

Unintended changes to the occlusion following the provision of night guards

T. Bereznicki,^{*1} E. Barry² and N. H. F. Wilson³

Key points

Addresses the need for increased awareness of unintended occlusal changes which may be associated with night guard use.

Highlights examples of cases demonstrating occlusal changes related to night guard use.

Provides clinical advice on how to minimise the risks of occlusal changes with night guard use

A review of the literature on night guards left questions unanswered about the risk and possible causes of occlusal derangement linked to night guard design and use. Cases are presented where night guard use resulted in anterior open bite and associated occlusal derangement. The aetiology of the occlusal changes observed is discussed. It is concluded that adverse occlusal effects linked to the use of night guards may be found to be more common than anticipated from existing literature. Patient follow-up is essential to monitor the use and effects of night guards, and regardless of appliance type, unintended occlusal changes may result. The use and effects of partial coverage appliances require very careful monitoring. Suggestions are provided for information and written instructions to be given to patients provided with night guards and removable orthodontic retainers.

Introduction

This paper considers cases in which night guards (stabilisation splints) supplied to help prevent night-time tooth wear and the fracture of existing or newly placed restorations resulted in unintended and unexpected occlusal changes.^{1,2}

There is a plethora of designs for night guards. These may be subdivided into four groups – upper and lower, preformed or custom made. All these appliances may be further subdivided into either full or partial coverage. Examples include:

- The miniature anterior bite appliance – eg, the Nociceptive Trigeminal Inhibition-tension suppression system (NTI-tss), Therapeutic Solutions International (TSI-Int,) USA

- Full arch, soft night guards
- Anterior, hard acrylic partial coverage discluding night guards
- Full arch night guards.

The design of the appliance provided is often down to the clinician's preference and the patient's inclinations and circumstances. It is suggested that patients, who may benefit from the provision of a night guard, roughly fall into one of two groups – 'chompers' who clench their teeth, and 'grinders' who are invariably bruxers. 'Chompers' seem to be able to tolerate almost any design of night guard and sleep well with them in place. Such patients typically show excellent compliance with night-time wear of a variety of appliances, including bleaching trays. In contrast, 'grinders' generally find that wearing soft design appliances aggravates their night time bruxing, adversely affecting their sleep patterns – an observation confirmed by Okeson.³ This observation may account for 'grinders' poor compliance in wearing bleaching trays at night, despite clear, determined motivation to do so.

Assuming no contraindications, such as symptoms of temporomandibular joint dysfunction (TMD), soft night guards can,

therefore, be recommended for 'chompers', but, in general, should be avoided in 'grinders'. When an appliance is being provided for a 'grinder', a hard-acrylic appliance is considered to be indicated.⁴ Patients, in particular 'grinders', often express a preference for partial rather than full coverage appliances. As explained below, the need for full coverage appliances, especially when the appliance is to be worn over an extended period, needs to be carefully explained to patients.

Full arch coverage, hard acrylic appliances are not only extremely time-consuming to produce and fit but, in many cases, can stimulate the gag reflex, especially if the third permanent molar teeth are present. Therefore, simple anterior discluding, partial coverage appliances are popular. They are easier, quicker and cheaper to produce than full arch appliances and tend to be well tolerated by patients with good wear compliance. However, as considered below, 'easier, quicker and cheaper' poses certain challenges.

As discussed by Wassell *et al.*,⁵ the potentially serious adverse effects of internet available, 'over-the-counter' (OTC) preformed bruxism splints include choking, and tissue and occlusal changes. The potential for occlusal

¹Department of Primary Dental Care, King's College London and Dawood & Tanner Dental Practice, Wimpole Street, London; ²Oral and Maxillofacial Surgery Dental Core Trainee, King's College Hospital; ³Emeritus Professor of Dentistry, King's College London
*Correspondence to: Tom Bereznicki
Email: tbereznicki@gmail.com

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Fig. 1 NTI-tss anterior discluding appliance

changes with the use of OTC splints has been considered to be associated with a lack of full occlusal coverage.⁵ Patients who believe that they may benefit from wearing a splint or night guard should seek professional help.

In reviewing the literature on the professional provision and use of occlusal splints, Wassell *et al.*⁵ highlighted many important issues, including bruxism, which as defined by an international expert group, is 'a repetitive jaw-muscle activity characterised by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible. It is a common disorder affecting an estimated 16% of the adult population for sleep bruxism and 24% for awake bruxism.'⁶

While an occlusal splint, irrespective of design, may not be relied on to treat bruxism in all patients, it is often used over long periods to protect the teeth in bruxing patients.⁷ Despite the lack of substantial scientific evidence supporting any particular splint design as being effective in reducing bruxism, many authorities recommend full coverage stabilisation splints⁶ to spread occlusal contact optimally⁸ and, thereby avoid unwanted occlusal changes.^{2,8,9}

There are case reports and trial data showing occasional problems with professionally fitted appliances, including stabilisation splints,¹⁰ soft splints⁹ and partial coverage appliances.² The recurring theme in these reports is the possibility of unwanted tooth movement and occlusal change, notably with partial coverage splints. Recommendations have been made to prescribe partial coverage splints only where dentists are confident about patient compliance, with opportunity for frequent follow-up review.^{2,11} In some patients, prolonged wear of a Gelb appliance – a mandibular repositioning

appliance which covers the posterior teeth only – resulted in posterior open bite, particularly if the appliance was worn full-time.¹²

With OTC bruxism splints, in particular partial coverage splints, the risk of unwanted tooth movement should be less if used only when sleeping and for limited periods – the effects of wear during the hours of sleep being considered to be equivalent to the effects of short term wear.

It was also reported that patients with both awake and sleep-related bruxism may decide to wear their splints for long periods, particularly if the directions for the use of the splint are unclear, specifically in relation to what constitutes a safe period of wear.⁵

In a review of the Dahl concept by Poyser *et al.*,¹³ the time to achieve intrusion/extrusion of teeth to a new, desired vertical dimension is considered to range from one to 24 months, with continuous 24 hour a day wear of an appropriate, suitably designed appliance.¹³ If a removable appliance is provided, failure to achieve the desired tooth movements is typically found to be attributable to poor patient compliance, that is, the desired effects will not be achieved without the appliance being worn 24 hours a day.¹³ The use of fixed Dahl appliances minimises the risk of such failure.

Based on the above findings, short term, night-time wear of partial coverage appliances may be considered unlikely to create any lasting occlusal changes. As such, any intrusion and passive eruption caused by a night guard worn for seven to eight hours a night, that is, 'short term' as described by Wassell *et al.*,⁵ is presumably reversed by normal occlusal forces during the day, when the appliance is not

being worn. That said, the benefits of a partial coverage appliance would need to be weighed against the possible adverse effects of repeated, short-term loading of a limited number of teeth over the time the appliance is worn.

In theory, misuse of miniature anterior discluding appliances (Fig. 1) may be most likely to result in adverse occlusal changes. These preformed appliances, being simple to fit, as well as being relatively inexpensive, may be considered suitable for diagnostic purposes or for short-term provision, especially for the relief of symptoms.

They are not recommended for 24-hour use, in a review by Clark and Minakuchi, providing details of a case of anterior open bite following 24-hour use of a miniature anterior discluding appliance over an extended period.¹⁴ They found no papers reporting any occlusal changes with the short-term use of these appliances. Notwithstanding these findings, it has been suggested that the provision of miniature anterior discluding splints should be limited, where indicated clinically, to patients likely to return for follow-up appointments.¹¹ Also, the use of such small appliances should be avoided in situations where there may be a risk of inhalation or swallowing.

Case reports

The following cases consider unintended and unexpected occlusal changes in patients wearing appliances provided solely for night-time or other short-term use.

Case 1

A 52-year-old male patient, FC, an irregular attender for more than ten years, who became concerned by his nocturnal bruxing-related anterior tooth wear causing a deterioration in his dental aesthetics, was provided with a hard acrylic, anterior discluding appliance for night-time use to help prevent further tooth substance loss. He could not tolerate wearing the appliance and discontinued its use. He was subsequently provided with a soft night guard, which, it was stressed, was designed for night-time wear only.

For a number of reasons, FC did not return for two years, but then presented with pain from both his upper left, first and second molars, which included advanced secondary caries. He was also concerned that his front teeth had moved and no longer met. He also remarked that he no longer knew how to get his teeth to meet together comfortably.



Fig. 2 (a, b and c) FC's front and lateral views in the intercuspal position following his return after two year absence



Fig. 3 (a, b and c) FC's front and lateral views with his self-shortened soft night guard in place. The molar teeth were noted to be in occlusion and found to hold shimstock



Fig. 4 (a) BH's appearance prior to provision of four anterior crowns; (b) BH's initial crowns which suffered fractures and chipping; (c) BH's replacement crowns

Although FC had been given his models for safekeeping ten years previously, he had unfortunately misplaced them, so, a record of his original occlusion does not exist. It is obvious, however, from the wear patterns in FC's anterior teeth, particularly the lower incisors, that he had a history of bruxing. Sometime in the past he had had anterior guidance with excursive contacts between all the upper and lower incisor and canine teeth.

Clinical examination (Fig. 2) revealed an anterior open bite, with all teeth anterior to the first molars out of occlusion, suggesting that either all the teeth except the molars had intruded, or the molars extruded or a combination of both.

On questioning, FC indicated that he wore his soft night guard at night only, but not every night as his sleep was disturbed when wearing the appliance. He also indicated that, recently,

while going through a very stressful period in his life, he had also been aware of grinding his teeth during the day. In addition, he had started suffering from 'headaches'. On further questioning, he admitted that he had found it difficult to tolerate the full coverage provided by the guard and he had cut the guard back to cover only the teeth up to and including the second premolars. The clinical picture with the self-modified soft night guard in place is shown in Fig. 3.

In all probability, the shortened night guard acted in a similar manner to a Dahl appliance with the molar teeth, which were not in contact initially with the night guard in place, over-erupting, possibly together with some degree of intrusion of the lower teeth anterior to the first molars. These changes would have been unlikely to occur if the patient's use of the guard had been monitored.

Case 2

A 36-year-old male, BH, was referred for a second opinion. He had a history of severe anterior tooth wear with incisal edge chipping. He had become concerned with both sustained tooth surface loss and the effect this had had on his dental appearance (Fig. 4a). The initial porcelain fused to metal (PFM) crowns provided by his dentist were pleasing aesthetically (Fig. 4b). As the patient was a bruxer, a soft night guard was provided to help protect the crowns. He returned to his dentist within months with fractures and chipping of the porcelain of the crowns. BH indicated that he had experienced difficulties sleeping with the soft night guard in place and had discontinued its use.

The patient accepted responsibility for the porcelain failures and agreed to replacement crowns, but asked whether a different type of night guard was available for him to wear once treatment had been completed. Replacement

crowns were provided and were deliberately shortened to reduce the overbite in the hope of limiting the risk of repeat fractures and chipping (Fig. 4c).

A hard acrylic anterior discluding night guard was provided solely for night-time usage (Fig. 5). The patient found this appliance

extremely comfortable to wear, to the extent that he did not sleep well without it in place.

Eighteen months following the provision of the replacement crowns, BH presented with discomfort of his back teeth. He felt his bite had changed and his front teeth no longer touched when he brought his back teeth together. On

questioning, he strongly denied wearing his night guard during the day.

An anterior open bite is apparent from Figure 6. Tooth movement – intrusion of the lower anterior teeth, with little, if any eruption of the posterior teeth – was considered to have occurred. There was a total loss of canine and incisal guidance (Fig. 7).

Dahl style tooth movement is rarely linear. On reflection, it is considered prudent to avoid edge-to-edge or shallow Class 1 occlusal relationships in the provision of anterior discluding guards given that even minor intrusion could result in total loss of anterior guidance.

Case 3

A 42-year-old patient, AT, gave a history of bruxing and anterior tooth wear in her teens. She did not recall having any TMD symptoms. Three years previously, she started to suffer neck pain and headaches and attended a local dentist who diagnosed a bruxing problem and recommended extraction of her lower left wisdom tooth – he apparently regarded this tooth to be acting as a trigger for her bruxing which, in turn, in his opinion, was the probable cause of her headaches. Following the extraction, the dentist provided a lower Tanner-style appliance which, although uncomfortable, the patient wore as instructed, only at night. The troublesome neck pains and headaches disappeared. However, sometime after this, AT noticed that her front teeth no longer met and she could not bite her fingernails. Subsequent to the loss of anterior tooth contact, AT had a recurrence of her headaches and neck pains. Also, AT's sleep patterns became an issue for the first time. The patient returned to her dentist concerned about her recurrent pains and sleeping problems and was encouraged to continue wearing the Tanner-style appliance at night to protect her teeth from further wear.

On examination, AT was found to only be occluding on her back molars and totally lacking in any anterior guidance in any mandibular excursive movements (Fig. 8). This is



Fig. 5 The hard acrylic anterior discluding night guard provided for BH

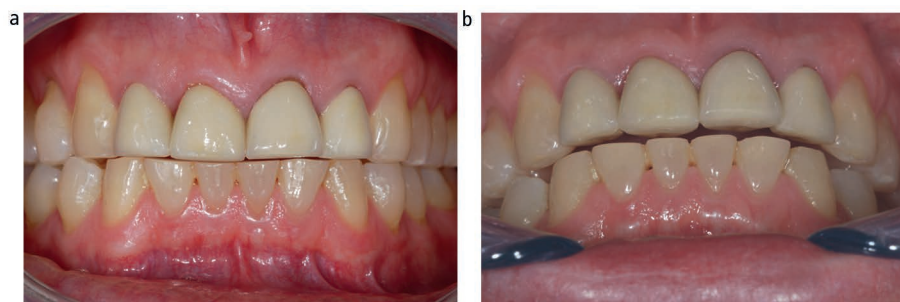


Fig. 6 (a and b) BH's clinical picture with the teeth in intercuspation 18 months following provision of the anterior discluding guard

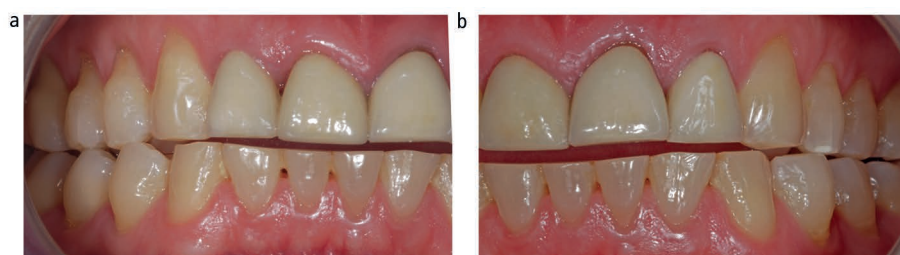


Fig. 7 (a and b) BH's lateral excursions with loss of canine and any anterior guidance



Fig. 8 (a, b and c) AT's clinical picture on presentation



Fig. 9 (a, b and c) The clearly visible wear facets on AT's study models

not the clinical situation the patient remembered from the time before she started to wear her appliance.

AT was reluctant to stop wearing the Tanner-style appliance at night as without it, she suffered from even greater acute head, neck and shoulder pains. There was clear evidence of anterior guidance having been present at some time in the past, as evidenced by wear facets in both the upper and lower incisor and canine teeth (Fig. 9). On questioning, the patient strongly denied wearing the appliance at any time other than at night.

The lower Tanner-style appliance had uneven occlusal contacts in the retruded contact position (Fig. 10), indicating that either the patient's occlusion had changed since the appliance was fitted, or the appliance had not been constructed or adjusted into either the retruded – or intercuspatal contact position. Both the upper right central and lateral incisors were noted to be out of contact with the appliance.

The design of the appliance was such that, when fitted, anterior guidance and posterior disclusion were absent (Fig. 11). Guidance in excursions was predominantly in the posterior quadrants with anterior disclusion – the exact opposite of the recommended arrangements for such an appliance.

Furthermore, the appliance did not cover the teeth beyond the first molars, leaving the second and third molars on the right side and second molars on the left side, which presumably had occluded at some point in time, out of occlusion. Despite only nocturnal wear of the appliance, Dahl type tooth movements of the unopposed molars had occurred. It was difficult to determine whether there had been some intrusion of the teeth opposing the appliance (Fig. 12).

The degree of occlusal derangement in the retruded contact position is shown in Figure 8. Figure 13 shows the complete loss of anterior

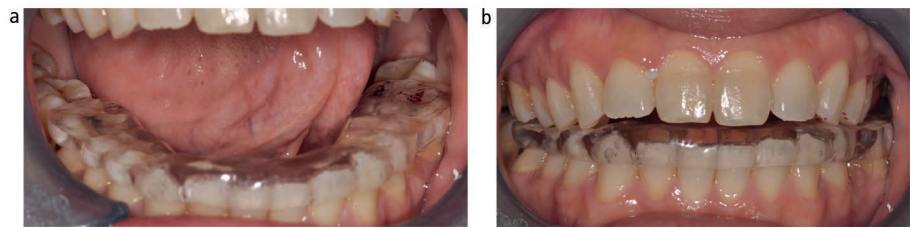


Fig. 10 (a and b) Clinical picture of AT's Tanner-style appliance in place

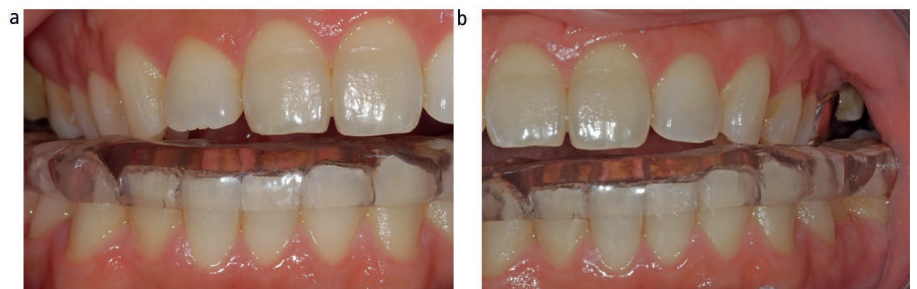


Fig. 11 (a and b) The absence of anterior guidance and posterior disclusion in AT's mandibular excursions with the appliance in place

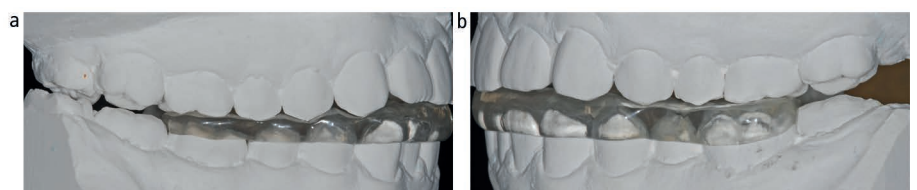


Fig. 12 (a and b) AT's study models with her Tanner-style appliance fitted

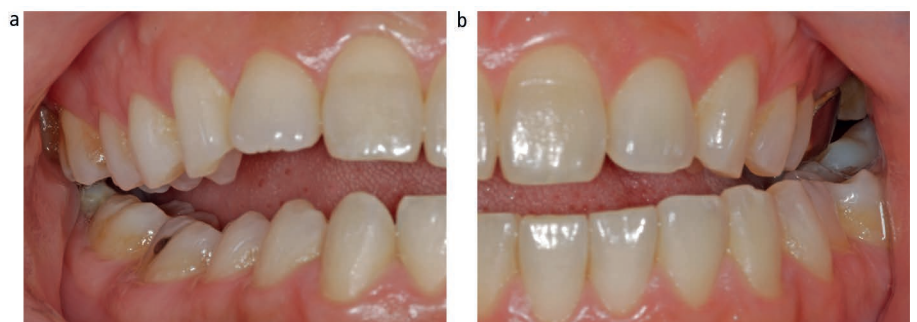


Fig. 13 (a and b) AT's lateral mandibular excursive movements show only posterior guidance

guidance, which had been present at some time in the past given the presence of wear facets on the anterior teeth and AT having given a history of nail biting.

Prior to the provision of any remedial treatment, the patient was fitted with a short-term diagnostic upper, hard acrylic anterior discluding appliance, which re-established anterior guidance and posterior disclusion. The patient was instructed to wear the appliance at night only. Two days later an email was received, commencing: 'Nightguard is working great. It is far better than I thought possible.' Re-establishing anterior guidance with the diagnostic appliance and the rapid improvement in the patient's symptoms in this case clearly indicates the clinical problems which may be associated with providing appliances which result in loss of anterior guidance.

Discussion

Full coverage upper arch guards

Full coverage, hard acrylic guards, such as the Michigan splint, are permissive appliances, intended to allow free movement of the teeth against a smooth surface, eliminating any occlusal interferences.¹⁵ They should provide all lower teeth with contact on the occlusal surface of the appliance in centric relation and disclusion of the posterior teeth in all excursive movements.

An appliance with full, even-contact coverage, when designed and executed properly, provides the patient with a stable occlusal splint, often relieving symptoms of TMD, and limiting nocturnal bruxism and uncontrolled daytime parafunction.¹⁶ These types of splints can be worn 24 hours a day if necessary, except during meal times. No evidence has been found in the literature of adverse occlusal changes associated with the wearing of properly constructed and fitted full coverage Michigan type splints. If provided for younger patients in whom the wisdom teeth have yet to erupt, regular reviews should be arranged to monitor whether these teeth are erupting and if so to arrange for their extraction, where indicated clinically, or to remake the splint to incorporate the wisdom teeth before supra-eruption occurs.

Patients often complain that upper arch, full coverage splints go too far back in the mouth and ask, sometimes demand, that the splint be cut back. Any temptation to comply with such requests should be resisted, even in cases in which only night-time wear compliance is considered to be good.

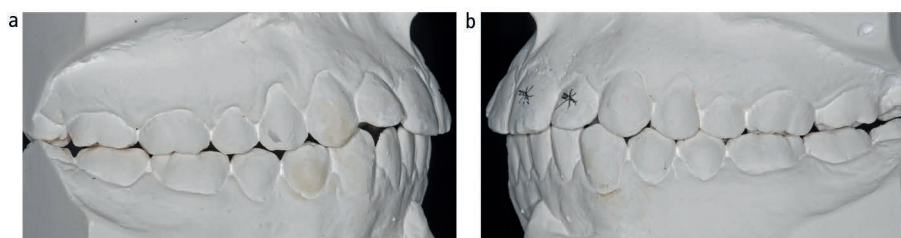


Fig. 14 (a and b) The orthodontic case – the occlusion prior to the start of orthodontics



Fig. 15 (a and b) Lower hard acrylic retainer which extends only as far as the second molars

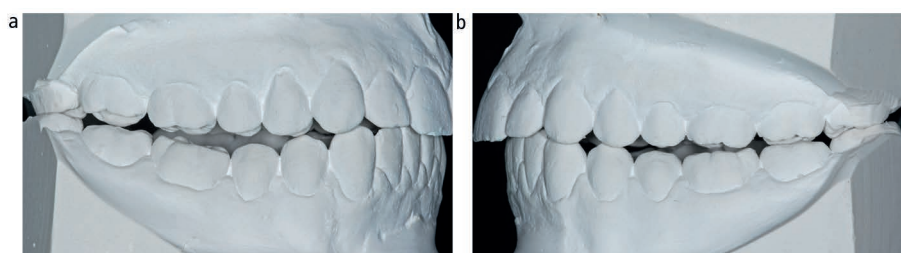


Fig. 16 (a and b) The occlusion following completion of orthodontics and a year of wearing the lower retainer. The occlusion is supported entirely on the over-erupted third molar

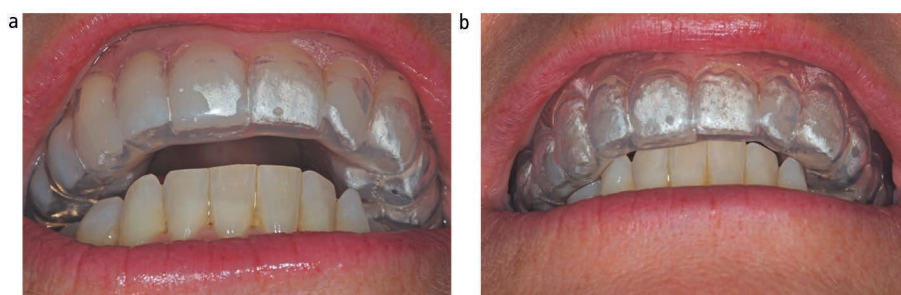


Fig. 17 (a) On initial fit, the only occlusal contacts on the laboratory constructed soft night guard are on the last standing molars; (b) Following adjustment, there are even contacts between all the lower teeth and the night guard

Orthodontic retainers

In general, following the completion of orthodontic treatment, retention is provided by means of either a fixed or removable retainer or both. Often removable retainers are of the Essix design. Based on the case studies presented, great care must be taken to cover all the teeth in the arch and to provide all opposing teeth with even occlusal contacts, if the decision is taken to provide a removable retainer. As many patients

complete their orthodontic treatment in their mid-teens, it is unlikely that the wisdom teeth will have erupted. It is important in patients provided with a removable retainer to monitor the eruption of the wisdom teeth. Assuming the wisdom teeth are retained, a new full coverage removable retainer must be provided once the wisdom teeth come into occlusion, despite possible remonstrations from the patient about the distal extension of the appliance.



Fig. 18 (a, b and c) Front and lateral views of JW's occlusion on presentation

Failure to deal with occlusal changes caused by the eruption of the wisdom teeth may lead to derangement of the occlusion (Figs 14, 15 and 16).

If full coverage Essix-style retainers are worn in both arches at the same time, there should be few, if any, occlusal implications. If, however, an Essix-style retainer, which is not based on the design of a Michigan splint, is worn in only one arch, it is unlikely that all the teeth opposing the retainer will occlude evenly. This carries the risk of intruding some teeth and others over-erupting, particularly if the retainer is prescribed to be worn 24 hours a day.

Soft night guards

In view of the above observations, it is suggested that soft night guards, if provided, should be both fitted and monitored, not simply handed to the patient with no recall arrangements (Figs 17a and b).

Correct occlusion with a soft night guard can be achieved by taking upper and lower impressions along with a bite registration and facebow recording. This is time consuming, costly and may not eliminate the need for chairside adjustments. Warming the posterior segments of the guard with a hot air blower and asking the patient to bite into the softened material until even contact is achieved around the entire arch is a simple means to refine the occlusion, with care being taken not to burn the patient, nor melt and deform the material. Following occlusal refinement, the occlusal surfaces should be polished.

'At-home' bleaching trays

When patients are provided with soft 'at-home' bleaching trays, it is prudent to advise them not to continue wearing the trays unsupervised after the bleaching process has been completed. It is not unusual for patients, who find it easier to sleep with their bleaching tray in, to continue wearing the upper tray



Fig. 19 (a and b) The degree of over-eruption of JW's lower second permanent molars; (c and d) The posterior working-side and protrusive interferences

post-bleaching and to return with their models sometime after bleaching to request a new tray, having worn through the one provided for bleaching. As bleaching trays often extend no further than the first molars, there is a risk of unwanted tooth movements similar to those illustrated in Figure 3.

Case 4

It is hoped that following the discussion of the cases presented the reader will be in a better position to understand the probable aetiology of this case.

A 53-year-old female, JW, was referred for the extraction of her upper left first permanent molar which had suffered a vertical fracture, with a view to its replacement with an implant-retained crown. Initial examination revealed a deranged occlusion, supported only on the last standing molars (Fig. 18).

The patient's history included the following information:

- A history of muscle tension over the last five, if not more, years, which she thought had started in the upper back and neck, spreading to the jaws. The patient could not, with certainty, state whether the problem started in the jaws or neck
- The patient had not had any recent orthodontic treatment
- The patient was aware of clenching her teeth at night
- The patient was aware that her teeth did not meet correctly, let alone fit comfortably together in any position; she was unable to say when she became aware of the problem
- The patient was confident that she used to be able to incise with her front teeth, but was not now able to do so (for example, bite through cotton thread or open packaging)
- The patient was aware of 'gnashing and clashing' her teeth in the daytime
- The patient had been provided with a soft night guard many years ago, but had recently

discontinued its use, when she felt that it seemed to be making matters worse. She could not remember whether the soft night guard had full or partial coverage of her teeth

- The patient reported that a 'gap' had developed between her upper left central and lateral incisors about eight years ago. The space was subsequently closed with composite bonding, but had recently started to reappear
- The patient could not remember any one time or incident when her occlusion changed; she felt that it had been a gradual process.

The degree of over-eruption of the lower second permanent molars is shown in Figures 19a and b. The posterior working-side interferences are illustrated in Figures 19c and in protrusive in Figure 19d. The patient could not find any mandibular position that would allow the front teeth to touch, as she remembered them once doing.

In all probability, based on the findings of this article, the patient had been provided with a soft night guard which did not extend beyond the upper first molars. The patient wore the guard unsupervised and her history is indicative of very slow occlusal derangement. It is extremely likely that as the degree of derangement increased, the extremely heavy protrusive interference was a large factor in the eventual vertical fracture of the upper first molar – reinforcing the recommendation that patients provided with any form of appliance should be reviewed on a regular basis and their occlusion studied in depth for any changes.

Conclusions

Whatever type of night guard may be provided, the existing occlusal scheme should be respected and maintained. If the patient has always had anterior guidance and posterior disclusion, then this should be maintained and not violated by the design of an appliance. Based on the evidence of the cases presented, inadvertent changes to the occlusal scheme can occur following the provision and night-time only wear of a night guard appliance. If occlusal derangement is to be avoided, correctly designed and fitted full coverage appliances should be considered to be the preferred treatment option.

Recommendations

It is considered prudent to give all patients being provided with, in particular, an appliance that is not full coverage in design, both written instructions as to the use of the appliance and an outline of the aims of treatment, together with warnings of the possible risk of unwanted side effects, which may be difficult, if not impossible to reverse. Specifically, the patient should understand and accept that:

- Regular monitoring will be required,^{1,17} with the patient bringing their appliance(s) with them for each review and any subsequent dental appointments
- In patients with edge-to-edge or shallow Class 1 occlusal relationships, partial coverage appliances are contraindicated
- There is a risk that unintended changes may occur to their occlusion
- They should immediately contact their dentist if their front teeth no longer meet together, that is, they develop difficulties in biting through threads, opening packaging etc
- They should not wear their appliances 24 hours a day, unless specifically instructed to do so
- They should never self-modify their appliance(s), typically for comfort or to reduce the risk of gagging
- In the event of losing an appliance, including a removable orthodontic retainer, they should return to their dentist for the provision of a new appliance, which should not be made on 'old' models as they may no longer reflect the occlusion
- In the event of any 'new' teeth beginning to erupt, typically wisdom teeth in younger patients, they should return to their dentist who will monitor the eruption and provide a new appliance as may be indicated clinically
- If any teeth covered by an appliance become sensitive, the patient should return to their dentist for review, to include consideration of any erosive wear which may have been accentuated by the presence of the appliance(s), for example, acidic drinks or regurgitated stomach acid being retained between the fitting surface of the appliance and the teeth.

In all cases of the type reported in this paper, good quality study casts and photographs should form an integral element of detailed

clinical records. Casts and photographs are invaluable for comparisons during monitoring and treatment, and facilitate communications with patients. Furthermore, casts and photographs provide objective evidence for reference in the event of any medico-legal issues stemming from the management of a deranged occlusion.

The management of occlusal derangement of the type described in the present paper, which will be the topic of a future article, involves the application of a diverse range of approaches, influenced by the nature and extent of the derangement and the circumstances, wishes and expectations of the patient. Wherever possible a patient-centred, minimum intervention approach is applied.

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