

FEATURES SECTION

Evidence-based orthodontics

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Bond failure and decalcification: a comparison of a cyanoacrylate and a composite resin bonding system. *Am J Orthod Dentofac Orthop* 2003; 123: 624–627

Le PT, Weinstein M, Borislow AJ, Braitman LE

Objectives: To compare the bond failure rates and enamel decalcification on teeth bonded with either cyanoacrylate or a traditional light-cured composite resin (Light Bond, Reliance Orthodontic Products, Itasca, Illinois, USA).

Design: A split-mouth, controlled clinical trial.

Setting: Philadelphia, Pennsylvania, USA.

Participants: Twenty-one patients seeking orthodontic treatment.

Interventions: Teeth were identified by the universal tooth-numbering system 1–32. Even numbered teeth were bonded with cyanoacrylate and odd-numbered teeth with light-cured composite resin.

Outcome measures: Initial bond failure during 12–14 months of treatment. Decalcification affecting 321|123, assessed from clinical photographs taken pre-treatment and 12–14 months later.

Results: Three hundred and twenty-seven teeth were involved in the bonding trial and 94 were assessed for decalcification. There was a statistically significant difference in the bond failure rate for cyanoacrylate and the light-cured composite resin (OR 0.188; 95% CI 0.068, 0.207). The bond failure rate for the cyanoacrylate was 54.0 and 12.2% for the light-cured composite resin. Decalcification worsened in 37 of 47 (78.7%) teeth bonded with cyanoacrylate and 36 of 47 (76.8%) teeth bonded with composite (OR 1.13; 95% CI 0.43, 2.99).

Conclusions: The bond failure rate for cyanoacrylate was significantly higher than for the light-cured composite resin. No differences between the two adhesives in the amount of decalcification were seen.

Implications: This study suggests that, although cyanoacrylate has been used successfully in other medical, dental and non-clinical areas, it is not suitable

for bonding brackets to teeth due to the high bond failure rate.

Dental and skeletal changes after 4 years of obstructive sleep apnea treatment with a mandibular advancement device: a prospective, randomized study. *Am J Orthod Dentofac Orthop* 2003; 124: 53–60

Ringqvist M, Walker-Engström M-L, Tegelberg Å, Ringqvist I

Objectives: To assess the dental and skeletal changes in patients with mild-moderate obstructive sleep apnea (OSA) after 4 years of treatment with a mandibular advancement device (MAD).

Design: A randomized controlled trial.

Setting: Västerås, Sweden.

Participants: Ninety-five men with confirmed mild-moderate OSA aged between 20 and 65 years.

Interventions: Mandibular advancement device (MAD), to advance the mandible by 50% (4–6 mm) of maximum protrusion, worn nights only or uvulopalatopharyngoplasty (UPPP).

Outcome measures: Dental and skeletal variables taken from lateral cephalograms.

Results: Thirty of the 49 patients (61.2%) assigned to the MAD group and 37 of the 46 (80.4%) allocated to the UPPP group completed the 4 years follow-up (OR 0.384; 95% CI 0.152, 0.971). There were no statistically significant differences between the groups in any of the dental and skeletal variables measured at baseline or at the 4-year follow-up. The paper reports that the vertical positions of the upper and lower incisors (mean difference 0.8; 95% CI 0.4, 1.1 and 0.7; 0.5, 1.2, respectively), and the horizontal and vertical positions of the mandible (mean difference –0.6; 95% CI –1.1, –0.1 and 0.5; 0.1, 0.8 respectively) changed significantly in the MAD group, but not in the UPPP group. There were no significant changes reported in the horizontal position of the upper or lower incisors, overjet, overbite or length of the mandible.

Conclusions: This study found that a MAD, that advanced the mandible to 50% of a patient's maximum protrusive capacity, produced small changes in dental and skeletal relationships that were reported to be statistically significant, but thought not to be of clinical significance.

Implications: This study suggests that after 4 years continuous night only use of a MAD the dental and skeletal effects were limited and not clinically important. It is reassuring for patients and clinicians that the MAD, which is essentially a functional appliance, used for OSA does not result in the dental and skeletal effects commonly seen when using similar appliances in younger patients.

Effectiveness of treatment for Class II malocclusion with the Herbst or Twin-block appliances: A randomized, controlled trial. *Am J Orthod Dentofac Orthop* 2003; 124: 128–137

O'Brien K, Wright J, Conboy F, Sanjie Y, Mandall N, Chadwick S, *et al.*

Objectives: To test the null hypothesis that there was no difference in effectiveness between the Twin-Block (TB) and Herbst appliances.

Design: A randomized controlled trial.

Setting: Hospital-based orthodontic departments in the UK.

Participants: Two hundred and fifteen patients, aged 11–14 years, with an established Class II division 1 malocclusion. One hundred and ten were allocated to receive treatment with the Twin-block appliance and 105 with the Herbst appliance.

Interventions: (1) *Twin Block appliance:* with Adams clasps on 64|46; 0.9 mm ball clasps in the interproximal areas of the mandibular incisors; a labial bow \pm midline expansion screw. The jaw registration was taken with 7–8 mm protrusion and the buccal segments apart by about 7 mm. (2) *Herbst appliance:* a cast cobalt-chrome design as described by Pancherz¹ extended from the canines to the last molar, and activated to an edge-to-edge occlusion with pre-adjusted edgewise appliances placed as soon as convenient after cementation.

Outcome measures: PAR score, cephalometric variables, patients' perception of the appliances, postcode, treatment length and treatment process data.

Results: None of the variables considered for the final overjet reduction was significant; however, girls responded better than boys. Patients treated with the TB

thought that their speech and sleep patterns were affected, felt embarrassed about their appliance, and that these consequences affected their relationships with their family. Children in the least-deprived quartile of the population had four times the chance of completing their treatment than those children in the most deprived quartile. There was no significant difference in the overall treatment length ($p = 0.53$). However, patients who wore a TB were less likely to complete treatment ($p = 0.01$), spent more time in the functional appliance stage of treatment ($p < 0.005$) and had more routine appointments ($p < 0.04$), but significantly fewer emergency appointments ($p < 0.005$) than the patients in the Herbst group.

Conclusions: There were no differences in treatment effect between the two appliances. Overall treatment time with the two appliances was similar. Patient cooperation was better and Phase I shorter with the Herbst appliance; however, it was more expensive, and prone to debonding and breakage.

Implications: This study suggests that the Herbst appliance may be the preferred appliance in terms of compliance and length of Phase I treatment. However, this has to be balanced against the cost of the additional clinical and laboratory time required to make and repair the appliance.

Health related quality of life and psychosocial function 5 years after orthognathic surgery. *Am J Orthod Dentofac Orthop* 2003; 124: 138–143

Motegi E, Hatch JP, Rugh JD, Yamaguchi H

Objectives: To assess health-related quality of life and psychosocial function following mandibular advancement for correction of a Class II skeletal discrepancy.

Design: Five-year follow-up of a randomized controlled trial.

Setting: San Antonio, Texas and Gainesville, Florida, USA.

Participants: Ninety-three patients who had a Class II skeletal discrepancy. Mean age $29.0 \pm$ SD 10.5 years, 71% female.

Interventions: Bilateral sagittal split osteotomy, carried out 5 years previously, stabilized with either rigid internal fixation or wire osteosynthesis and intermaxillary fixation.

Outcome measures: The Sickness Impact Profile (SIP), Oral Health Status Questionnaire (OHSQ), Symptom Checklist 90 Revised (SCL-90-R) and Eysenck Personality Inventory (EPI).

Results: There were no statistically significant differences between the rigid and wire fixation groups or between the surgical sites for any of the outcome measures. Data for the two groups were combined and compared with the baseline data. All components of the assessment tools showed statistically significant improvements between baseline and 5 year follow-up ($p < 0.05$) except the physical dimension score of SIP and symptoms of somatization in the SCL-90-R that increased, but remained below the mean non-patient level. Most improvements remained stable between the 2 and 5-year follow-up.

Conclusions: General and oral-health related quality of life and psychosocial function showed significant improvements following mandibular advancement for Class II malocclusion. These improvements were stable between 2 and 5 years post-surgery.

Implications: This study suggests that orthognathic surgery provides significant benefits to patients in terms of health related quality of life and psychosocial function.

External apical root resorption in Class II malocclusion: a retrospective review of 1- versus 2-phase treatment. *Am J Orthod Dentofac Orthop* 2003; 124: 151–156

Brin I, Tulloch JFC, Koroluk L, Phillips C

Objectives: To test the hypothesis that the maxillary incisors of Class II children treated in a single phase with fixed appliances are more likely to experience moderate/severe external apical root resorption (EARR) compared with children treated in 2 phases of treatment.

Design: A *post-hoc* analysis of a randomized controlled trial.

Setting: Chapel Hill, North Carolina, USA.

Participants: One hundred and thirty-eight children who had completed the fixed appliance phase of an RCT.

Interventions: *2-phase treatment:* headgear to $\overline{6|6}$ or a modified bionator appliance in the mixed dentition followed by fixed appliances. *1-phase treatment:* fixed appliances in the permanent dentition.

Outcome measures: EARR, root development, root morphology and trauma history/evidence for $\underline{2|1|2}$ assessed at clinical examination or from radiographs, taken just before and after fixed appliance treatment, by examiners who were blinded to the patients' initial group assignment.

Results: At the end of treatment 12.4% of all maxillary incisors had moderate/severe root resorption (≥ 2 mm).

Children in the 2-phase functional/fixed group had the least moderate/severe resorption (5%) and those in the 1-phase treatment group (20.4%) the most. A total of 16.6% of incisors had possible signs of previous trauma or reported injury. Less than 22% of incisors had no discernable resorption. Incisors with evidence or a history of trauma had similar levels of resorption as those without injury. Roots with abnormal root morphology were slightly more like to have moderate/severe resorption than those with normal morphology. A partial proportional odds model indicated that the length of Phase 2 ($p = 0.04$) and the change in OJ ($p = 0.004$) during Phase 2 were significant explanatory variables for root resorption.

Conclusions: It can be expected that 10–15% of maxillary incisors of children treated for Class II division 1 malocclusion will experience moderate/severe EARR on one or more maxillary incisors. The degree of moderate/severe EARR was significantly associated with the amount of OJ reduction during and the duration of fixed appliance treatment.

Implications: Although there is little difference in the effectiveness of early versus delayed treatment for pre-adolescent children with Class II malocclusion,¹ early growth modification treatment, that reduces the overjet prior to fixed appliance therapy, may have a role in reducing the likelihood of EARR.

Reference

1. Tulloch JFC, Phillips C Proffit WR. Benefit of early Class II treatment: progress report of a two-phase randomized clinical trial. *Am J Orthod Dentofac Orthop* 1998; 113: 62–72.

Lactate dehydrogenase activity in gingival crevicular fluid during orthodontic treatment. *Am J Orthod Dentofac Orthop* 2003; 124: 206–211

Serra E, Perinetti G, D'Attilio M, Cordella C, Paolantonio M, Festa F, Spoto G

Objectives: To determine whether lactate dehydrogenase (LDH) in gingival crevicular fluid (GCF) is a sensitive marker for periodontal tissue changes during the early phases of orthodontic treatment.

Design: A controlled clinical trial.

Setting: Chieti, Italy.

Participants: Thirty-seven patients, mean age 18.7 ± 3.6 years, requiring fixed appliance therapy to align teeth in the maxillary anterior segment.

Interventions: (1) *Maxillary arch:* brackets (MBT, 3M Unitek, Monrovia, California) were placed on incisors, canines and premolars, and bands on the first molars together with an 0.016 inch nickel titanium arch wire. (2) *Mandibular arch:* No appliance. GCF was collected, on a single occasion, from the mesiobuccal aspect of a randomly selected maxillary canine and its antagonist at 2–12 weeks following appliance placement.

Outcome measures: Volume of and lactate dehydrogenase activity (determined spectrophotometrically) in gingival crevicular fluid.

Results: There were no statistically significant differences in the volume of GCF produced by the test teeth at different times following appliance placement ($p > 0.5$) or the test and control teeth ($p > 0.5$). The level of LDH activity was more than three times greater in the GCF from the test teeth than from the control teeth ($p < 0.01$).

Conclusions: LDH activity in GCF increases during orthodontic tooth movement.

Implications: LDH activity in GCF may be considered for use as a sensitive marker of periodontal metabolic changes during orthodontic tooth movement. However, longitudinal data are required to further assess the role of LDH in the process of tooth movement during orthodontic treatment.

Effectiveness of early orthodontic treatment with the Twin-Block appliance: a multicenter, randomized, controlled trial. Part 1: Dental and skeletal effects. *Am J Orthod Dentofac Orthop* 2003; 124: 234–243

O'Brien K, Wright J, Conboy F, Sanjie Y, Mandall N, Chadwick S, *et al.*

Objectives: To test the null hypotheses that orthodontic treatment provided with the Twin-Block appliance during the transitional dentition has no effect on antero-posterior relationship of the maxilla to the mandible, overjet and PAR score after treatment.

Design: A randomized controlled trial.

Setting: Hospital-based orthodontic departments in the UK.

Participants: One hundred and seventy-four patients, aged 8–10 years, with an overjet of at least 7 mm. Eighty-nine were allocated to receive treatment with the Twin-Block appliance and 85 to the control group.

Interventions: (1) *Twin-Block (TB) appliance:* with Adams clasps on 64|46; 0.9 mm ball clasps in the interproximal areas of the mandibular incisors; a labial

bow \pm midline expansion screw. The jaw registration was taken with 7–8 mm protrusion and the buccal segments apart by about 7 mm. (2) *Control group:* treatment delayed for at least 15 months.

Outcome measures: Cephalometric variables, overjet and PAR score.

Results: Fourteen children (16%) did not complete their course of TB treatment and one patient in the control group was lost to follow-up (0.01%). Regression analyses indicate that, when the baseline data were taken into account, the treatment group was the only independent variable to affect the final skeletal discrepancy ($n = 146$, $p < 0.005$, adjusted $R^2 = 0.54$) and overjet ($n = 147$, $p < 0.005$, adjusted $R^2 = 0.77$). Age and sex were also significant variables for the final PAR score ($n = 153$, $p < 0.005$, adjusted $R^2 = 0.70$). The contribution of the dental and skeletal change, with the TB, to the overjet change was 73% and 27%, respectively, and to the molar correction 59% and 41%, respectively.

Conclusions: Although the TB does produce some skeletal change the most important changes resulting from treatment are dentoalveolar. The TB appliance resulted in significant reductions in overjet, but did not, on average, change the skeletal pattern to a clinically significant effect. This supports the results of similar RCTs.

Implications: The TB appliance appears to be an effective appliance for reducing an overjet, but the changes are dentoalveolar, rather than skeletal. Clinicians should not be under the illusion that the TB produces 'growth modification', but rather that it is effective at reducing an overjet though dentoalveolar changes.

Five-year outcome and predictability of soft tissue profile when wire or rigid fixation is used in mandibular advancement surgery. *Am J Orthod Dentofac Orthop* 2003; 124: 249–256

Dolce C, Hatch JP, Van Sickels JE, Rugh JD

Objectives: To assess the horizontal positions of soft and hard tissue landmarks for patients who had received a bilateral sagittal split osteotomy, and either wire or rigid fixation.

Design: A multi-center, randomized controlled trial.

Setting: Gainesville, Florida; San Antonio, Texas and Emory, Atlanta, USA.

Participants: Ninety patients from 127 who originally enrolled in the trial, who had been followed for 5 years post-surgery.

Interventions: Orthodontic treatment and a bilateral sagittal split osteotomy, with/without a genioplasty, and

either wire or rigid fixation to correct a Class II skeletal discrepancy. *Wire fixation* ($n = 78$): inferior border wires followed by 6 weeks of inter-maxillary fixation. *Rigid fixation* ($n = 49$): 2 mm bi-cortical position screws.

Outcome measures: Soft and hard tissue landmarks from cephalometric radiographs.

Results: Thirty-seven patients were lost to follow-up mainly because the study finished after 2 years in Emory. Immediately following surgery there were no significant differences between the groups in the amount of advancement of the mandibular incisor (LI; $p = 0.61$) or B point ($p = 0.64$). The position of the LI remained unchanged after 5 years in the rigid fixation groups. There was significant distal movement of the LI in the wire fixation groups by the 1 year follow-up. There was some relapse in the position of B point in the rigid fixation groups (3–10%), but significant relapse (33–36%) in the wire fixation groups. Changes in the symphysis, pogonion were similar to those at B point. For most groups the hard to soft tissue movement ratio was 1:1 at B point and 1:0.8 at pogonion.

Conclusions: The distal segment of the mandible was stable 5 years post-surgery with rigid fixation, but there was 30% skeletal relapse in the wire fixation group. Correlation co-efficients and percentages of hard to soft tissue movement vary with procedure and over time.

Implications: It appears that treatment with rigid fixation is more stable than with wire fixation. Clinicians can use the hard to soft tissue movement correlations and percentages to counsel their patients on the immediate and long-term effects of treatment on their profile.

An *in vivo* investigation into bond failure rates with a new self-etching primer system. *Am J Orthod Dentofac Orthop* 2003; 124: 323–326

Ireland AJ, Knight H, Sherriff M

Objectives: To assess the bond failure rates of Transbond adhesive pre-coated brackets (3M Unitek, Monrovia, California) with a new self-etching primer system.

Design: A split-mouth, randomized controlled trial.

Setting: Hospital-based orthodontic department, Bath, UK.

Participants: Twenty patients needing upper and lower fixed appliance therapy with or without extractions.

Interventions: Adhesive pre-coated (APC) brackets were bonded following pre-treatment tooth preparation with either self-etching bond or conventional acid etching with 37% phosphoric acid and primer.

Outcome measures: Initial bond failure during the first 6 months of treatment.

Results: There was no statistically significant difference in the bond failure rate between the two clinicians (OR 0.81; 95% CI 0.38, 1.74). There was a statistically significant difference in the bond failure rate for the two pre-treatments (OR 0.42; 95% CI 0.19, 0.95). The bond failure rate for the self-etch primer was 11% and 5% for the conventional acid etch and primer.

Conclusions: The bond failure rate for Transbond APC brackets was significantly higher with self-etching primer than with conventional acid etch and primer.

Implications: This study suggests that the convenience of the self-etching primer may be outweighed by the disadvantage of increased bond failures during treatment.

Angle Orthodontist

Effect of a mechanical interdental cleaning device on oral hygiene in patients with lingual brackets. *Angle Orthod* 2003; 73: 579–587

Hohoff A, Stamm T, Kühne D, Wiechmann D, Haufe S, Lippold C, Ehmer U

Objectives: To evaluate the effectiveness of a battery operated inter-dental cleaning device (ICD) (WaterPik Flosser, Intersanté GmbH, Bensheim, Germany) at reducing plaque accumulation and inflammation in patients with lingual brackets (Ormco 7th Generation, Ormco, Amersfoort, Netherlands).

Design: A split-mouth, controlled clinical trial.

Setting: University orthodontic department, Muenster, Germany.

Participants: Forty-eight patients with lingual appliances.

Interventions: All patients received a single session of instruction on how to use the ICD. Teeth in all quadrants were brushed manually (Elmex 29, Gaba GmbH, Lörrach, Germany) using the modified Bass technique for 3 minutes. The ICD was used once a day, for 10 seconds, in each inter-proximal space in the 2nd and 4th quadrants only.

Outcome measures: Patients' subjective assessment and blinded clinical assessment of approximal plaque index (API) and bleeding on probing (BOP) at t^0 , $t^1 =$ mean 38.6 days and $t^2 =$ mean 46.0 days after starting to use the ICD.

Results: There were significant differences between right and left-handed participants in the BOP in the 4th quadrant at t_0 ($p \leq 0.026$). Men had significantly better API than women in the 1st quadrant at t_0 ($p \leq 0.003$). Left-handed people ($n = 4$) and men ($n = 12$) were therefore excluded. The final analysis was undertaken on 32 right-handed women. The ICD was rated as 'very helpful' by 46.9% of participants; 'leaving their teeth cleaner' by 65.6%; 'very good to handle' by 12.5% and 'leading to a clear-cut saving in time' by 50%. There were statistically significant decreases in API and BOP in the ICD ($p = 0.000$; $p = 0.000$, respectively) and non-ICD ($p = 0.001$; $p = 0.035$, respectively) quadrants from $t^0 - t^1$, which were maintained to t^2 . However, the differences between the API and BOP in the ICD and non-ICD quadrants were not statistically significant at any time point.

Conclusions: The addition of the ICD did not reduce plaque accumulation and inflammation in patients with lingual brackets when compared to manual brushing alone. However, both measures were improved significantly over the period of the study.

Implications: This study suggests that the oral hygiene instruction given to patients as part of the trial may have had more of an effect on plaque control and inflammation than the method of cleaning.

A systematic review concerning early orthodontic treatment of unilateral posterior crossbite. *Angle Orthod* 2003; 73: 588–596

Petrén S, Bondemark L, Söderfeldt B

Objectives: To determine whether early treatment of unilateral posterior crossbite (UPXB) is effective, which treatment is the most effective and whether it is stable.

Design: A systematic review.

Data sources: All articles assessing the effects of treatment of UPXB in the primary and mixed dentitions identified from searches of Medline and the Cochrane Controlled Clinical Trials Register from January 1966 to October 2002.

Study Selection: Studies that were RCTs, prospective or retrospective observational studies with concurrent controls that were either untreated, had a normal occlusion or were receiving an alternate treatment, and were written in English, German, French or a Scandinavian language. Two independent reviewers assessed the articles separately.

Data Extraction: Data were extracted without blinding to authors. Inter-examiner differences were resolved by discussion.

Data Synthesis: A meta-analysis was not performed. Results were presented in descriptive and tabular forms.

Results: One thousand and one studies were identified by the searches and 12 were included in the review. All but one of the studies were undertaken in Scandinavia. Two RCTs were identified. Studies compared treatment with the quad-helix (QH) appliance, expansion plates, rapid maxillary expansion (RME) and occlusal grinding. Reported success rates for the QH and RME were near to or 100%, expansion plates 51%–100% and grinding 27%–90%. Spontaneous correction was found in 16%–50% of untreated cases. Three studies found the QH to be equivalent to expansion plate, but two studies reported significantly more expansion with the QH. Four studies compared occlusal grinding to spontaneous correction. Two of these found the success rates equal and two favored grinding in the primary dentition.

Conclusions: From the studies examined occlusal grinding in the primary dentition was found to be beneficial and treatment with the QH, expansion plates and RME effective in the mixed dentition. However, there was no strong evidence to determine which modality was superior. Most studies lacked power and methodological vigor to draw any evidence-based conclusions.

Implications: From the studies examined all treatments appear to be effective, but further good quality, adequately sized RCTs are required to establish the most effective treatment for unilateral posterior crossbites in the primary and mixed dentitions.