effect on the occurrence or degree of relapse. (5) The degree of postretention anterior crowding is both unpredictable and variable and no pretreatment variables either from clinical findings, casts, or cephalometric radiographs before or after treatment seem to be useful predictors. (Semin Orthod 1999;5:191-204.) Copyright © 1999 by W.B. Saunders Company



- 'LONG-TERM' RETENTION
- 70 YEARS???
- UNTESTED
- ● ● ● ● ● ● ●
- PITFALLS:
 - COMPLIANCE
 - BREAKAGE AND LOSS
 - PERIODONTAL

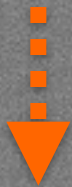




RESEARCH: CHANGING MY PRACTICE



FIXED RETENTION



- INCREASED USE
- ALL ADULTS (UPPER AND LOWER)
- MAJORITY OF ADOLESCENTS



REMOVABLE RETENTION



- DECREASED USE
- LONGEVITY/ THICKNESS
- IMPROVING COMPLIANCE

RANDOMIZED CONTROLLED TRIAL

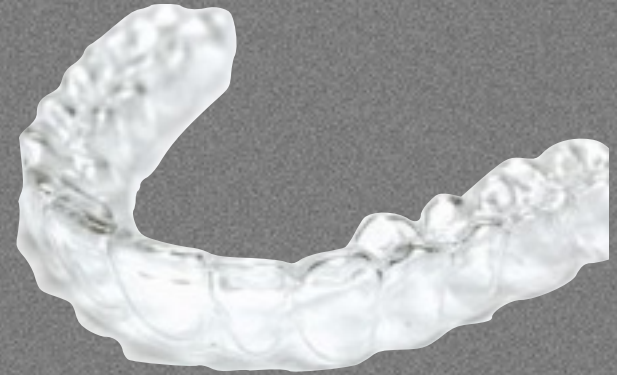


AJO-DO

Effects of fixed vs removable orthodontic retainers on stability and periodontal health: 4-year follow-up of a randomized controlled trial



Dalya Al-Moghrabi,^a Ama Johal,^b Niamh O'Rourke,^c Nikolaos Donos,^b Nikolaos Pandis,^d Cecilia Gonzales-Marin,^b and Padhraig S. Fleming^b
London, United Kingdom, Riyadh, Saudi Arabia, Bern, Switzerland, and Corfu, Greece



REMOVABLE
RETENTION

- COMPLIANCE:
- 100% AT 6 MONTHS
- 81% AT 12 MONTHS
- 48% AT 2 YEARS
- 33% > 2 YEARS



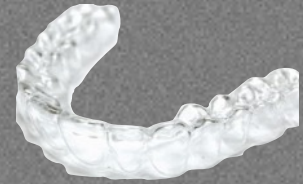
PATIENT PERSPECTIVES

Scientific Section

Factors influencing adherence to vacuum-formed retainer wear: A qualitative study

Dalya Al-Moghrabi^{1,2}, Fiorella Beatriz Colonio Salazar^{1,3}, Ama Johal¹ and Padhraig S Fleming¹

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1-8
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SAGE



- QUALITATIVE STUDY
- 15 PARTICIPANTS: ESSIX GROUP
- ONE-TO-ONE INTERVIEWS
- THEMATIC ANALYSIS





PATIENT PERSPECTIVES

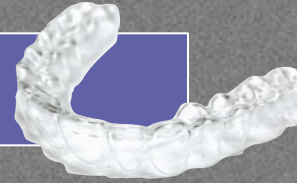
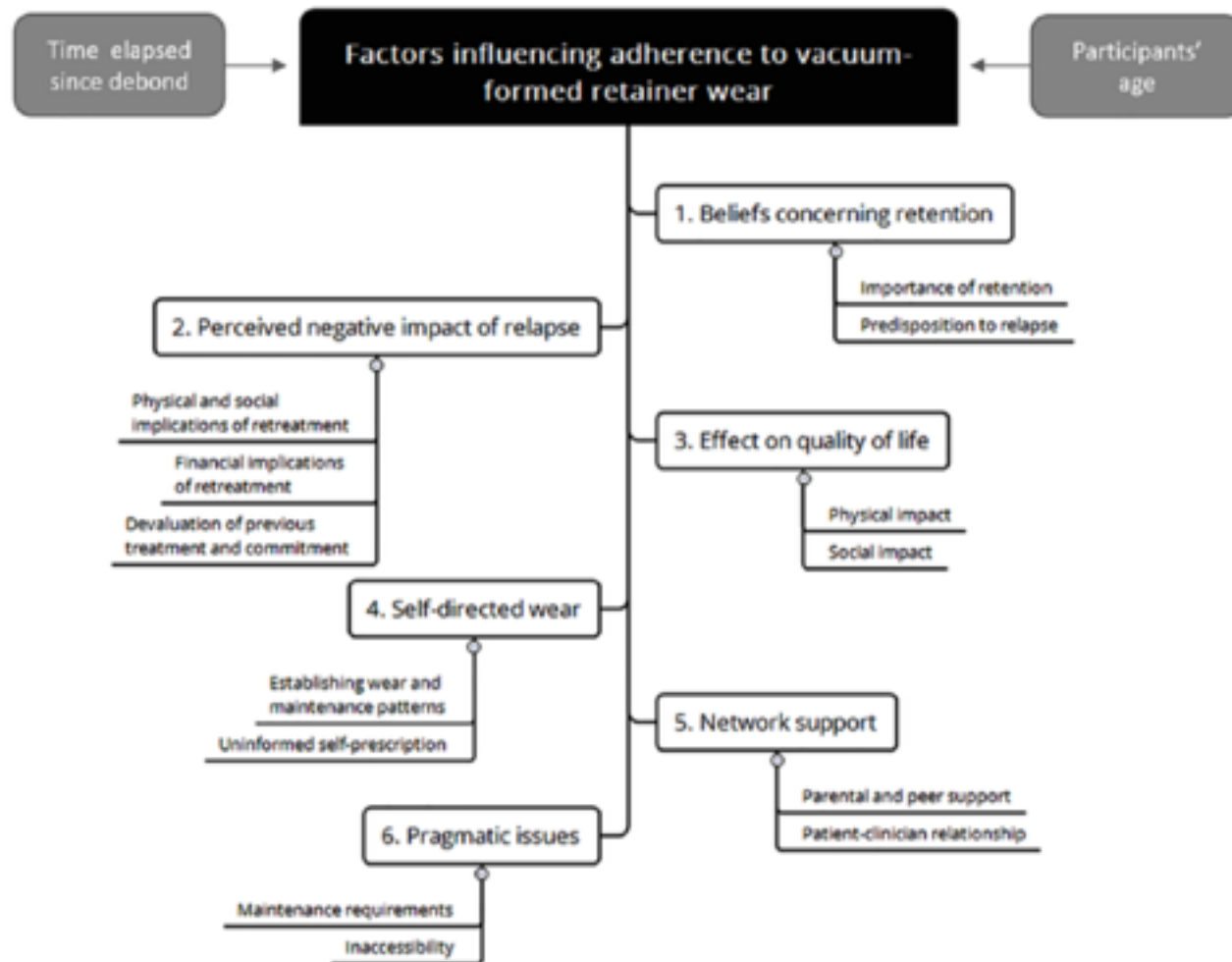
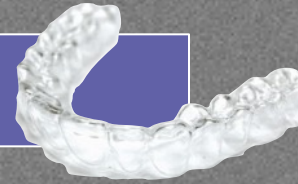


Figure 1. Factors influencing adherence to vacuum-formed retainer wear.

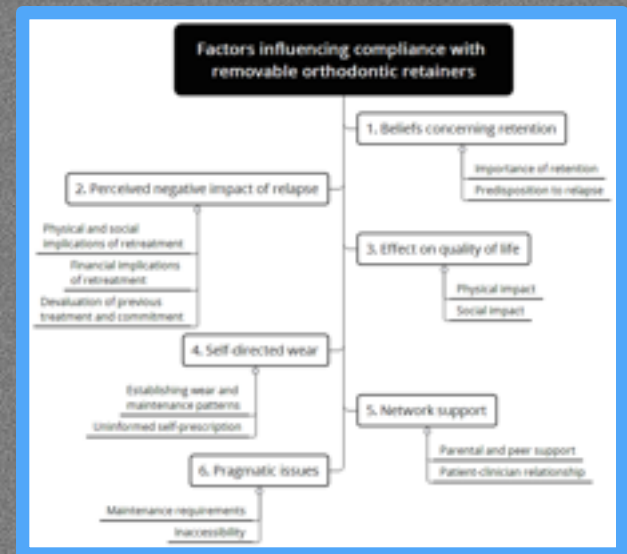




PATIENT PERSPECTIVES



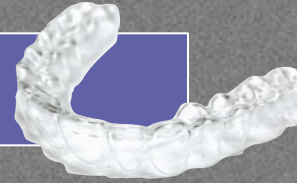
"FOUR YEARS-WORTH OF BRACES THAT I CANNOT LET GO DOWN THE DRAIN... I DIDN'T GO THROUGH ALL OF THAT FOR NO REASON. I DIDN'T WEAR BRACES TO MY PROM FOR NO REASON." (F- COMP THROUGHOUT P⁵)



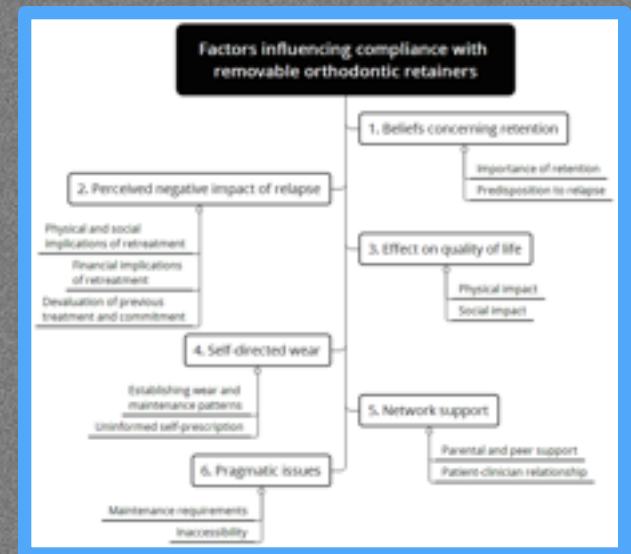
- "MENTALLY, THE TREATMENT'S ALREADY DONE. I DON'T NEED TO CONTINUE." (F- COMP TO 2MON P¹⁵)



PATIENT PERSPECTIVES

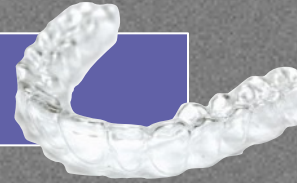


"I JUST DIDN'T THINK THAT I REALLY NEEDED TO WEAR IT [RETAINER] AS OFTEN AS THEY SAID SO I JUST WENT MY OWN WAY... THAT WAS MY OWN DECISION... I DON'T THINK WHEN YOU HAVE YOUR BRACES OFF IT'S NORMAL FOR YOU TO CONTACT YOUR ORTHODONTIST (F- COMP TO 2Y^{P2})

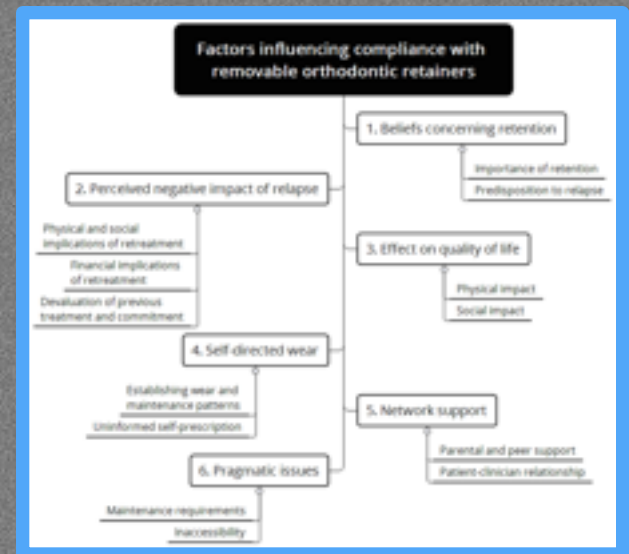




PATIENT PERSPECTIVES



"IT WAS MY MUM, SHE PUSHED ME TO WEAR THE RETAINERS. SHE SAID THAT I WOULD HAVE TO LISTEN TO THE DOCTOR AND I'M LIKE 'OKAY YEAH, I'LL WEAR THEM'. BUT, I JUST COULDN'T AS I FELT LIKE IT WASN'T HELPING ME" (F-COMP TO 2MON P¹²)





What are people tweeting about orthodontic retention? A cross-sectional content analysis



Dalya Al-Moghrabi,^a Ama Johal,^b and Padhraig S. Fleming^b
London, United Kingdom, and Riyadh, Saudi Arabia

quently determined. **Results:** Of 827 tweets, 660 were included in the analysis. The main themes identified included compliance, impact, maintenance, patient-clinician relationship, and positive and negative feelings. Compliance with orthodontic retainers was the most frequently coded theme ($n = 248$), with most reporting suboptimal compliance. The negative impact of orthodontic retainers on social and daily activities ($n = 192$) and the maintenance requirements ($n = 115$) were commonly mentioned. Patients also frequently expressed feelings about their clinician. **Conclusions:** Subjective experiences in relation to orthodontic retainers were commonly shared on Twitter. Most of the publicly available tweets portrayed retainer wear in a negative light.

What are people tweeting about orthodontic retention? A cross-sectional content analysis

Dalya Al-Moghrabi,^a Ama Johal,^b and Padhraig S. Fleming^b
London, United Kingdom, and Riyadh, Saudi Arabia

no point the dentist telling me to wear my retainers throughout the day when all i do is eat

6:41 AM - 21 Dec 2016

1



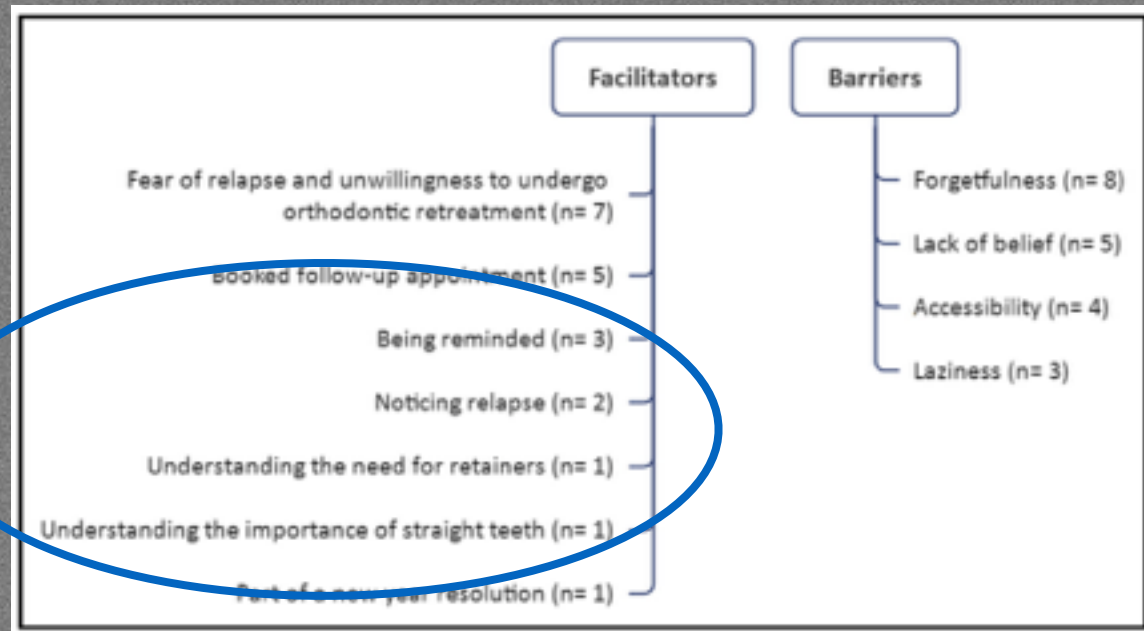
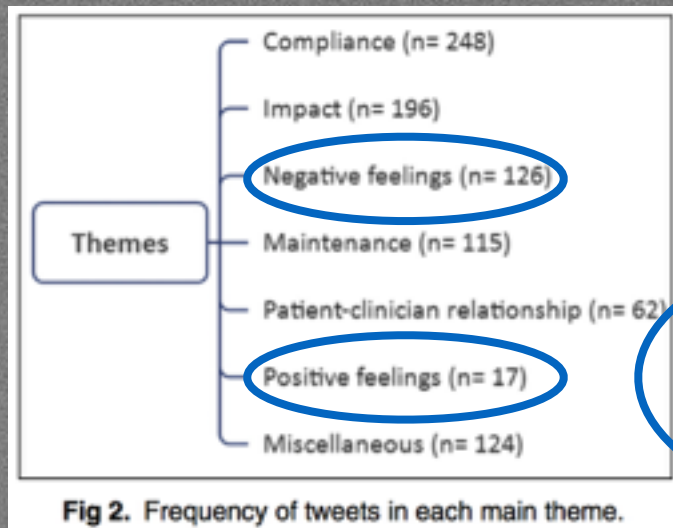
Table I. Main themes, with definitions and a relevant representative tweet

Main theme	Definition	Representative tweet
Compliance	Indicates retainer wear status, consequences of poor compliance, barriers, or facilitators.	"Omg i just realized Ive been forgetting to sleep with my retainers in ... for like ... the last 3 years"
Impact	Illustrates the effects of retainers on daily activities or social life.	"The dentist told me I need to start wearing my retainers again ... cant wait to look nerdy w/ugly lips"
Maintenance	Refers to the care needed to maintain or prevent the loss of orthodontic retainers.	"Flossing with permanent retainers is difficult. I should be paid for this. I made my orthodontist so much money."
Patient-clinician relationship	Concerns the ease or difficulty in dealing with or accessing clinicians, or describes the quality of communication between patients and clinicians.	"When your orthodontist says you can start wearing your retainers at night only but you've already been doing that."
Positive feelings	Any tweet related to retainer wear expressed in a positive tone.	"Feel so accomplished for having worn my retainers every night this week lol."
Negative feelings	Any tweet related to retainer wear expressed in a negative tone.	"I HATE HATE HATE HATE HATE RETAINERS."
Miscellaneous	Any tweet providing information not categorized in the main themes.	"Dentist tomorrow to pick up retainers and finally get this ... screw out my jaw then post brace life officially starts."



What are people tweeting about orthodontic retention? A cross-sectional content analysis

Dalya Al-Moghrabi,^a Ama Johal,^b and Padhraig S. Fleming^b
London, United Kingdom, and Riyadh, Saudi Arabia



INFORMATION AND UNDERSTANDING

De-bond Patient Questionnaire: Non-App Patients

Congratulations, your braces will be coming off today!

We would like you to tell us what you remember about what will be happening on today's appointment. Please only circle one option in each of the questions below.

1. Removing the attachments off my teeth will take

☐ A few seconds

☒ A few minutes

☐ A few hours

2. Cleaning the glue off my teeth, taking moulds and photos will take another

☒ 5 minutes

☐ 30-40 minutes

☐ 2-3 hours

3. When removing your braces, you will feel

☐ Nothing at all

☒ Slight pressure

☐ Lots of pain

4. Attachments on my teeth (and metal bands if you have had them placed) will be removed using

☒ Scissors

☐ Drill

☐ Pliers

☐ Your orthodontists hands






5. When the attachments are removed the glue remaining on your teeth will be removed using:

☐ Air and water

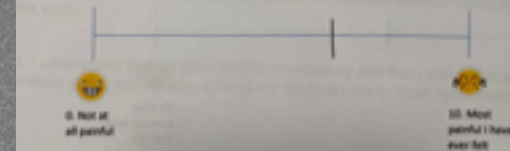
☒ Suction

☐ A rotating hand piece (dental drill)

☐ Nothing- it will be left on your teeth

Questions	1. 	2. 	3. 	4. 	5. 
1. How well prepared did you feel before having your braces removed?		<input checked="" type="checkbox"/>			
2. How would you rate your overall experience of having your braces removed?			<input checked="" type="checkbox"/>		
3. Do you feel that the procedure went as you expected?		<input checked="" type="checkbox"/>			

Place a vertical line on the horizontal line below to indicate your level of pain in relation to the process of having your braces removed.



Factors influencing compliance with removable orthodontic retainers



INFORMATION AND UNDERSTANDING

De-bond Patient Questionnaire: Non-App Patients

Congratulations, your braces will be coming off today!

We would like you to tell us what you remember about what will be happening on today's appointment. Please only circle one option in each of the questions below.

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☐ 30-40 minutes

☐ 2-3 hours

3. When removing your braces, you will feel

☐ Nothing at all

☒ Slight pressure

☐ Lots of pain

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☐ Drill

☐ Pliers

☐ Your orthodontists hands

5. When the attachments are removed the glue remaining on your teeth will be removed using:

☐ Air and water

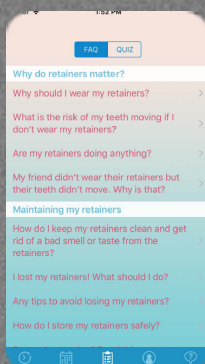
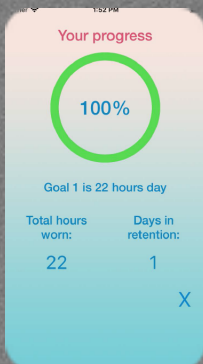
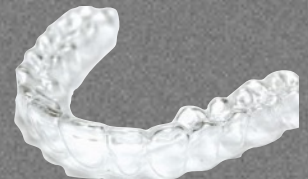
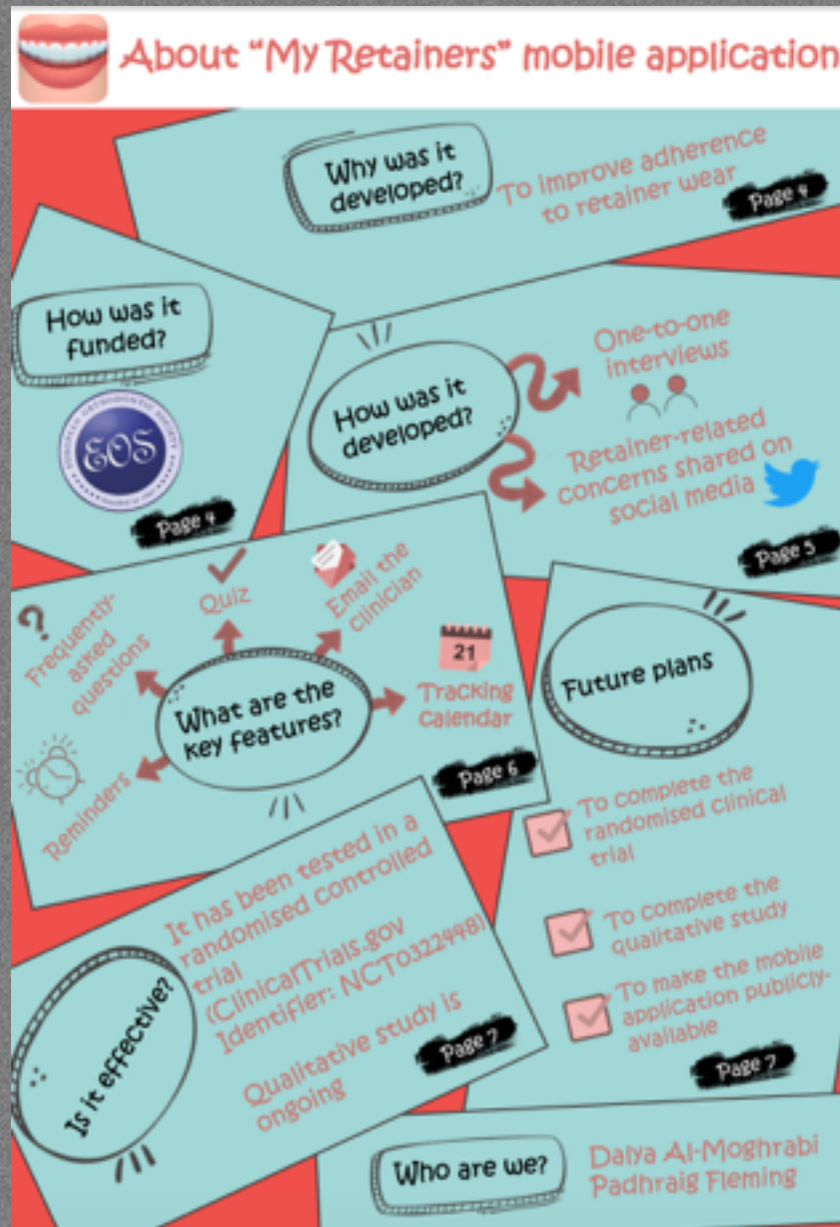
☒ Suction

☐ A rotating hand piece (dental drill)

☐ Nothing- it will be left on your teeth



REMOVABLE RETENTION: APP DEVELOPMENT



REMOVABLE RETENTION: APP DEVELOPMENT

FAQ

FAQ

QUIZ

Why do retainers matter?

Why should I wear my retainers? >

What is the risk of my teeth moving if I don't wear my retainers? >

Are my retainers doing anything? >

My friend didn't wear their retainers but their teeth didn't move. Why is that? >

Maintaining my retainers

How do I keep my retainers clean and get rid of a bad smell or taste from the retainers? >

I lost my retainers! What should I do? >

Any tips to avoid losing my retainers? >

How do I store my retainers safely? >



Hours



Calendar



FAQ & Quiz



Profile



Help

Calendar

May 2019

M	T	W	T	F	S	S
		01	02	03	04	05
06	07	08	09	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

Add Hours



Hours



Calendar



FAQ & Quiz



Profile



Help

Auto-generated responsive feedback system

Great, you've done it for today!



Hours



Calendar



FAQ & Quiz



Profile



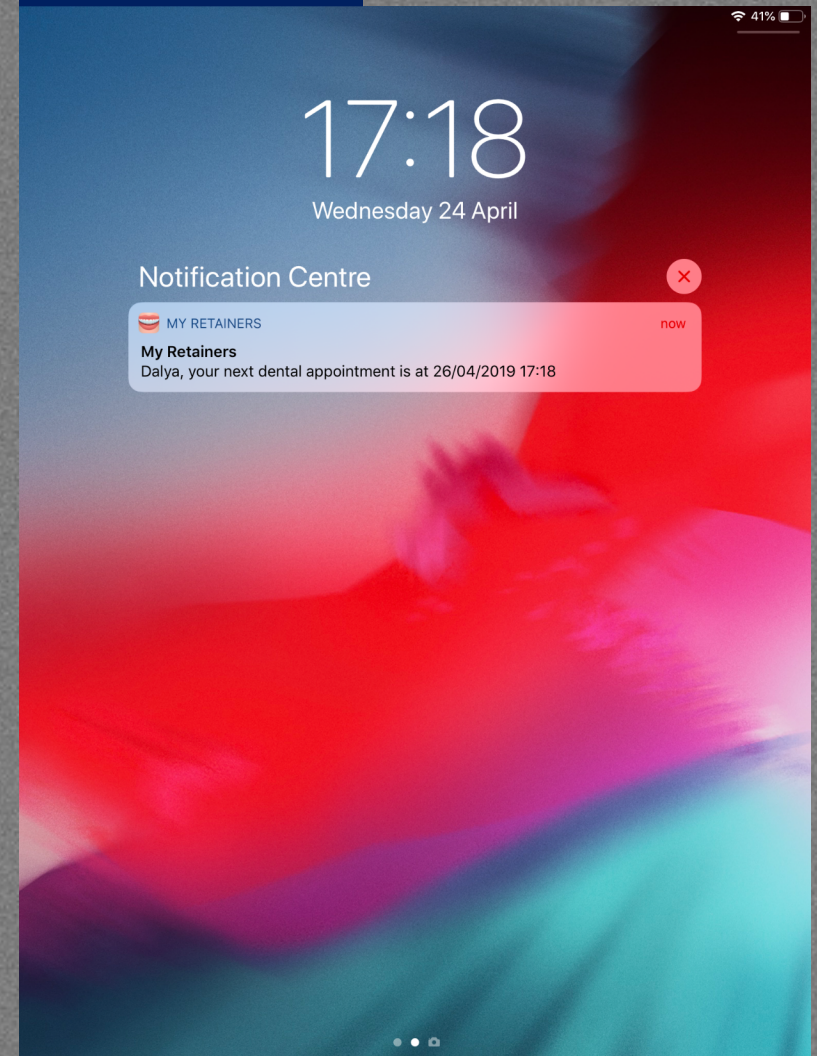
Help

REMOVABLE RETENTION: APP DEVELOPMENT

Notifications



Appointment reminder

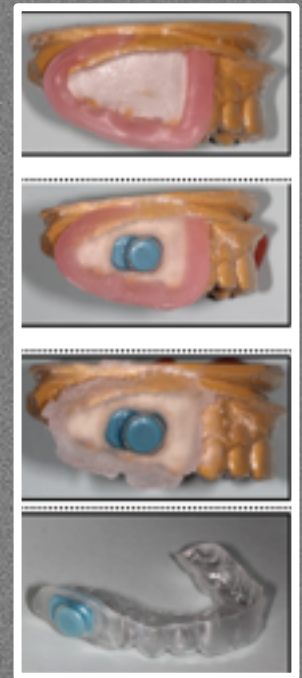
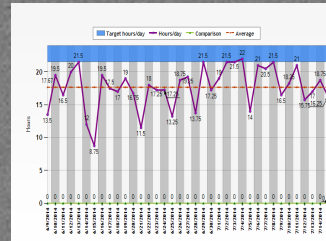
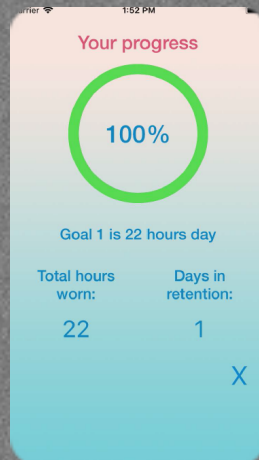
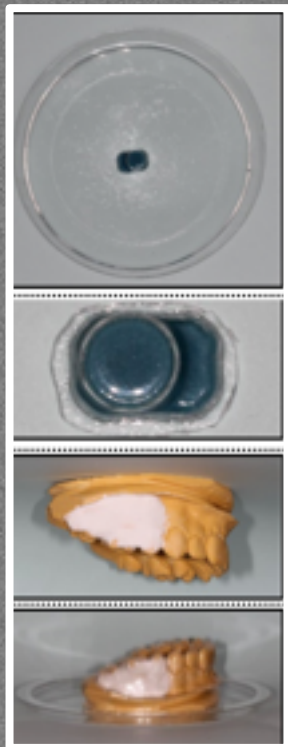


REMOVABLE RETENTION: APP DEVELOPMENT

APP

VS.

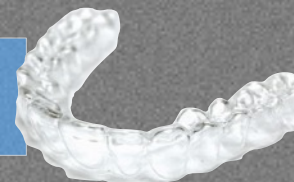
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APP

VS.

NO APP



Mobile Application RCT



Aims

Adherence

Stability

Periodontal outcomes

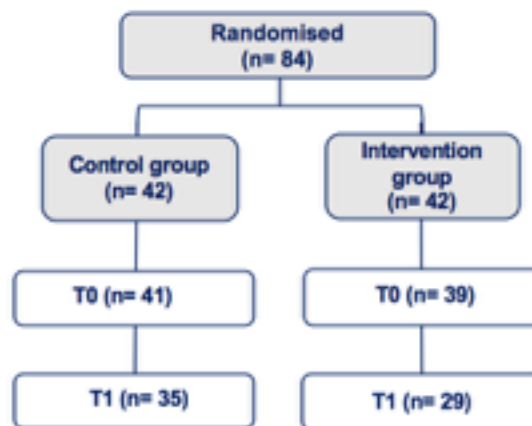
Patient perspectives

Methods

- Selection criteria
- Randomisation
- Allocation
- Follow-up
- Interventions
- Outcomes
 - Wear time
 - Irregularity
 - Periodontal outcomes
 - Experiences
 - Knowledge



Results



- **Objective wear time:**
 - 0.91 hours/day ($P= 0.56$; 95% CI: -2.19, 4.01 hours/day)
- **Stability** ($P= 0.92$; 95% CI: -0.03, 0.04)
- **Periodontal outcomes** ($P>0.05$)
- **Experiences** ($P= 0.94$) and **knowledge** ($P= 0.26$)

Conclusions

- Provision of the bespoke 'My Retainers' application did not lead to an improvement in adherence with thermoplastic retainer wear over a 3-month follow-up period.
- Further refinement and research are required to develop and investigate means of enhancing adherence levels.



APP

VS.

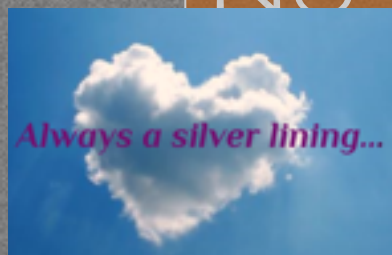
NO APP

Outcomes		Control group*	Intervention group	Coefficient	95% CI	P-value
Adherence levels	Objective data (h/d)	6.21 (7.86)	7.25 (6.71)	-0.91	-4.01, 2.19	0.56
	Percentage of participants with ≥3 consecutive days of no retainer wear	57.6%	53.6%	-		
	Median percentage of days with wear as instructed (8 h/d and a minimum of 2 hours of continuous use)	46.67 (70.26)	55.70 (59.86)	-		
Stability outcomes	Maxilla	T0: 0.12 (0.1) T1: 0.14 (0.17)	T0: 0.16 (0.18) T1: 0.19 (0.22)	0.002	-0.03, 0.04	0.92
	Mandible	T0: 0.16 (0.14) T1: 0.16 (0.21)	T0: 0.11 (0.12) T1: 0.16 (0.13)			

6-7 HOURS PER DAY

NO DIFFERENCE BETWEEN GROUPS

NO RELAPSE YET!!





APP

VS.

NO APP

Periodontal outcomes	Plaque scores	Maxilla	T0: 0.84 (0.27) T1: 0.74 (0.22)	T0: 0.84 (0.18) T1: 0.75 (0.17)	-0.02	-0.07, 0.03	0.44
		Mandible	T0: 0.79 (0.25) T1: 0.76 (0.18)	T0: 0.84 (0.17) T1: 0.77 (0.17)			
	Bleeding on probing	Maxilla	T0: 0.17 (0.18) T1: 0.09 (0.1)	T0: 0.16 (0.17) T1: 0.08 (0.14)	-0.01	0.05, 0.03	0.61
		Mandible	T0: 0.17 (0.18) T1: 0.1 (0.14)	T0: 0.20 (0.14) T1: 0.11 (0.1)			
	CAL	Maxilla	T0: 2.0 (0.18) T1: 1.93 (0.24)	T0: 2.0 (0.25) T1: 1.92 (0.31)	-0.01	-0.09, 0.07	0.79
		Mandible	T0: 1.7 (0.27) T1: 1.62 (0.22)	T0: 1.8 (0.18) T1: 1.6 (0.27)			



NO DIFFERENCE

NO PERIODONTAL PROBLEMS



REMOTE MONITORING

DENTAL MONITORING[®]

Connected Orthodontics

DENTAL
MONITORING

[WHY DM?](#)

[ABOUT US](#)

[REGISTER](#)


Be the orthodontist your patients want
you to be


Show your patients you value their time, while we help you and your
team optimise your appointments and treatment outcomes.



Watch video



23 AUG 2018







Overbite: ?
Overjet: ?


R L


Molar  

Cuspid  

VIEW DM NOTIFICATION



4 DEC 2018







Overbite: ?
Overjet: ?

R L

Molar  

Cuspid  

VIEW DM NOTIFICATION

DEC 4, 2018

Notification sent to patient (Action performed by DM)
Notified patient to change their aligners.
GO – despite unseat

DEC 4, 2018

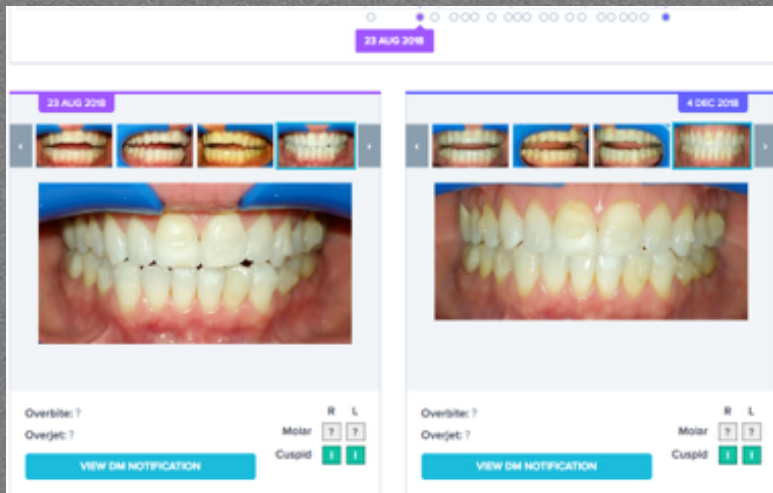
New notification to doctor (Action performed by DM)
Slight unseat still present: 2.2
Patient message: GO – despite unseat
Patient message: RECOMMENDATION – Use the chewies
Patient message: RECOMMENDATION – Improve aligner wear

REMOTE MONITORING

DENTAL MONITORING[®]

Connected Orthodontics

- ACTIVE TREATMENT
- SUPERVISION OF RETENTION???



BRUSH YOUR TEETH!!



**DENTAL
MONITORING**
Connected Orthodontics

SEP 14, 2018

Message sent to patient

Hi Yen, Please when you brush your teeth in the upper arch - if you angle the brush towards the gum margins. I thought this YouTube video might help. It is a subtle alteration of your technique possibly, but it will help you to improve the gums during your treatment.


<https://uk.video.search.yahoo.com/search/video?fr=mcafee&p=brushing+bass+technique+you+tube#id=17&vid=17758096a5acc8ee8eed61e29e8e6650&action=view>
[\[view details\]](#)

Accuracy of a smartphone-based orthodontic treatment–monitoring application: *A pilot study*

Heather B. Moylan^a; Caroline K. Carrico^b; Steven J. Lindauer^c; Eser Tüfekçi^d

CONCLUSIONS

- In-office and software measurements of the intercanine and intermolar widths are equivalent within 0.5 mm.
- There is insufficient evidence of a difference in image quality when the intraoral video scans are taken by patients vs by the clinician.
- Provided the quality of the video scans are acceptable, the use of monitoring software can be reliable for making clinical decisions.

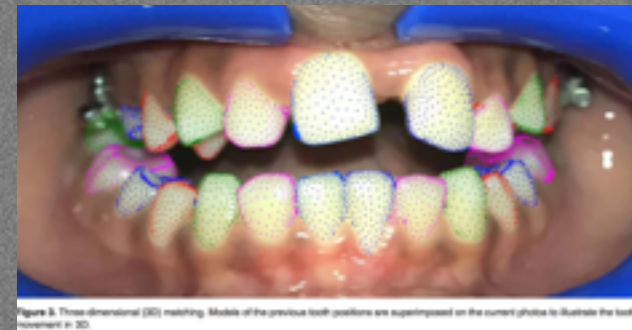


Figure 3. Three-dimensional (3D) matching. Models of the previous tooth positions are superimposed on the current photos to illustrate the tooth movement in 3D.

Techno bytes

Accuracy of Dental Monitoring 3D digital dental models using photograph and video mode

Ryan S. Morris ^a, Lauren N. Hoyer ^a, Mohammed H. Elnagar ^b✉, Phimon Atsawasuwan ^b, Maria Therese Galang-Boquiren ^b, Jennifer Caplin ^b, Grace Costa Viana ^b, Ales Obrez ^b, Budi Kusnoto ^b



- DM (PHOTO/VIDEO) VS ITERO
- STEREOLITHOGRAPHS
- 0.0015 TO 0.028 MM DIFFERENCE
- CLINICALLY INSIGNIFICANT

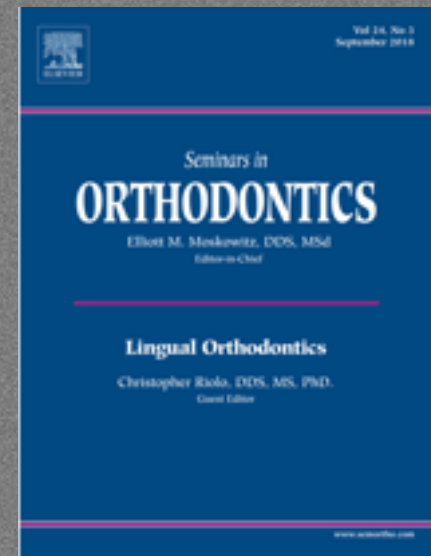
BIG BROTHER IS WATCHING



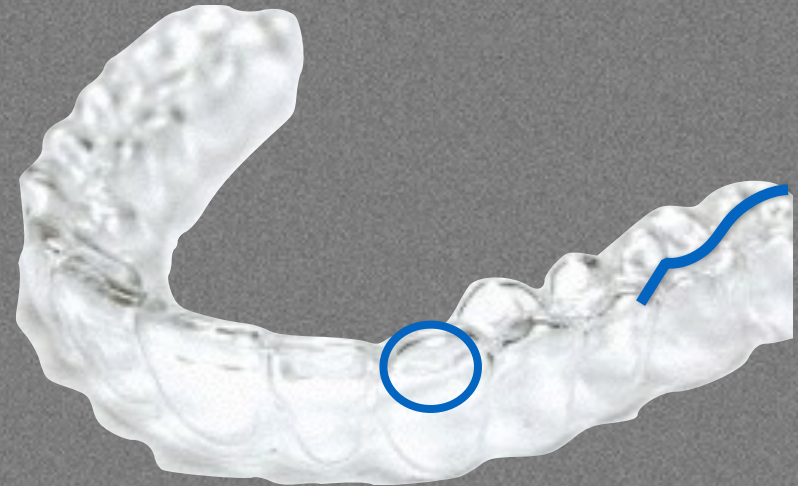
Remote monitoring and “Tele-orthodontics”: Concept, scope and applications

Ismaeel Hansa, Steven J. Semaan, Nikhilesh R. Vaid, and Donald J. Ferguson

Tele-orthodontics is a broad term that encompasses remote provision of orthodontic care, advice, or treatment via information technology. The Purposes of the article were two-fold: (1) to review the rather new concept, applications and scope of teleorthodontics, and (2) to present preliminary results of a study with and without **Dental Monitoring™** (DM) usage on appointment efficiency, patient perspectives and patient demographics. The sample was comprised of 74 consecutively treated Invisalign® patients using DM™ and 85 consecutively completed Invisalign® patients. An online questionnaire was given to the DM™ group to assess the patients' perspective on the ease of use and benefit to treatment experience using a 5-point Likert scale. Also requested was a list of 5 benefits and problems while using DM™. Independent *t*-tests were used to determine any inter-group differences in, number of appointments and age; a chi-square test was used for differences between genders. Significance was set at $P \leq 0.05$. Mean number of appointments was significantly lower by 1.68 appointments for DM compared to control ($P < 0.001$). Age averaged 3.2 years younger for the DM group ($P < 0.05$). More males used DM than the control group (31.6% vs 16.7%, $P < 0.05$, respectively). The mean Likert scale rating for “ease of use” was 4.31 out of 5.0, while benefit to treatment experience rating was 4.4. The most oft-mentioned perceived benefits were “better communication” (47 times), “increased convenience” (44 times), “reduced number of appointments” (40 times), and “ease of use” (38 times). The most oft-mentioned problems were related to the “difficulty of taking scans” (27 times) and “reduced communication” (12 times). Preliminary study results suggest the number of appointments may be reduced with Dental Monitoring. In addition, there was a positive patient perception on the use of DM. (Semin Orthod 2018; ■:1–12) © 2018 Elsevier Inc. All rights reserved.



REMOVABLE RETENTION: ESSIX THICKNESS



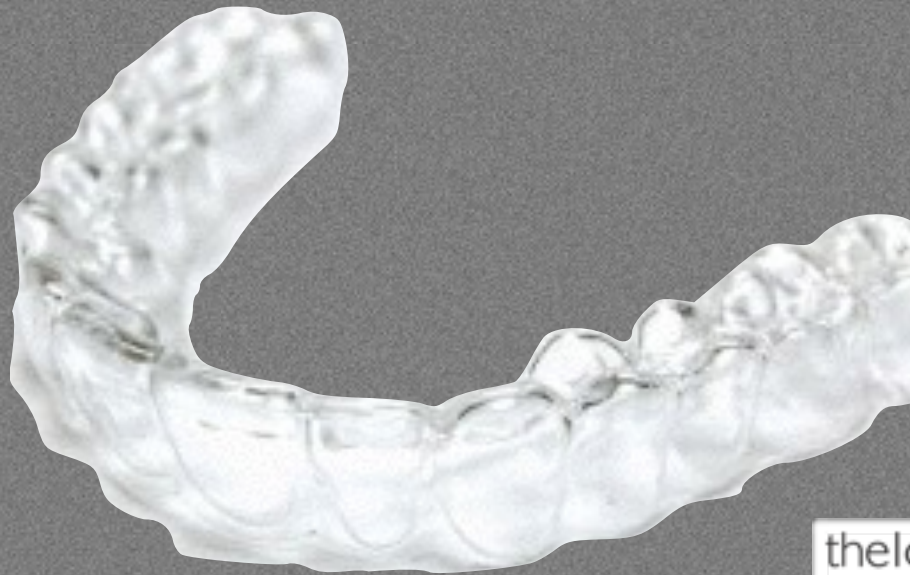
REMOVABLE RETENTION: ESSIX THICKNESS

2017:
1MM

0.6MM

2018:
1.5MM

0.9MM

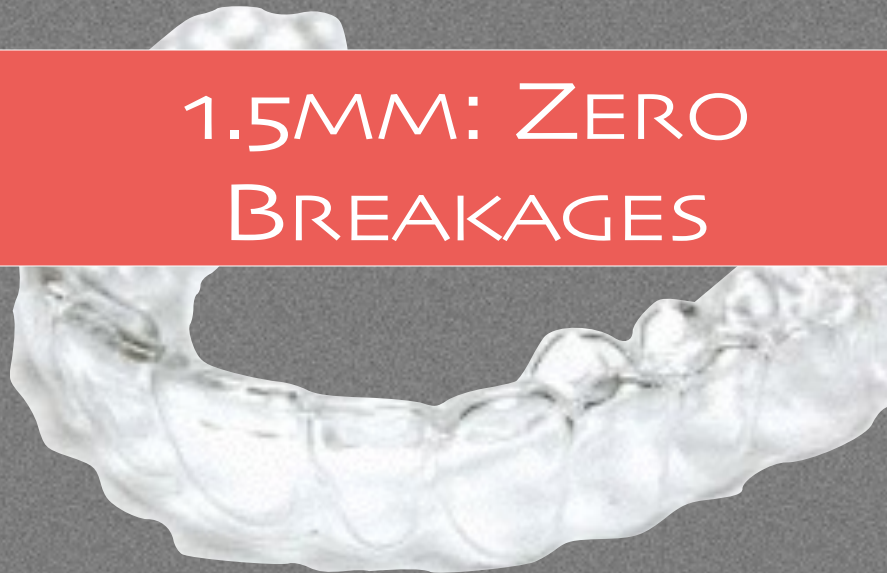


REMOVABLE RETENTION: ESSIX THICKNESS

BREAKAGE
RATE
2017
(APR-
JUNE)

14: 1, 7, 6

BREAKAGE
1MM:
100%



1.5MM: ZERO
BREAKAGES

BREAKAGE
RATE
2018
(APR-
JUNE)

14: 5, 5, 4

BREAKAGE
1MM:
100%

FIXED RETENTION: COMPLICATIONS

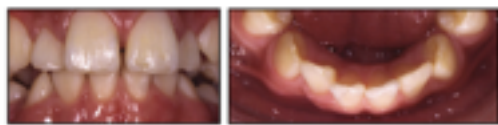


Fig 1. Pretreatment photographs.

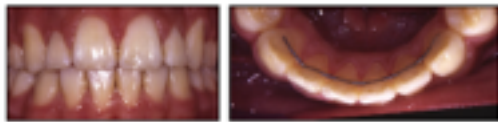
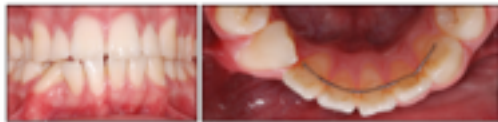


Fig 2. Posttreatment photographs.



Severe complication of a bonded mandibular lingual retainer

Pawel Pazera,¹ Piotr Fudalej² and Christos Katsaros³
Bern, Switzerland, and Olomouc, Czech Republic

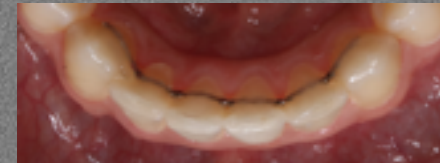
- RESIDUAL ACTIVITY?
- DE NOVO ACTIVITY?
- 'STRESS-BREAKER'

Myths and realities in orthodontics

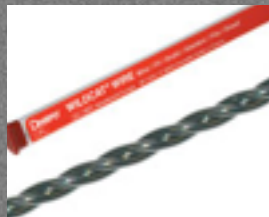
P. S. Fleming,¹ S. D. Springate² and R. A. C. Chate³



FIXED RETENTION: COMPLICATIONS



2016



2019



FIXED RETENTION: DESIGN



- WIDE AREA
- SHALLOW, BROAD FOOTPRINT
- FORCE PROPAGATION?

FIXED RETENTION: COMPLICATIONS

- CAD-CAM NiTi
- SCAN
 -
 -
 -
 -
 -
 -
 -
- ADDITIONAL APPOINTMENT (DURING FINISHING STAGE)
- COST









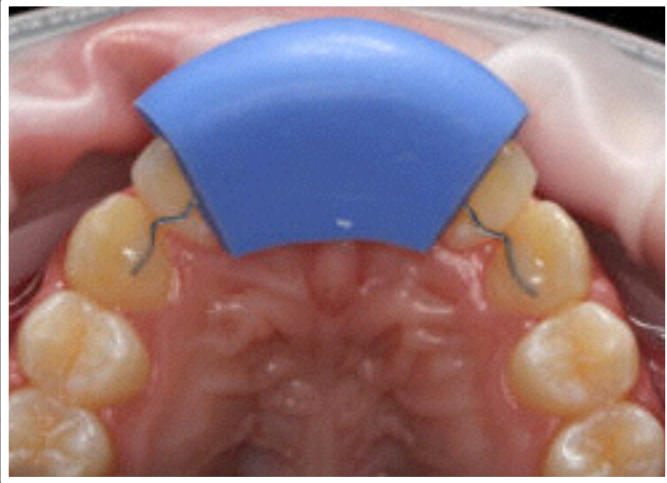
'OTHER HALF'



FIXED RETENTION: PLACEMENT



PLACEMENT: INDIRECT



• TRANSFER JIG



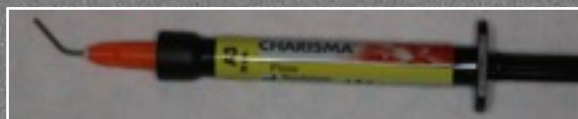
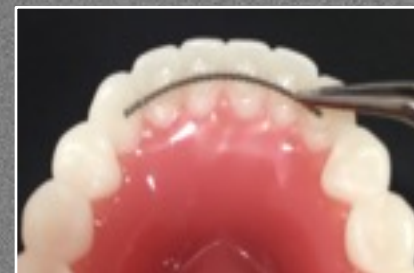
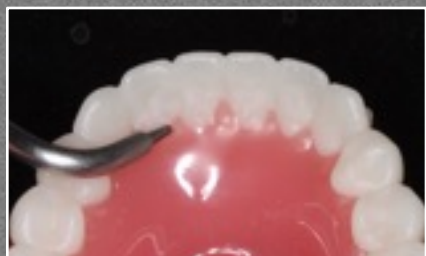
FIXED RETENTION: PLACEMENT



• £50-£125



FIXED RETENTION: PLACEMENT



FIXED RETENTION: PLACEMENT





HIERARCHY



- 
- ALIGNMENT: IRREGULARITY AND SPACING
 - TRANSVERSE CHANGE
 - VERTICAL CHANGE: AOB
 - VERTICAL CHANGE: DEEP OVERBITE
 - ANTERO-POSTERIOR CHANGE

The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension



HIERARCHY



- 
- ALIGNMENT: IRREGULARITY AND SPACING
 - TRANSVERSE CHANGE
 - VERTICAL CHANGE: AOB
 - VERTICAL CHANGE: DEEP OVERBITE
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The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension


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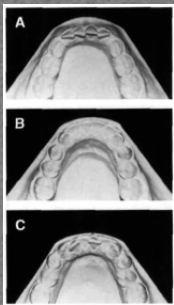
The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension

HIERARCHY

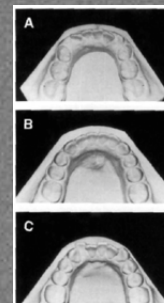
- 
- ALIGNMENT: IRREGULARITY AND SPACING
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 - ANTERO-POSTERIOR CHANGE



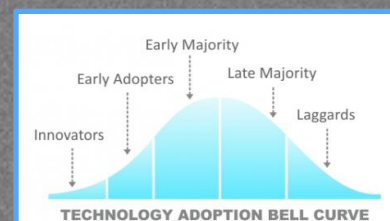
The hierarchy of stability and predictability in orthognathic surgery with rigid fixation: an update and extension



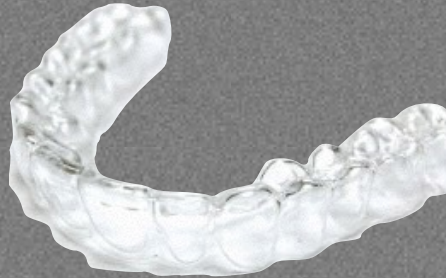
CONCLUSIONS



- RETENTION: CONSIDER THE LONG-TERM
- REMOVABLE: COMPLIANCE, DURABILITY, MONITORING
- FIXED: TECHNIQUE
- NEW TECHNOLOGIES?



RETENTION: NOT LETTING GO?



PADHRAIG FLEMING

