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The Twin Block Appliance for the Correction of Class II Malocclusion

Abstract: A number of treatment approaches are available for the management of Class II malocclusion. Functional appliances are commonly used for the management of mandibular retrognathia in growing subjects. The twin block appliance is the most popular functional appliance in use within the United Kingdom. The aim of this article is to review the clinical management of the twin block appliance and to discuss some of the hard and soft tissue changes that accompany treatment with this appliance.
Clinical Relevance: The twin block appliance is now widely used in the treatment of Class II malocclusion.
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The twin block appliance was described by Clark in 1982[1] and is the most popular functional appliance used within the United Kingdom.[2] Its popularity arises from its high patient acceptability and its ability to produce rapid treatment changes. Table 1 outlines the main advantages and disadvantages of the twin block appliance. The aim of this article is to review the design, clinical use and treatment effects of the twin block appliance.

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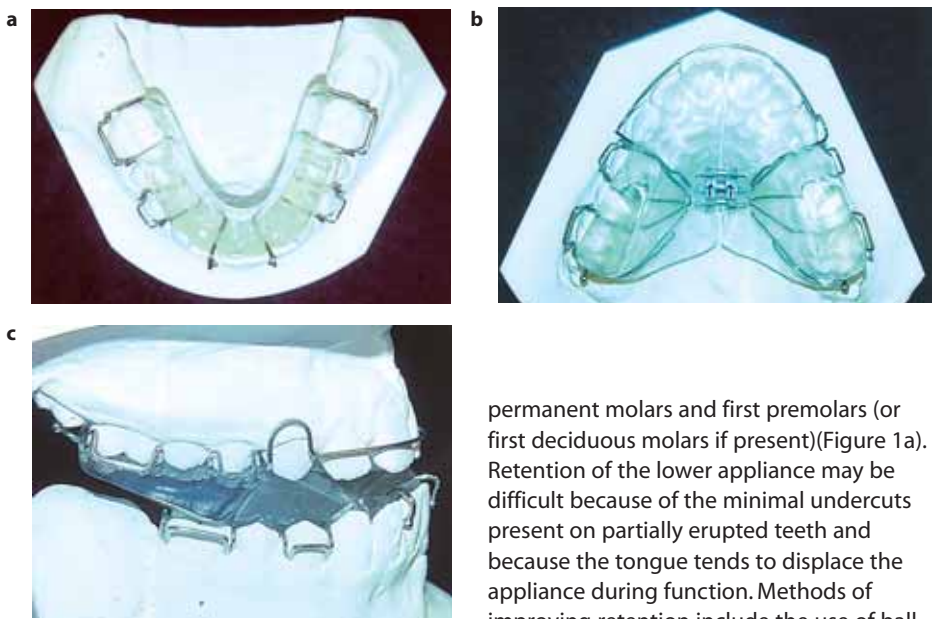

Figure 1. (a–c) The twin block appliance consists of a mandibular component **(a)** and a maxillary component **(b)** which interdigitate to cause forward mandibular posturing **(c)**.

Appliance design (Figure 1)

The mandibular component

The mandibular component consists of an acrylic baseplate with Adam's clasps often placed on to the first permanent molars and first premolars (or first deciduous molars if present)(Figure 1a). Retention of the lower appliance may be difficult because of the minimal undercuts present on partially erupted teeth and because the tongue tends to displace the appliance during function. Methods of improving retention include the use of ball-ended clasps between the lower incisors, or the incorporation of an acrylated labial bow. Some clinicians replace the Adam's clasps with the Delta clasp as they feel this offers superior retention . The Delta clasp replaces the arrow head of the Adam's clasp with a closed loop. The advantage of a closed loop is that the clasp does not open with repeated removal and is therefore less likely to fracture during use.

The baseplate incorporates

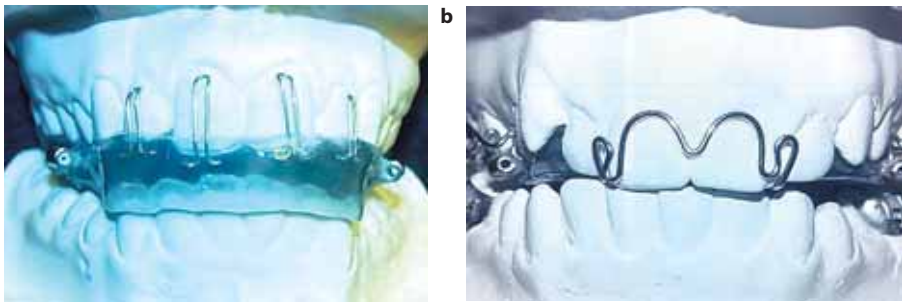

Figure 2. (a–b) Torquing spurs **(a)** or torquing springs **(b)** can be used to control upper incisor inclination during Twin block treatment.

biteblocks in the region of the premolars, which, by occluding with the maxillary biteblocks, encourages the mandible to be postured forwards. The baseplate can be further modified with the incorporation of lower incisor acrylic capping. The potential benefits of lower incisor capping include:

- Improved appliance retention;
- Inhibition of lower incisor eruption and therefore improved overbite control;
- Reduced lower incisor proclination;
- A potentially reduced incidence of lower appliance breakages in the midline as the capping increases the rigidity of the appliance in this region.

Lower incisor capping may be detrimental in patients with poor oral hygiene as decalcification can occur on the tips of the lower incisors.

The maxillary component

The maxillary component consists of an acrylic baseplate, with a mid-sagittal expansion screw, incorporating Adam's clasps in a similar arrangement to the mandibular appliance (Figure 1a). The biteblocks cover the occlusal surface of the premolars and molars, including the second molars if these have erupted at the time of appliance construction.

Some clinicians incorporate a labial bow to aid retraction of the upper incisors and improve appliance retention. The incorporation of a labial bow may adversely affect compliance as patients often do not like the appearance of the additional wirework. The upper incisors tend to retrocline and retract even without a labial bow owing to the Class II intermaxillary forces produced between the biteblocks. As the mandible is postured forwards the upper incisors come under control of the lower lip, which also provides a retracting force.

Additional components which may be incorporated to help reduce unwanted increases in face height during treatment include tubes for the insertion of headgear in the upper premolar region and occlusal rests to prevent overeruption of the second molars, if these are not present at the time of appliance construction. In patients who have excess gingival exposure on smiling, the upper incisors may also be capped with acrylic so that the headgear applies an intrusive force to the anterior dentition. As the incorporation of headgear tends to apply additional retraction forces on to the incisors, it is often also beneficial to have torquing auxiliaries to help control the inclination of the maxillary incisors during treatment using headgear (Figure 2).

As well as correcting the sagittal relationship, it is also possible to add additional active components, such as springs, to help improve the general alignment of the arches.

The relationship between the maxillary and mandibular components

Once the appliances are inserted in the mouth, the relationship of the biteblocks encourages the patient to posture the mandible forwards in order to achieve lip closure. The blocks are often made to interdigitate at an interface angle of 70 degrees as clinical experience has shown this angle to be effective in maintaining an anterior mandibular posture (Figure 1c). It is also important that the blocks are of sufficient height to maintain anterior mandibular posturing.

Patient selection

Functional appliance treatment is appropriate for the management of well motivated, growing patients with moderate mandibular retrognathia. The twin block appliance is especially appropriate for the

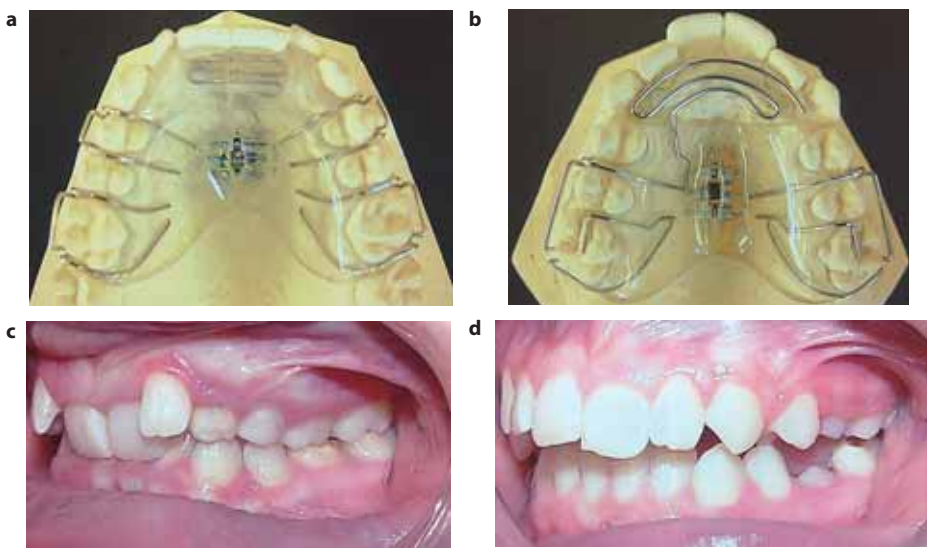

Figure 3. (a–d) Examples of appliance designs that can be used to decompensate the maxillary incisors before functional appliance treatment **(a, b)**. **(c, d)** Examples of Class II division 2 cases which have been decompensated to allow forward mandibular posturing for twin block appliance construction.

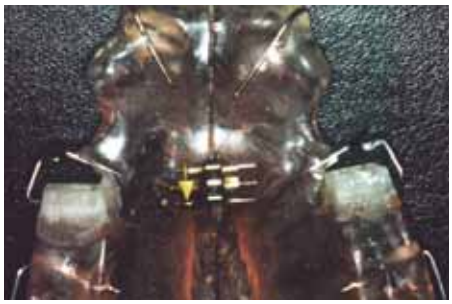

Figure 4. Progressive mandibular advancement may be achieved by the addition of acrylic to the front of the maxillary blocks.

Figure 5. A sectional fixed appliance may also be used to decompensate the maxillary incisors to a more favourable inclination.

treatment of patients with a reduced lower anterior facial height as treatment tends to increase this facial dimension. Treatment is often started once the first premolars have erupted as these teeth can be clasped to improve retention. Current evidence suggests that the greatest skeletal response occurs if treatment is undertaken during the pubertal growth spurt.[3]

The stages of treatment

Prefunctional expansion

In patients with a Class II division 2 incisal relationship, or instanding maxillary lateral incisors, treatment may commence with an upper removable appliance to procline the maxillary incisors into alignment (Figure 3). Sufficient overjet can be created to allow forward posturing for the construction of the twin block appliance. The removable appliance can also incorporate a midline expansion screw to begin expansion and an anterior bite plane to commence overbite reduction by levelling the lower curve of Spee. One disadvantage of undertaking prefunctional expansion is that it increases the total treatment time by approximately six months, which may affect patient compliance later in treatment. A modified approach has recently been described for the management of Class II division 2 malocclusion, which involves the use of maxillary incisor torquing spurs on the twin block appliance and is constructed with minimal mandibular posturing.[4] As the torquing spurs cause incisor proclination, the twin block can be progressively activated with the addition of acrylic to the front of the maxillary biteblocks (Figure 4).

An alternative approach to decompensate the maxillary incisors in Class II division 2 malocclusion is with the use of a sectional fixed appliance between the maxillary canines or first premolars (Figure 5). The disadvantage of using this approach compared to using a removable appliance is that a bite plane or expansion screw cannot be incorporated using a sectional fixed appliance.

a

b

Figure 6. An *Exactobite stick* **(a)** may be used to record the construction bite for appliance construction. **(b)** The *Exactobite* in the mouth with the incisors in an edge-to-edge position and sufficient separation of the buccal segments to allow adequate block height.

Fabricating the twin block appliance (construction bite)

In the majority of cases the construction bite can be made with the incisors in an edge-to-edge position and the buccal segments separated by approximately 8 mm. If the overjet is very large (>10 mm), it may be necessary to have less activation initially and then advance the bite during treatment as the overjet is reduced. Adequate separation of the molars in the vertical dimension is essential so that the blocks can be constructed with sufficient height. The construction bite can be taken using wax alone or with the aid of an *Exactobite stick* (Forestadent Ltd, Milton Keynes, UK) (Figure 6).

The active phase of treatment

The active phase of treatment may be commenced by asking the patient to wear the appliance initially only a few hours a day and then to increase wear to full-time over a two-week period. This may make it easier for the patient to tolerate the appliance, particularly as speech and mastication can be adversely affected initially. Clark[5] advises that the appliance be worn full-time, including during mastication, although many patients may not tolerate eating with the appliance *in situ*. It is important that the patient remembers to turn the expansion screw 1/4 turn weekly in order to maintain arch co-ordination if this is required. The patient should be reviewed on a six-weekly basis in order to monitor treatment changes, check oral hygiene and ensure that the appliance has adequate retention. It is important that the overjet, molar relationship and transverse relationships are recorded at each visit. Some clinicians prefer to monitor treatment changes by measuring the maximum reverse overjet achievable by the patient when posturing, as it can be difficult to gain a true overjet reading because the patient experiences pain when the mandible is forcibly retruded into the retruded contact position.

After a few weeks of wear, patients who are compliant will often show a significant reduction in overjet and

Figure 7. (a) Pretreatment overjet; **(b)** twin block appliance *in situ* and **(c)** the end of the functional appliance stage with the incisors in an edge-to-edge position and the presence of lateral open bites.

the presence of lateral open bites. This is because there is increased resting activity in the protractor muscles of the mandible and hyperplasia of the condylar cartilage. This early effect must not be confused with true overjet reduction as the mandible will rapidly adopt its original position if the appliance is kept out continuously. As a general rule, with good compliance one can expect approximately 1 mm of true overjet reduction per month. The active stage of treatment is usually complete after 9–12 months when the incisors are in an edge-to-edge relationship and the molars are in a Class III relationship (Figure 7). It is desirable to achieve a degree of overcorrection as there will almost certainly be some rebound when the appliances are removed.

The supportive phase of treatment

At the beginning of the supportive phase the overjet will have been corrected but the patient will have lateral open bites. The aim of the supportive phase is to maintain the corrections that have been achieved while closing the lateral open bites.

A number of different techniques may be used to close the lateral open bites, which can take between 4 and 6 months. These include removal of the lower first molar clasps and trimming of the upper biteblock to allow free eruption of the lower molars,[5] or asking the patient to wear the appliance for only 12 hours per day. It is important to remember that there is a space requirement to level the lower curve of Spee, as it consists of a series of slipped contact points, and the lateral open bite can be extremely difficult to close in crowded arches. Owing to the difficulty in closing lateral open bites, some clinicians prefer to use fixed appliances immediately after the active phase of functional appliance treatment to extrude the buccal segments actively. An anterior clip-over biteplane with a reverse slope can be used at this stage to maintain the sagittal correction until Class II intermaxillary traction is commenced (Figure 8).[6]

Fixed appliance phase

Following the use of functional appliances, patients may undergo a period of fixed appliance therapy to detail the occlusion. Before making a decision about the space requirement of the case, it is important to take a lateral cephalogram to check how much proclination of the lower incisors occurred during twin block therapy. This is important in order to make a decision about the ideal pattern of extractions, if these are indicated. Other features which must be taken into account before making this decision include the facial profile, the degree of crowding, the size of the overjet and the depth of the curve of Spee. In cases that are treated on a non-extraction basis, it may be prudent to reinforce anchorage with the use of headgear.

Retention

After treatment, the patient will often revert to his/her original growth pattern and there is therefore a risk of relapse of the corrected malocclusion. Although very few studies have been undertaken to identify the ideal retention regime following functional appliance treatment, some clinicians recommend the use of active retainers. These may be in the form of a sloped anterior biteplane on a standard retainer to help maintain an anterior mandibular posture, or standard functional appliances with reduced biteblocks which are worn on a 'nights only' basis. There is also evidence to suggest that a well intercuspated occlusion at the end of treatment is more likely to lead to a stable sagittal correction.[7]

Treatment effects of the twin block appliance

A number of clinical trials have

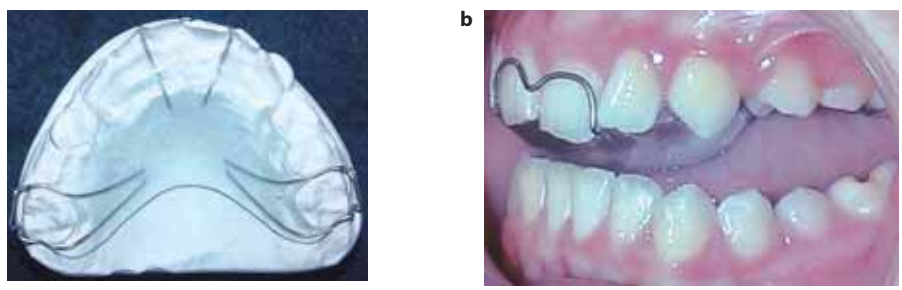

Figure 8. (a) Clip-over anterior biteplane with a steep inclined plane can be used to retain Class II correction and close the lateral open bites. **(b)** The biteplane *in situ*.

Advantages	Disadvantage
Rapid overjet correction	Minimal mandibular growth benefit
Two piece design allows freedom of mandibular excursions	Tendency to increase the face height in patients with increased face heights
Facility to control upper arch width	Lateral open bites can be difficult to close
Ease of incorporating additional active components	Lower incisor proclination
	Retention may be poor during the mixed dentition
	Difficulty in incorporating fixed appliances

Table 1. The advantages and disadvantages of the twin block appliance.

been carried out to assess the effects of the twin block appliance. The designs of the trials are described in Table 2.

Dento-skeletal effects

Increased mandibular length

Evidence from prospective cephalometric studies suggests that mandibular length increases between 2 and 2.5 mm more than controls during treatment with the twin block appliance.[8,9,10,11] One factor in common with all studies is the large variability in treatment response and, currently, the best pre-treatment indicator of possible treatment success is a deep overbite.[12] This may be because the mandible is restricted by the deep bite in such cases, and functional appliances help to remove this obstruction, encouraging expression of

Study	Design	Randomized	Matched Controls	Sample Size
Illing *et al.*, 1998[8]	Prospective	Yes	No	TB = 19 C = 20
Lund and Sandler, 1998[9]	Prospective	No	No	TB = 36 C = 27
Mills and McCulloch, 1998[13]	Retrospective	No	Yes (Burlington growth study)	TB = 28 C = 28
Morris *et al.*, 1998[20]	Prospective	Yes	No	TB = 19 C = 20
Toth and McNamara, 1992[14]	Retrospective	No	Yes (Michigan growth study)	TB = 40 C = 40
Tümer and Gültan, 1999[10]	Prospective	No	Yes	TB = 13 C = 13
McDonagh *et al.*, 2001[21]	Prospective	Yes	No	TB = 12 TB+HG = 13
O'Brien *et al.*, 2003[11]	Prospective	Yes	Yes	TB = 89 C = 85

Table 2. Summary of trial designs used to evaluate hard and soft tissue changes during twin block appliance treatment. TB = twin block appliance, C = Control group, HG = Headgear.

underlying growth potential.

Retrospective studies[13,14] tend only to consider successfully treated cases. These suggest that mandibular length increases by approximately 4 mm more than controls and the chin moves significantly forwards by a mean of 1.5–2 mm more than controls. In both prospective and retrospective studies, there was a large amount of individual variation in treatment response.

Effects on maxillary growth

The majority of studies have found no significant orthopaedic effect exerted on the maxilla with the use of the twin block appliance.[8,9,14] The results of one large multicentre study[11] conducted in the UK found a small maxillary restraining effect using twin blocks, which contributed only 13% to the overall skeletal change and was therefore considered clinically not significant.

Increased facial height

Both prospective and retrospective studies are consistent in showing that treatment with the twin block appliance results in an increase in total anterior face height ranging, on average, between 2.5 and 4 mm more than control groups.[8-11,13,14] As with changes in mandibular length, there is a large variability in treatment response. In patients with an increased face height, where it would be advantageous to prevent any further increase, the addition of high pull headgear may be effective at reducing the proportionate lower face height, but not the overall face height.[15]

Retroclination of the maxillary incisors

Class II traction forces are transmitted to the maxillary dentition during functional appliance treatment. These forces, in addition to those transmitted to the upper incisors as they are brought under the control of the lower lip during mandibular protrusion, result in palatal movement of the incisors. As overjet correction is often taken as the end point of functional appliance treatment, a disadvantage of retroclination is that a large component of overjet correction is due to incisor movement rather than mandibular growth.

Lund and Sandler[9], Illing *et al.*[8], Mills and McCulloch[13], Toth and McNamara[14] and Tümer and Gültan[10] found that the twin block appliance retroclined the maxillary incisors on average by 11, 7.5, 2.5, 4.3 and 5.8 degrees, respectively. Lund and Sandler[9] incorporated a labial bow into their appliance and this may account for the greater retroclining effect found by these authors. However, it is clear that the upper incisors become retroclined, even in the absence of a labial bow. O'Brien *et al.* [11] showed that upper incisor retraction contributed significantly to overjet correction. Data from clinical trials suggest that torque control auxiliaries are effective at limiting retroclination of the maxillary incisors.[16]

Proclination of the mandibular incisors

Proclination of the lower labial segment during treatment is undesirable in most cases because:

- It contributes to overjet reduction and therefore limits the potential for further skeletal growth;
- The lower incisors are susceptible to relapse;[17]
- Subsequent fixed appliance treatment is more likely to involve extractions as space is required if the lower incisors are to be retracted to their pretreatment position.[18]

Lund and Sandler[9], Mills and McCulloch[13], Toth and McNamara[14] and Tümer and Gültan[10] found that the lower incisors proclined, on average, by 8, 5.2, 2.8 and 4.3 degrees during treatment, respectively. Illing *et al.*[8] found no significant change in the lower incisor inclination following twin block therapy. Treatment effects on the lower incisors may not have been detected because the mean change was small and there was a large individual variation in treatment response (mean proclination = 2°; SD = 7.3°). Currently, there are no clinical data on the effects of lower incisor capping on controlling lower incisor movement during twin block therapy.

Effects on the buccal segments

Generally, changes in molar position are difficult to assess as these teeth are often poorly defined cephalometrically.

With regards to the horizontal molar position, the majority of studies have found that the upper molars are distalized up to 2 mm more than controls and the lower molars move forward, on average, 2–4 mm more than corresponding controls.

When considering vertical molar changes, it has generally been found that the maxillary molars are restrained and the lower molars are extruded up to 2 mm more than controls. Lower molar eruption helps in the correction of a class II molar relationship, aids overbite reduction and helps minimize the extent of lateral open bites found at the end of twin block therapy.

Summary

To summarize, it appears that the twin block appliance achieves sagittal correction in Class II malocclusion predominantly by dento-alveolar change. Mandibular growth enhancement and maxillary restraint effects may be statistically significant in some prospective studies, but it is questionable if these changes are clinically relevant. Treatment is also associated with an increase in the vertical facial dimension, which may be detrimental in cases starting with an increased face height, but advantageous in patients with reduced face height. In the longer term, evidence would suggest that the early growth benefit may not be maintained in the long term with twin block appliance treatment.[19]

Soft tissue changes

A number of studies have now been undertaken to assess the effects of twin block appliance treatment on the facial soft tissues.

Transverse facial changes

Facial three dimensional optical laser scans have been used to study the effects of twin block therapy on transverse facial growth.[20,21] These studies have found that there is a general widening of the lateral extremities of the face in patients treated with both the twin block and twin block/headgear combinations.

Changes in lip position

Studies have found no significant changes in the sagittal position of the upper lip in patients treated with the twin block appliance, despite large reductions in the overjet.[20,21]

The lower lip becomes more protrusive when measured cephalometrically or using optical scans. This may be related to proclination of the mandibular incisors during

treatment and favourable mandibular growth, which may be found in some patients.[20,21]

Changes in soft tissue chin position

Studies indicate that changes in the soft tissue chin point tend to reflect those found cephalometrically with changes in the hard tissue chin position.[20,21] The long-term nature of these changes has yet to be studied. Additionally, it is worth noting that McDonagh *et al.*[21] did not notice any further movement of the soft tissue pogonion (3.1 mm) in a twin block group wearing headgear.

Soft tissue total anterior facial height

The changes in the soft tissue dimensions appear to be well correlated to the underlying skeletal changes. It should also be noted that there is large variation in treatment response for most of the parameters measured.[20,21]

Conclusion

The twin block appliance is a popular appliance for the treatment of Class II malocclusion because of its high patient acceptability and its ability to produce rapid treatment changes. The appliance works principally by inducing dento-alveolar changes with a small amount of favourable skeletal change in the short term. Changes in the soft tissues tend to accompany hard tissue changes, perhaps apart from changes in the upper lip position.

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Abstract

DO BETTER BURS RESULT IN BETTER RESTORATIONS?

Effects of diamond bur particle size on dentin bond strength. Y Hosoya, H Shinkawa, C Suefiji, K Nozaka and Garcia-Godoy *American Journal of Dentistry* 2004; **17**: 359–364.

The authors of this interesting paper realized that most dentine bond strength studies are performed on specimens that have been ground with 600-grit silicone carbide paper, whereas clinically adhesive resins are applied to dentine prepared by a high speed bur. The dentine on the buccal surface of three groups of teeth were prepared with respectively 25µ burs, 50µ burs and the standard silicone paper. Two sets of teeth were prepared for comparison of two adhesive systems. Following application of the adhesive material according to the manufacturer's instructions, shear bond strength testing was performed.

Although the results showed no significant difference between specimens with one of the restorative materials, in the other group a statistically significant difference in bond strength was achieved using the super-fine grit bur (25µ) when compared to the coarser bur. Ensuring that cavity margins are as smooth as possible may give a significant improvement to the quality of your adhesive restorations!

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