Nahal Razaghi
Mike Hughes and Mital Patel

Can Implant-retained Overdenture Components Cause Damage to the Opposing Natural Dentition?

Abstract: This clinical case series highlights an under-reported and often unidentified complication of implant-retained overdentures that may leave patients with a risk of long-term discomfort and preventable damage to the opposing dentition. A variety of cases is discussed to demonstrate potential problems and symptoms that can flag up signs of parafunctional habits in implant patients, and how these can be managed successfully.
CPD/Clinical Relevance: Implant-retained overdentures provide a significant improvement in quality of life; however, careful patient assessment and management is essential to ensure the components do not cause damage to the opposing dentition.
Dent Update 2021; 48: 571–578

When a patient presents for rehabilitation of an edentulous arch, the prosthodontic options are a complete tissue-supported removable denture, an implant-retained overdenture or an implant-retained fixed prosthesis.

The McGill Consensus 2002 concluded that first-choice treatment for the edentulous mandible was an overdenture retained by two implants.[1] In 2009, the York statement, based on randomized controlled trials, stated that 'patients' satisfaction and quality of life with implant supported mandibular over-dentures are significantly greater than for conventional dentures'.[2,3]

There is less guidance and evidence available for implant-retained overdentures in the maxilla. According to the International Team for Implantology (ITI),[4] conventionally loaded maxillary overdentures are well documented with four to six implants. In a systematic review on maxillary overdenture systems,[5] the most successful was six implants splinted together with a bar with a survival rate of 98.2%, followed by 96.3% with four implants and a bar, and 95.2% in cases of four implants with a ball anchorage system for a period of at least 1 year. Six dental implants in the edentulous maxilla connected with a bar have also been shown to provide a proper base for the support of an overdenture opposed by mandibular teeth.[6] Sanna *et al* reported a cumulative survival rate of 99.3% over 10 years of maxillary four to six interconnected implant-supported overdentures.[7] There was no detail, however, on the positions of the implants in the studies.

There is evidence that indicates a higher frequency of prosthetic complications for maxillary implant-retained overdentures.[8] A randomized controlled trial by Naert *et al*[9] comparing the prosthetic aspects of different attachment types (ball, bar and magnets) in two implant-retained mandibular overdentures, showed the ball group was the most favourable for retention of the overdenture, fewer soft tissue complications and patient satisfaction at 10 years. The bar group scored lower for comfort and stability of the maxillary complete overdenture; magnets were the least favoured for comfort. Tightening of abutment screws was the most common mechanical complication in the ball group, whereas in the magnet and bar

Nahal Razaghi, BDS (Hons), MJDF RCS (Eng), PG Dip (Dis), StR in Restorative Dentistry, Royal London Dental Hospital, Barts Health Trust, London. **Mike Hughes,** BDS, MFDS RCS (Eng), PG Cert Endodontics, Dip Rest Dent RCS (Eng), MSc, FFGDP (UK), ITI Fellow (UK), Lead Clinician and Clinical Director, Deintyddfa Na-Nóg Dental and Implant Team, Parc Menai, Bangor, Wales. **Mital Patel**, BDS, BSc(Hons), MFDS RCS(Eng), MSc, FDS (Rest Dent), RCS(Eng), FDS RCS (Ed), Consultant and Honorary Senior Clinical Lecturer in Restorative Dentistry, Royal London Dental Hospital, Barts Health Trust, London.
email: nahal.razaghi@nhs.net

groups respectively, the most common complications were wear and corrosion, and the need for clip activation.

A 3-year prospective study of attachment systems for four-implant-supported maxillary overdentures concluded that the locator system produced superior clinical results compared with telescopic crowns or bar attachments in terms of the frequency of prosthodontic maintenance, cost and ease of denture preparation.[10] At the time of writing, the most commonly used system was locators; however, the research was not robust.

Despite a lack of consensus regarding the number and configuration of implants in the maxilla, more patients are opting for implant-retained overdentures for a better quality of life compared to a tissue-supported complete denture.

Current understanding of implants and bruxism

There is a general lack of consensus regarding the definition, grading and treatment for bruxism; however, it has been linked to clinical signs, including orofacial pain, tooth wear and failing restorative treatment. An expert group described bruxism as a 'repetitive jaw-muscle activity characterized by clenching or grinding of the teeth and/or by bracing or thrusting of the mandible'. It is broadly classified into two groups, that occurring during sleep, or during wakefulness.[11] Attempts have been made to specify personality traits of bruxists, reported to be those with greater anxiety or stress; however, this is controversial.[12] General consensus is that bruxism has a multifactorial aetiology. Recent literature suggests that bruxism is mainly regulated centrally (pathophysiological and psychological factors), rather than peripherally (morphological factors).[13]

Management can be categorized as: dental; pharmacological; and psychobehavioural.[12] Often conservative management advice, which aims to reduce symptoms, is given as first line, although this does not eliminate the risk of on-going damage to the dentition. In dentate patients, occlusal splints are often used for habit management and to prevent/limit damage to the teeth or any fixed prosthesis.[14] In a small study investigating the effects of hard and soft occlusal splints on nighttime muscle activity, the hard splint significantly reduced muscle activity in eight of the 10 participants, compared to the soft splint, which significantly increased muscle activity in five of 10 subjects.[15]

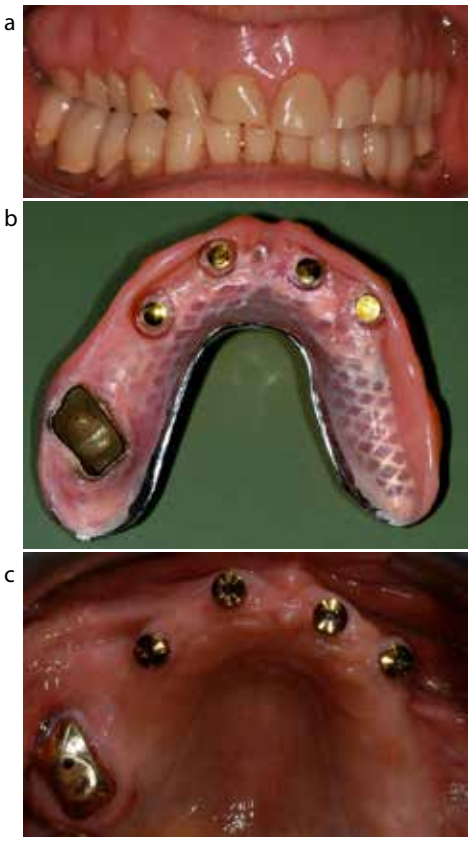

Figure 1. Case 1: (a) pre-operative labial view showing worn upper implant-retained denture. **(b)** Pre-operative fit surface of denture with magnet and housing for telescopic crown. **(c)** Pre-operative upper occlusal view

As with other patients, implant patients can also have bruxism. Owing to lack of the periodontal ligament, osseo-integrated implants, unlike natural teeth, may be more prone to occlusal overloading because of the lack of proprioceptive feedback.[16] Signs of this include those seen in dentate patients, as well as significant wearing away of denture teeth in implant-retained overdenture patients. It is widely accepted that the planned occlusion for implant-retained overdentures should be balanced to evenly distribute occlusal loads.[17,18] Occlusal overloading has been shown to be a primary aetiological factor in biomechanical implant complications, commonly resulting in marginal bone loss, fracture of the implant-supported prosthesis or retentive component, loosening/fracture of abutment screws, and even implant failure. Occlusal overloading of dental implants has been positively associated with parafunctional habits such as bruxism.[19]

Figure 2. Case 1: (a) wear on magnet housing within fit surface of denture. **(b)** Loss of UR4 magnet from fit surface of denture.

Figure 3. Case 1: use of existing overdenture to increase the vertical dimension.

It is important to identify patients with bruxist habits so that the practitioner can plan to reduce force on implants and their restorations. This can include increasing implant–bone surface area by the addition of extra implants, the use of wider implants and different surface implant designs. Metal occlusal surfaces can reduce chance of porcelain fracture and canine guidance in excursions can reduce lateral posterior force.[20]

Normal advice given following provision of implant-retained overdentures is to remove the denture at night as per standard denture hygiene instructions to allow for mucosal hygiene, reduction in inhalation

Figure 4. Case 1: (a) replacement of magnet locators with an upper implant retained bar. **(b)** Post-operative labial view. **(c)** Post-operative fit surface of upper bar-retained implant overdenture

Figure 5. Case 1: (a) upper implant-retained bar in contact with lower teeth without overdenture in place. **(b)** Wear on LR3 correlating with shape of upper bar.

Figure 6. Case 1: (a) soft splint on the lower teeth to provide protection when overdenture not being worn. **(b)** Wear marks evident on soft splint from opposing bar at review.

risk and the use of cleaning agents. In bruxist patients, where an implant-retained overdenture is opposed by natural dentition, removal of overdenture can result in the implant-retaining features being exposed to the opposing dentition. This can result in detrimental effects on the natural dentition from attritive wear by the implant components or vice versa. There is, however, limited literature discussing the effect of implant components against the natural dentition and their possible iatrogenic damage. This case series highlights the diagnosis and management of tooth surface loss caused by implant components in patients with parafunctional habits.

Clinical case series

Case 1

A 71-year-old male presented in 2004 with a maxillary overdenture supported by four implants with magnets, and an upper molar telescopic Konus crown. This was opposed by conventional and implant-retained crowns in the lower arch (Figure 1). In 2012, the UL3 magnet had displaced and shortly after, the UR4 magnet was lost (Figure 2). The patient was aware of daytime grinding, which had resulted in extreme wear of the magnets, keepers and occlusal surface on the denture. A treatment plan was agreed to replace the existing overdenture with a bar-retained overdenture at an increased occlusal vertical dimension. The existing denture was initially used to increase the vertical dimension by approximately 5 mm (Figure 3). Once satisfied with the occlusal vertical dimension, a copy denture technique was applied to construct the new bar-retained overdenture (Figure 4). The prosthesis was successfully delivered to the patient; however, 3 years later, the patient complained of an aching sensation from his lower right teeth, which was worse in the mornings. The patient continued to show signs and symptoms of on-going bruxism. He was diligently taking his upper denture out at night, but as a result, the titanium bar was bruxing against his natural dentition. Clinical examination showed obvious signs of tooth wear on the lower anterior teeth. In particular, the pattern of wear on the lower right canine coincided perfectly with the shape of the upper bar (Figure 5).

To prevent further damage to the opposing dentition, it was agreed to provide the patient with a nighttime splint. A soft splint was made for the lower teeth to separate the bar away from the natural dentition and act as a shock absorber. At subsequent review, the patient was pain-free with no further signs of wear on his natural teeth, although wear marks were seen on the soft splint (Figure 6).

Case 2

In 2010, a 62-year-old female self-referred (Figure 7). Following consultation, she was diagnosed with moderate–severe periodontitis with a failing dentition.

Initial non-surgical periodontal therapy was completed along with extraction of several hopeless prognosis teeth. At this stage, few strategic teeth were retained to help stabilize an upper immediate denture (Figure 8). After discussing options with the patient, a decision was made to have an implant bar-retained complete maxillary overdenture. Four implants were placed with simultaneous sinus grafting, along with extraction of the remaining teeth in the maxilla. Other treatment consisted of mandibular molar implants and orthodontics to improve inter-occlusal space for the provision of a maxillary titanium bar. Fixed prosthodontic treatment was completed, followed by provision of the final maxillary bar-retained overdenture (Figure 9). The patient was provided with a vacuum-formed

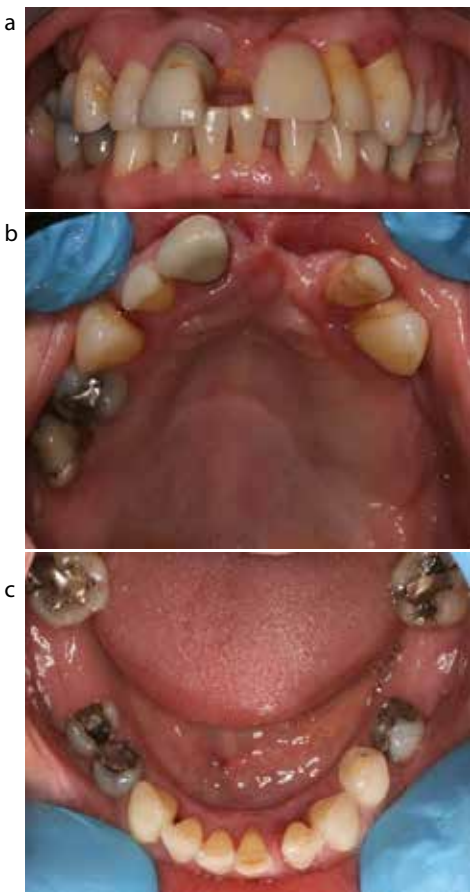

Figure 7. Case 2: (a) pre-operative labial view with existing upper partial denture. **(b)** Pre-operative upper occlusal view. **(c)** Pre-operative lower occlusal view

Figure 8. Case 2: extraction of poor prognosis teeth; uneven lower occlusal plane evident prior to orthodontic treatment

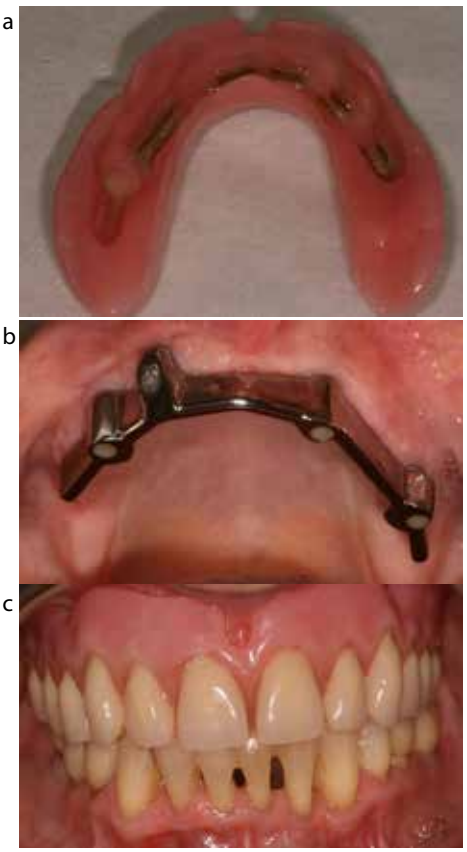

Figure 9. Case 2: (a) post-operative upper implant-retained bar overdenture. **(b)** Post-operative implant-retained upper titanium bar. **(c)** Post-operative labial view of upper implant-retained overdenture.

Figure 10. Case 2: obvious signs of wear on the lower orthodontic retainer on the anterior teeth.

Figure 11. Case 2 without the overdenture, bar is contacting lower teeth, correlating with wear on retainer.

Figure 12. Case 2. Thicker vacuum-formed soft splint provided to prevent risk of wear of natural dentition from opposing bar.

retainer in the lower arch for retention following orthodontic treatment.

At 6-month review, obvious signs of wear were present on the orthodontic retainer (Figure 10). On assessing the occlusion without the denture, as it would be every night, it was obvious the titanium bar was contacting the lower left anterior teeth and therefore a potential risk for tooth surface loss (Figure 11). In order to protect the lower teeth from the bar bruxing against the natural dentition, a thicker vacuum-formed soft splint (Figure 12) was provided to wear at night, which was well tolerated and provided good protection to the dentition.

Case 3

A 73-year-old female was referred regarding mobile teeth associated with periodontitis. The patient was also unhappy with the appearance of her upper teeth and unretentive lower denture (Figure 13).

The treatment plan involved stabilization of the periodontitis, exploration of leaking crowns (UR1, UR3, UR5), which consequently required root canal treatment followed by post-retained cores, as well as extraction of mobile teeth of poor prognosis. The patient had been on oral bisphosphonates for over 5 years and after having uneventful extractions and explanation of the risks, the patient decided to have a mandibular implant-retained overdenture. Two implants were placed in the mandibular canine regions. The patient opted for fixed bridgework

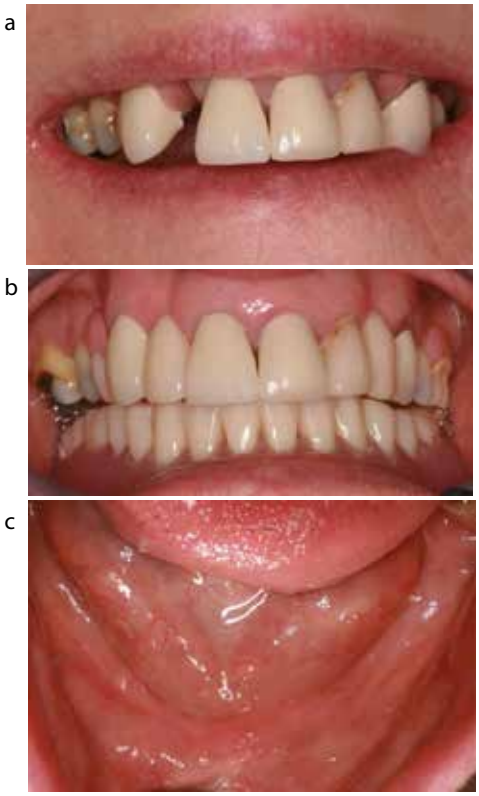

Figure 13. Case 3: (a) pre-operative smile photo without existing denture. **(b)** Pre-operative labial view with existing upper and lower acrylic dentures *in situ*. **(c)** Pre-operative occlusal view of lower edentulous ridge showing severe resorption.

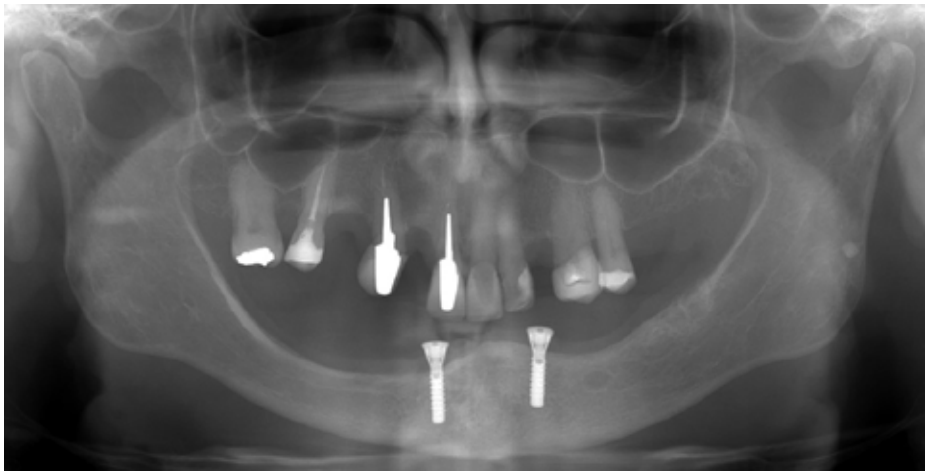

Figure 14. Case 3: OPG radiograph showing lower canine implants *in situ* and root angulation of UR3 in relation to crown.

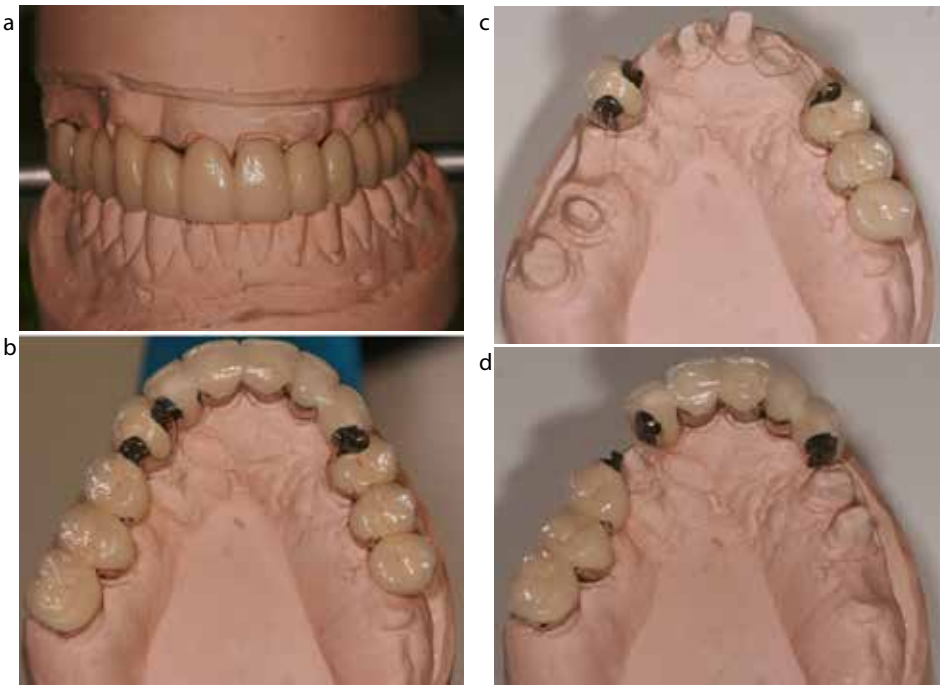

Figure 15. Case 3: (a) fixed-movable four-piece bridge designed for upper arch. **(b)** Occlusal view of fixed-movable full arch upper bridge. **(c)** Female components of fixed-movable bridge. **(d)** Male components of fixed-movable bridge.

rather than dental implants or a new removable partial denture in the maxillary arch. The UR3, which needed a cast post, was deemed to be at risk of potential root fracture due to the crown to root angle and, therefore, it was deemed essential to design a bridge with potential future tooth loss in mind (Figure 14). A fixed-movable four-piece bridge was designed (Figure 15) and provided in the upper arch, and a locator-retained lower overdenture in the lower arch (Figure 16).

The patient presented 1 month later complaining of an ache in the UR3 area. Peri-apical radiographs excluded any obvious pathology (Figure 17), and there was no periodontal pocketing suggesting a root fracture. No teeth were tender to percussion. After multiple reviews over many months, and some occlusal adjustments, no obvious diagnosis could be reached to explain the patient's symptoms.

Owing to ill health, the patient returned 1 year later; by this time, the male part of the fixed-movable joint on the mesial aspect of the UR3 was sitting above the occlusal plane and a gap had appeared above the UR2 pontic (Figure 18). All of the bridgework otherwise was stable and teeth asymptomatic. Due to continued reports of discomfort in the UR3 area, a cone beam CT scan was prescribed; this also showed no pathology or fracture. Further discussion with the patient revealed that she had been taking her denture out at night as instructed. Clinical assessment without the lower denture *in situ* showed that the lower left locator attachment was higher than the right side in contact in occlusion (Figure 19). Fine chipping of the porcelain was also noted on the incisal edge of the UL3.

An assumption was made that the patient was potentially grinding unilaterally

Figure 16. Case 3: Post-operative labial view with full arch upper bridge and lower implant-retained overdenture.

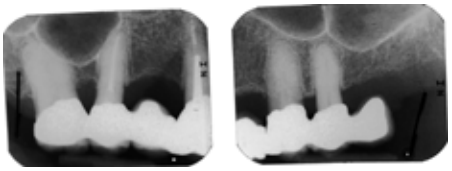

Figure 17. Case 3: post-operative peri-apical radiographs of bridge abutments.

a

b

Figure 18. Case 3: (a) at review, space developed between UR2 pontic and soft tissue. **(b)** Male part of the fixed-movable joint on the mesial aspect of the UR3 sitting above the occlusal plane.

on the UL3 causing localized overloading. Since there was no change in the connector between UL3 and UL4, it was hypothesized that there could be some potential intrusion on the upper left hand side of the anterior segment of the bridge, resulting in the upper right hand side of the segment to pivot away at the mesial connector on

Figure 19. Case 3: without the lower denture *in situ*, the left locator sits higher than the right and is the only contact in occlusion.

Figure 20. Case 3: upper hard splint made to provide more robust protection against opposing implant components.

UR3 through a fulcrum point in the upper central incisor region. This would explain why the pontic at UR2 had come away from the tissues. On discussion with the patient, it was decided to make an upper hard acrylic splint (Figure 20).

At the 1-year review, symptoms had subsided from the UL3 and no further changes were noted. The raised connector between UR2 and UR3 was cut back flush with the occlusion, and it was decided to fill the gap above the UR2 pontic with composite resin. At further annual review, the patient remained symptom free, suggesting that occlusal overloading from the implant over denture attachment was the cause of the patient's symptoms.

Discussion

Despite implant-retained overdentures being a good option in improving patients' quality of life and function, it is important to be aware of the possible detrimental effects the implant-retention system can have on the natural dentition, especially in those patients who show bruxist tendencies. Most literature discussing complications and failures of implants focus on biological and mechanical complications related to direct damage to the implants, implant-retained prosthesis and local hard and soft tissues.

These case examples highlight tooth surface loss on the opposing dentition caused by implant-retention systems because of parafunctional behaviour and which were identified early, or were challenging to identify. In two of these cases, a maxillary implant-retained bar was opposing natural dentition, and in one case, there were two mandibular locators opposing a full upper arch sectional bridge, suggesting that all types of components are at risk of causing potential damage to the opposing dentition. In each case, either a soft or hard splint was used to protect against parafunctional damage and which were effective in reducing pain and discomfort, and protecting the opposing dentition while the denture was out of the mouth.

The choice of splint used can be influenced by multiple factors. A soft splint is easier to construct and can be a fraction of the price compared to a hard acrylic splint. Some patients may, however, grind through a soft splint depending on their level of parafunctional bruxism. For these patients, a hard acrylic splint may need to be considered.

Conclusion

This case series highlights an important, but under-reported and often unidentified aspect of implant dentistry that can leave patients with ongoing discomfort and preventable damage to the opposing dentition. Careful patient assessment prior to undertaking implant treatment is essential, and we recommend a soft splint for all patients showing signs of parafunctional bruxism following the provision of implant-retained overdenture treatment. This should be discussed with the patient at the outset, as part of the treatment planning and consent process.

Compliance with Ethical Standards

Conflict of Interest: The authors declare that they have no conflict of interest.

Informed Consent: Informed consent was obtained from all individual participants included in the article.

References

1. Feine JS, Carlsson GE, Awad MA *et al.* The McGill consensus statement on overdentures. Montreal, Quebec, Canada.

May 24–25, 2002. *Int J Prosthodont* 2002; **15**: 413–414.
2. Thomason JM, Feine J, Exley C *et al*. Mandibular two implant-supported overdentures as the first choice standard of care for edentulous patients – the York Consensus Statement. *Br Dent J* 2009; **207**: 185–186. https://doi.org/10.1038/sj.bdj.2009.728.
3. Thomason JM, Kelly SA, Bendkowski A, Ellis JS. Two implant retained overdentures – a review of the literature supporting the McGill and York consensus statements. *J Dent* 2012; **40**: 22–34. https://doi.org/10.1016/j.jdent.2011.08.017.
4. Gallucci GO. Guidelines for selecting the appropriate loading protocol. In Wismeijer D, Buser D, Belser U (eds) *ITI Treatment Guide – Volume 4*. Batavia, IL: Quintessence, 2010.
5. Slot W, Raghoebar GM, Vissink A *et al*. A systematic review of implant-supported maxillary overdentures after a mean observation period of at least 1 year. *J Clin Periodontol* 2010; **37**: 98–110. https://doi.org/10.1111/j.1600-051X.2009.01493.x.
6. Ohkubo C, Baek KW. Does the presence of antagonist remaining teeth affect implant overdenture success? A systematic review. *J Oral Rehabil* 2010; **37**: 306–312. https://doi.org/10.1111/j.1365-2842.2010.02054.x.
7. Sanna A, Nuytens P, Naert I, Quirynen M. Successful outcome of splinted implants supporting a 'planned' maxillary overdenture: a retrospective evaluation and comparison with fixed full dental prostheses. *Clin Oral Implants Res* 2009; **20**: 406–413. https://doi.org/10.1111/j.1600-0501.2008.01664.x.
8. Andreiotelli M, Att W, Strub JR. Prosthodontic complications with implant overdentures: a systematic literature review. *Int J Prosthodont* 2010; **23**: 195–203.
9. Naert I, Alsaadi G, Quirynen M. Prosthetic aspects and patient satisfaction with two-implant-retained mandibular overdentures: a 10-year randomized clinical study. *Int J Prosthodont* 2004; **17**: 401–410.
10. Zou D, Wu Y, Huang W *et al*. A 3-year prospective clinical study of telescopic crown, bar, and locator attachments for removable four implant-supported maxillary overdentures. *Int J Prosthodont* 2013; **26**: 566–573. https://doi.org/10.11607/ijp.3485.
11. Lobbezoo F, Ahlberg J, Glaros AG *et al*. Bruxism defined and graded: an international consensus. *J Oral Rehabil* 2013; **40**: 2–4. https://doi.org/10.1111/joor.12011.
12. Bader G, Lavigne G. Sleep bruxism; an overview of an oromandibular sleep movement disorder. *Sleep Med Rev* 2000; **4**: 27–43. https://doi.org/10.1053/smrv.1999.0070.
13. Lobbezoo F, Naeije M. Bruxism is mainly regulated centrally, not peripherally. *J Oral Rehabil* 2001; **28**: 1085–1091. https://doi.org/10.1046/j.1365-2842.2001.00839.x.
14. Dao TT, Lavigne GJ. Oral splints: the crutches for temporomandibular disorders and bruxism? *Crit Rev Oral Biol Med* 1998; **9**: 345–361. https://doi.org/10.1177/10454411980090030701.
15. Okeson JP. The effects of hard and soft occlusal splints on nocturnal bruxism. *J Am Dent Assoc* 1987; **114**: 788–791. https://doi.org/10.14219/jada.archive.1987.0165.
16. Kim Y, Oh TJ, Misch CE, Wang HL. Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. *Clin Oral Implants Res* 2005; **16**: 26–35. https://doi.org/10.1111/j.1600-0501.2004.01067.x.
17. Rilo B, da Silva JL, Mora MJ, Santana U. Guidelines for occlusion strategy in implant-borne prostheses. A review. *Int Dent J* 2008; **58**: 139–145. https://doi.org/10.1111/j.1875-595x.2008.tb00189.x.
18. Dhanasekar B, Aparna IN, Mall N, Garg A. Occlusion in implant dentistry – issues and considerations. *J Oral Health Community Dent* 2012; **6**: 91–96. https://doi.org/10.5005/JOHCD-6-2-91
19. Hsu YT, Fu JH, Al-Hezaimi K, Wang HL. Biomechanical implant treatment complications: a systematic review of clinical studies of implants with at least 1 year of functional loading. *Int J Oral Maxillofac Implants* 2012; **27**: 894–904.
20. Misch CE. The effect of bruxism on treatment planning for dental implants. *Dent Today* 2002; **21**: 76–81.