



Simon B Critchlow

Janice S Ellis and James C Field

# Reducing the Risk of Failure in Complete Denture Patients

**Abstract:** This paper aims to review the factors associated with an increased risk of failure in complete denture patients, based on the strength of the available evidence base. These include accuracy of jaw relations, a poorly formed mandibular ridge, poor quality dentures and patient neuroticism. Clinical strategies for overcoming these issues are described with particular reference to impression-taking and jaw relations.

**Clinical Relevance:** Identifying potential problems will help to improve outcomes for edentulous patients treated with conventional complete dentures.

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The clinical management of some edentulous patients can be a source of frustration for both patient and clinician as, despite best efforts, patients remain unable to adapt to wearing the dentures that have been provided. Often the patients who fall into this category have had poor previous experience of denture-wearing and may arguably have unrealistic expectations. Nonetheless, repeated adjustments, or even remakes, can significantly add to the cost of denture construction and this can result in a negative experience for both the clinician and patient. In recent years, the evidence base for implant-supported overdentures, especially in the mandible, has strengthened the argument for this particular strategy, and for many patients this should become the gold standard.<sup>1,2</sup>

**SB Critchlow**, BDS, MSc, MFDS RCS(Ed), Specialist Registrar in Restorative Dentistry, The Royal London Dental Hospital, **JS Ellis**, BDS(Hons), PhD, FDS RCS(Ed), PGCE, Senior Lecturer and Honorary Consultant in Restorative Dentistry, Newcastle University and **JC Field**, BSc(Hons), BDS, MDFS RCS(Ed), MFGDP RCS(Eng), PGCAP, Cert(Clin)Ed, DipEd, FHEA, Clinical Fellow in Restorative Dentistry, Newcastle University, UK.

Unfortunately, not all patients are in a position to receive implant overdentures and the aim of this article is, firstly, to consider which dentist and patient factors have a robust evidence base that supports their role in determining success or failure and, secondly, to outline some techniques and strategies for maximizing the potential of conventional complete dentures, based on the best evidence available.

Factors that may influence the satisfaction of a denture patient can be categorized according to the strength of their evidence base (Table 1).

## Patient-centred problems

### Mandibular ridge anatomy

The evidence with regard to the influence of ridge anatomy on prosthodontic outcomes is variable, both in terms of research quality and in the conclusions of the available studies. Some studies have shown residual ridge anatomy to be of no influence on patient satisfaction,<sup>2,7</sup> whereas others show a positive relationship in the maxilla; the better the ridge form, the more satisfied the patient.<sup>8</sup> Other studies have shown a similar relationship in the mandible.<sup>9,10</sup> In drawing conclusions from seemingly contradictory data, more weight must be

given to the rigorous and well-conducted studies. The best available data shows patients with a poorly formed lower ridge are least likely to be satisfied with their lower denture.<sup>9</sup> Indeed, this study goes further, proposing a mechanism as to why this may be; mandibular ridge anatomy was shown to have a strong influence on the accuracy of jaw relations and this not only significantly influenced patient satisfaction with dentures, but also had a significant influence on the patients' usage of their dentures.

Managing the severely resorbed mandibular ridge can be a problem for the clinician. The flat aspect of the ridge offers little bracing against lateral or antero-posterior movement. Often the mentalis muscle is attached close to the residual ridge 'crest', leading to posterior displacement of the denture. This is exacerbated when the denture does not extend fully past the pear-shaped pads, and partially onto the retromolar pads. The mucosa overlying the ridge is often atrophic and can become painful when pressure is applied, or if the denture moves excessively in function. There may also be prominent mentalis or genial tubercles, or a large tongue. When they present at the same time, these problems can sometimes seem insurmountable.

	Factor	Strength of evidence base	Shown to influence patient satisfaction?
<b>Patient-centred problems</b>	Mandibular ridge anatomy	Robust	Yes
	Patient neuroticism	Robust	Yes
	Previous denture-wearing experience	Moderate	Yes
	Patient age and socio-demographics	Robust	No
<b>Clinician-centred problems</b>	Taking a good impression	Moderate	Yes
	Accuracy of jaw relations	Robust	Yes
	Prescribed aesthetics	Moderate	Yes
<b>Technical problems</b>	Construction of technically correct dentures	Robust	Yes

**Table 1.** Factors influencing patient satisfaction of complete dentures.

### Patient neuroticism

Patient neuroticism has been shown to be problematic in a number of studies, with neurotic patients being less satisfied with their dentures than non-neurotic patients.<sup>11,12</sup> In these studies, neurotic traits were identified using a variety of personality questionnaires. As it is highly unlikely that dentists have the time, or the relevant psychology qualifications, to administer or interpret these questionnaires in practice, it is debatable how helpful having this insight would be to the general practitioner.

### Previous denture-wearing experience

If a patient has worn complete or partial dentures in the past, is he or she better able to cope with new dentures than a first time denture wearer? A number of studies have investigated this area.<sup>3,8,13-15</sup> Unfortunately, the conclusions reached are varied, with some showing that previous denture-wearing experience is an advantage and these patients will be more satisfied with their new dentures.<sup>8,13,14</sup> In contrast, others have shown that having a previous set of dentures has little or no effect,<sup>3</sup> or the wearing of a previous set of dentures to be a disadvantage.<sup>15</sup> In light of the mixed evidence, it would seem sensible to take each patient on his/her individual merits in terms of experience, tolerance and expectation.

### Patient age and socio-demography

Neither of these factors has been shown to have any influence on patient satisfaction with his/her dentures.<sup>3-7</sup> The fact that age is included in this category may come as a surprise to many as it is often said that older patients may have more difficulty in adapting to a new set of dentures, yet this association has never been demonstrated. Older patients may have more difficulty tolerating the transition to the edentulous state, but no studies exist to confirm or refute this theory. Socio-demographic details examined have included sex, marital status, housing status, social status, occupation and hobbies, amongst others.<sup>5,6,15-17</sup>

### Clinician-centred problems

Only a small number of randomized controlled trials exist regarding the methods of conventional denture construction.

It has been shown that, for patients with an atrophic lower ridge, an admix (a mixture of greenstick and red impression compound in a 7:3 ratio) or silicone secondary impression produces a more satisfactory lower denture than one made using zinc oxide eugenol.<sup>18</sup> A lingualized occlusal scheme has also proved to be superior in terms of patient satisfaction.<sup>19</sup> While these well-conducted studies have shown how different clinical

techniques affect patient satisfaction, the evidence base is still largely incomplete and it is difficult to recommend one technique over any other. Each study was carried out in a hospital setting by prosthodontic specialists. It is impossible to say how the results would change if the dentures were manufactured by dentists within primary care.

It is perhaps more appropriate to ensure a good understanding of basic principles, good communication with the patient and laboratory and a passion for quality, which are likely to be the critical factors. Thereafter, clinicians will often adopt the technique and materials which they perceive work best for them. The following section considers the two stages of denture construction that perhaps incite the greatest debate between clinicians.

### Recording the fitting surface/taking an impression

Maximizing the area from which a mandibular denture can gain support is particularly important when faced with an atrophic mandibular ridge. Additional support can be gained by extending the denture base onto the buccal shelves (Figure 1, arrows).

The pear-shaped pads (representing the keratinized scar tissue from the last standing molar) and part of the retromolar pads (representing the glandular, non-keratinized mucosa distal to



**Figure 1.** A lower primary cast showing the buccal shelves (arrows).



**Figure 2.** A lower complete denture with appropriate extensions.



**Figure 3.** Using alginate in the lower arch frequently results in an under extended impression.

the pear-shaped pad) can also be utilized to combat the action of the mentalis muscle pushing the denture posteriorly; further, the denture can also become more resistant to lateral movement if extended into the retromylohyoid area (Figure 2).

Correctly recording denture base extensions relies on accurate functional impressions. A two-stage impression technique (the major impression taken with special trays



**Figure 4.** A well extended, border-moulded primary impression results in an accurate record of the entire denture-bearing area and a subsequent special tray that requires minimal adjustment.



**Figure 5.** Marking of the primary impression to indicate the position of the functional sulcus.



**Figure 6.** A putty impression of an upper denture that will allow the special tray to be made directly.

fabricated on a primary cast) is still widely taught in many UK dental schools. However, in the hands of prosthodontic specialists, a single impression technique has been shown to result in dentures of comparable quality.<sup>7</sup> In order to achieve this, the clinician needs to be mindful of the requirements to record the full denture-bearing area, with functional

border moulding and close tissue adaptation; this can be a challenge using only a single material in a stock tray as this may fail to deliver the three attributes described.

A two-stage technique allows the use of materials with optimal physical properties in order to achieve extension, detail and functional adaptation. Whilst alginates may be a popular choice for primary impressions, they can perform poorly owing to their inability to carry themselves to the peripheries of the denture-bearing area, notably the retromylohyoid areas and the more distal aspects of the lower ridge. Alongside other faults, Figure 3 highlights this particular problem. To overcome this, some manufacturers suggest a reduced water-to-powder ratio that will provide a more compressive material. Nonetheless, the alternatives of compound and silicone putty should be considered for their excellent physical properties that provide the opportunity to record both the full sulcal depth and functional border moulding (Figure 4).

Functional border moulding during the primary impression ensures that the special tray will require minimal adjustment, saving time at the chair-side. Sometimes it is not possible to record a functional sulcus in the primary impression, and this is often due to the unavailability of appropriately designed stock trays. Good communication between clinician and the technician is essential in these circumstances and this can be facilitated by marking the desired dimensions of the special tray onto the primary impression (Figure 5).

An efficient alternative to using a stock tray to record a primary impression is to use lab putty to record an impression of the fitting surface of the current denture. This technique can only be realistically used if the clinician is confident that the current denture has acceptable extensions (Figure 6). If not, it may be possible to correct an under-extension with putty or greenstick before taking the putty record.

If a two-stage impression technique is to be used, the material for the major impression should be decided upon prior to construction of the special tray; this is so that the technician



**Figure 7.** Border moulding completed with greenstick.



**Figure 8.** A zinc oxide eugenol wash after greensticking of the tray.



**Figure 9.** Heavy-bodied silicone has been used as an alternative to greenstick for border moulding before a wash impression in this Kennedy Class I situation.

can include an appropriate spacer. Traditionally, greenstick compound is used to ensure that the extensions of the major impression (and therefore the finished denture) are optimal, whilst at the same time creating a border seal; a more fluid wash impression of the fitting surface is then taken. However, the use of greenstick for border moulding is less popular now. It is relatively difficult to manipulate efficiently, and the warmed



**Figure 10.** Trays with stud handles.



**Figure 11.** A pared out upper block to allow room for the tongue and testing of the speaking space for sibilant sounds.

material must be tempered down to an appropriate temperature. Nonetheless, the ability to develop the border seal gradually by repeated softening and moulding has much to recommend it. Encapsulating the tuberosity region of the maxillary impression and achieving compression of the post-dam area may be helpful in ensuring a seal is achieved, and the reassurance given by a retentive border-moulded tray is welcome. Care should be taken to apply greenstick to a dry tray, and to ensure that the material is gently but thoroughly softened before attempting to border-mould (Figure 7). The advantage of greenstick is that it can be reheated and remoulded in order to develop a border seal. At this point the wash impression can be taken with the reassurance that it is possible to gain adequate retention (Figure 8).

The advent of silicone impression materials offers an alternative means of recording optimal extensions. A heavy-bodied silicone impression material can be applied around the peripheries of a correctly-adjusted tray; the syringe delivery

system ubiquitously employed with these materials conveniently delivers an appropriate width of material with relative ease (Figure 9).

Stud-type tray handles (Figure 10) are helpful in the case of atrophic mandibular ridges as they are less likely to interfere with the impression in the anterior region.

#### Accuracy of jaw relations

Recording accurate horizontal and vertical jaw relations is often seen as the most difficult stage in producing complete dentures. However, it is an important step because ensuring co-incidence of centric relation (the retruded arc of closure) and the intercuspals position has been shown to have a significant positive influence on patient satisfaction.<sup>9</sup> The presence of an atrophic mandibular ridge and thus the lack of a stable registration block for this process have been suggested as the two most significant factors that contribute to success or failure.

Prior to recording the relationship between mandibular and maxillary arches, the wax blocks should have already been adjusted to prescribe tooth position, occlusal plane and vertical dimension. It is often worth spending the time to make sure that the patient has both:

- Adequate space to pronounce sibilant sounds such as 'silly sausages' or counting through 65 to 70;
- A stable lower denture, particularly anteriorly, by making sure that the base is not overextended into the labial sulcus, and that the teeth are not being prescribed too far labially.

In real terms, this means that the dentures are being 'tested' in function. This is often facilitated by paring out excess wax from the lingual and palatal aspects of the blocks to make room for the tongue (Figure 11).

The jaw registration is often accomplished by heating the wax rims with a hot wax knife and allowing the patient to close together. Although quick and easy, this technique has a number of drawbacks:

- If the wax is over-heated, the patient may over-close into the soft wax. This will result in an increase in the amount of prescribed inter-occlusal (freeway) space.





**Figure 12.** Stability and speech can be maintained by asking the laboratory to wax-in a palatal bite plane if required. Frequently it is worthwhile prescribing the upper block for aesthetics, and the lower block (notably the lower labial bulk) for stability.



**Figure 13.** Deep opposing notches cut into the bases prior to registration with a suitable paste.



**Figure 14.** Blocks registered together without the introduction of foreign material between the occlusal surfaces, and without any contact of the heels of the permanent bases.

- The soft wax may allow the mandible to slide during registration. This will most likely result in an early contact and a horizontal slide at try-in.
- It is difficult to ensure that the wax is evenly soft across the whole block. If one side is harder or softer than the other then this can tip the registration block, often resulting in a unilateral open bite



**Figure 15.** Heel clash of the permanent bases at try-in. This should have been checked at registration and, if necessary, the bases trimmed and the blocks re-registered.

at try-in.

These problems can be largely overcome by not heating the wax in the way described above and instead using a bite registration paste on cold, firm wax. Examples include *Blu Mousse*, *Jet bite* and *Stone Bite*.

Often, the main difficulty during registration is ensuring even contact of the wax rims. This can be overcome by removing the wax from the lower block in the 3–3 region and in the second molar region.<sup>20</sup> The remaining wax in the premolar regions will have enough surface area for an accurate registration and it is significantly easier to ensure even contact on this reduced area of wax. Further, since the occlusal plane is prescribed by the upper block, this trimming should not affect the occlusion of the finished denture.

Manipulating the patient into centric relation can be difficult. It is especially problematic if there is an existing TMD or arthritic change in the joint. In these difficult cases, a specialist referral may be considered.

It is important for the patient to understand his/her 'role' during the process of registering the blocks together. Importantly, the patient should be closing into centric relation (on the retruded arc of closure). This position is used because of its reproducibility. To achieve centric relation, the patient can be instructed to curl the tip of the tongue to the back of the mouth on closure and keep it there. Bi-manual manipulation is generally considered the gold standard for locating centric relation,<sup>21</sup>

but the presence of potentially unstable registration blocks means they may have to be stabilized whilst simultaneously manipulating the patient; this is not easy. Further, there is a risk with bi-manual manipulation that the patient is registered into a position that is actually quite difficult to tolerate. Tilting the patient's head back about 45 degrees may well be all that is required to achieve this.

Problems may also occur when dentures are routinely registered and set-up in a Class I incisor relationship (either by the dentist or the laboratory). There is no contra-indication to dentures that prescribe an overjet if this is appropriate to the patient's skeletal base (Figure 12).

It is important for registration to be a passive process. Asking a patient to 'bite' down means that early contacts and gradual slides will often go unnoticed. It is often better to ask a patient to close gently and slowly until he/she feels the blocks touch.

The paste is then syringed onto the upper or lower registration block and the mandible manipulated. Some advocate cutting opposing deep notches into the blocks (Figure 13), gently closing the patient into the desired position, and then syringing the registration paste into the voids (Figure 14). In this way, there is no introduction of foreign material between the blocks and the blocks are less likely to slide over one another. The blocks can also be easily re-opposed in the laboratory.

Once complete, a few seconds spent checking for heel clash of the denture bases and/or casts is important if large scale occlusal errors are to be avoided. (Figure 15).

Paying attention to these factors will result in a satisfactory try-in. Any errors that may be present are usually minor and easily corrected. There is little evidence to suggest that the use of more complex registration tools, such as face bows, are of benefit in complete denture patients.<sup>10,22</sup> In the laboratory, an average value articulator will suffice in the vast majority of cases.

In producing dentures of high quality, dentists are, of course, reliant on their laboratory technicians. However, technicians can only work with the clinical records provided, and errors in this or failure to communicate effectively can

result in problems. A common example is that of asking for registration blocks to be made on primary impressions. Once the major impression is cast up, invariably the registration blocks will be too overextended to sit accurately onto the cast. The technician has to make a 'best' guess about how the block relates to the model, often leading to large occlusal errors at try-in. Therefore, constructing a registration block on primary casts is not recommended.

### Aesthetics

It is reasonable to assume more 'natural' looking dentures will result in a more satisfied patient. However, some studies have tended to conclude that aesthetics have only a weak influence on patient satisfaction.<sup>3,23</sup> A unique focus-group-based study asked edentulous patients what they wanted from their dentist when attending for complete dentures. One of the main themes that emerged was that the patients did not want any changes to their appearance.<sup>24</sup> The idea of patient involvement with a choice of aesthetics was first identified in the 1970s.<sup>25</sup> Patients were given the choice of four differing anterior tooth set-ups before their treatment began. In some cases, the patients then received their first choice tooth set-up. In other cases, the researchers gave the patients their least preferred set-up. Incredibly, the levels of satisfaction with the aesthetics were the same in both groups, despite a number of the participants being deliberately given their least preferred choice. It was postulated that it is patient involvement with aesthetic choices which is important, rather than the aesthetics themselves. In a wide-ranging study of what influences patient satisfaction with complete dentures, the only factor found to be significant were others' opinions of the patient's new dentures.<sup>4</sup> It may therefore be worthwhile, in some cases, asking the patient to take the try-in home, prior to finishing, so that he/she can show friends or relatives and gauge their reactions. Whatever approach is adopted, involving the

patient in the aesthetics of his/her denture will most likely contribute to patient satisfaction at the end of the treatment.

### Technical problems

#### Construction of technically correct dentures

What constitutes a technically correct denture is a matter for debate. Does it imply that the denture covers the optimal denture-bearing area, and restores facial features and aesthetics to within the norm? Or does it imply that the patient is absolutely happy with his/her prosthesis, and can use it for its intended function? This difference was demonstrated in one study that examined the proportions of patients that were using what were considered to be 'optimal' dentures. The figure quoted was 20%.<sup>3</sup> Most dentists will have examined a patient who is perfectly happy with his/her ill-fitting, mobile and maloccluded dentures. Indeed, patient ratings for satisfaction with their dentures have been shown to change significantly over time.

This illustrates the influence of adaptive capacity on patient satisfaction with dentures, however, this should not be used as an excuse for poor prosthodontic work, as the need to rely on adaptive capacity will be minimized by producing technically correct dentures. Not all patients display such adaptive capacity. Additionally, there is a small number of studies that demonstrate that technically correct dentures will better satisfy patients than poor quality ones.<sup>9,16,26</sup>

Regardless of the integrity and strength of these studies, they collectively point to the existence of a group of people who cannot tolerate complete dentures, even if they are technically excellent. No-one really knows why this group exists and there is little information in the dental literature about what unites them or how to identify them.

Since dentures are essentially replacement body parts, there may be clues as to the make-up of this group contained within research done on patients with other prostheses. These studies may give us a greater insight into the nature of wearing dentures from the patient's perspective. Work done in amputee, as well as in edentulous populations, suggests

that factors involved with continued dissatisfaction with dentures include prosthetic secrecy,<sup>24,27</sup> social isolation and withdrawal<sup>28,29</sup> and dissatisfaction with sexual relations.<sup>30-32</sup> Whilst it would be difficult to ask questions about a denture patient's sexual relations without causing embarrassment, dentists could easily ask if a patient's partner or family knows they wear dentures, establishing an estimation of levels of prosthetic secrecy. Similarly, a few casually asked questions about whether the patient regularly sees family members or friends may give a clue into the level of the patient's social withdrawal. Regardless of research findings, it is worth taking these factors into account as they might give some important clues regarding the likely outcome of complete denture therapy in individual cases.

Finally, we must also consider failure to meet the patient's expectations. Without absolute openness and honesty from the patient about what he/she would like, the dentist is almost destined to fail. It is worth remembering though that, unless patients are made to feel relaxed and accepted whilst in the dental chair, they are unlikely to be open about their needs. Five or ten minutes spent actively listening to denture patients about why they actually want new dentures would be time worth spending.

### Conclusions

Successful prosthodontic therapy is multi-factorial. Factors which have been shown to carry a high risk of failure include:

- Dentist-related factors;
- Inaccurate jaw relations;
- Not involving patients in aesthetic choices;
- Poor impression-taking;
- Patient-related factors;
- Neurotic patients;
- A severely resorbed lower ridge.

It is suggested that, if these patient-related factors are present, the patient should be considered high risk for non-adaptation to new complete dentures. This should be discussed with the patient prior to commencing treatment so that expectations can be appropriately managed.

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