Implant treatment planning for the edentulous jaws

By Christopher Ho, BDS (Hons), Grad.Dip.Clin.Dent.(Oral Implants), M.Clin.Dent.(Prosthodontics)

"The treatment options for the edentulous jaw... range from removable dentures to implant retained dentures and fully fixed implant supported bridgework..."

The treatment of the edentulous jaws presents a difficult challenge requiring careful diagnosis and treatment planning to achieve an aesthetic and functional result. These patients, especially the fully edentulous mandible, suffer from poor function and consequently lack of self confidence, often being termed "dental cripples".

The treatment options for the edentulous jaw are listed in Table 1 and can be either removable or fixed in nature. They range from removable dentures to implant retained dentures and fully fixed implant supported bridgework (Figures 1-6). These are normally retained or supported by multiple implants (typically 2-8 implants).

Diagnostic factors

Treatment planning encompasses assessment of diagnostic findings, the patient's symptoms and complaints to meet the patient's functional and aesthetic expectations. The following factors should be considered (Jivraj et al):

Extra-oral factors

- **Facial and lip support:** Lip and facial support is provided by the alveolar ridge shape and cervical crown contours of the anterior teeth. A diagnostic tool can be utilised to make an assessment with/without the maxillary denture in place (Figure 7). This is done to determine if the buccal flange of a removable prosthesis may be required to provide lip/facial support. In cases where there is a need for a flange to be provided, this must be done with a removable prosthesis allowing patients the ability to remove and clean the device, or alternatively, if a fixed prosthesis is

Table 1.
Edentulous jaw treatment options

- No treatment
- Complete denture
- Fixed implant supported restorations:
  - Ceramo-metal bridge
  - Hybrid bridge - cast gold, silver palladium alloy or Titanium with acrylic/composite. e.g. Procera Implant Bridge (Titanium), "All on Four"
  - All Ceramic bridge - eg. Zirconia Procera Implant Bridge
  - Brånemark System® Zygoma
- Removable Prostheses (bar or attachment retained):
  - Implant retained and supported overdenture
  - Implant retained and tissue supported overdenture

Figures 1a and 1b. Procera Implant Bridge - Titanium hybrid bridge (Nobel Biocare).

Figure 2. Ball attachment implant retained overdenture.

Figure 3. Procera Implant Bridge - Zirconia (Nobel Biocare).

Figure 4. Locator attachment retained overdenture.

Figure 5. Procera Implant Bridge - Zirconia (Nobel Biocare).

Figure 6. Procera Titanium Bar (Nobel Biocare).

requested then the patient would need to undergo extensive grafting procedures. In Figure 8, note the fixed implant bridge that was constructed by the patient's previous clinician with a large flange that provided lip support, however it had no accessible areas for cleansing with subsequent food trapping under the bridgework.

Table 2. Implant (attachment) retained overdenture comparison

Advantages	Disadvantages
Reduced number of implants	Implants cannot diverge too much
Ability to convert existing prostheses	Prosthesis still require tissue support
Ease of repair	Periodic maintenance to replace attachments and reline for resorption

Figure 7. Assessment of patient's lip/facial support without denture. In this case there is no need to provide additional support with a flange.

Figure 8. Fixed implant bridge with buccal flange, which is not accessible for cleaning with subsequent food trapping under bridge.

Figure 9. Patient has a high smile line with the transition between the bridge and the soft tissues able to just be seen. In this case this is acceptable but if the patient had a higher smile line, aesthetics would have been compromised.

Figure 10. Use of pink porcelain to simulate lost gingival tissues in case of moderate ridge resorption.

- **Smile line and lip length:** During speech and smiling, the movement of the upper lip should be carefully evaluated in the maxillary edentulous case. This should be assessed with and without the denture. If the ridge is displayed during smiling, junction between restoration and gingival complex will be visible which may be unaesthetic. A long upper lip or low smile line is a more favourable situation to have when restoring implant restorations.
- **Speech:** The ability to speak clearly is an important factor in the satisfaction attained with maxillary fully edentulous implant prostheses. Speech problems are mainly with fixed implant prostheses and often occur during the first weeks after delivery. Difficulty is often seen with linguo-palatal consonants where the tongue approximates the convex plateau of the anterior palate. Sufficient space needs to be allowed under fixed prostheses for hygiene, but this may also allow air escape with subsequent phonetic problems. Lundqvist et al (1992) reported that 60% of the patients in a clinical trial had distorted speech soon after treatment and 3 years later, the rate was still 30%! Heydecke et al (2004) in a within-subject comparison of maxillary fixed and removable prostheses found more speech errors with implant supported maxillary bridges than with removable prostheses. They also reported speaking ability to be lower with the fixed prosthesis. They concluded that maxillary implant overdentures with and without palates enable patients to produce more intelligible speech than do fixed prostheses.

Intra-oral factors

- **Thickness and quantity of soft tissue:** A thick biotype is easier to mould and hide abutment margins. With advanced resorption and loss of interdental papilla, this may necessitate the use of pink coloured ceramics/acrylic to give the illusion of correct soft tissue contours (Figure 10).
- **Bone quality and quantity:** The length, number and distribution of implants influences the treatment planning of the final restoration. With overdenture cases, there may be a possibility to have a reduced number of implants due to the provision of tissue support provided by the base of the removable denture.
- **Inter-arch space:** Overdentures require inter-arch space to allow for retentive components. Mounted casts should be assessed to allow for adequate space for all componentry with conventional screw

Table 3. Overdenture vs fixed prostheses comparison

Factor	Overdentures	Fixed prosthesis
Patient preference	Usually 2nd choice	Preferred
Planning	Less complex	More complex
No. of implants	2 or more	4 or more
Stability	Design dependent	Very high
Oral hygiene	Less difficult	More difficult
Surgery	Less involved	More involved
Economics	Less expensive	More expensive
Bone present	Less bone for fewer implants	More bone for more implants
Bulk	More bulky	Minimal
Tooth positions	More versatile	Limited, due to cantilevering
Interarch space	More required	Less required
Phonetics	Bulky contours	More air escape
Soft tissue replacement	Can be extensive with flange	Limited by cantilevering and hygiene
Gag reflex	May be problem	Fewer problems

retained prostheses requiring 10-12mm of space between the edentulous ridge and the opposing occlusal plane. In an overdenture case, it has been recommended to have additional space of 12-16mm in total to allow for the attachments and also enough acrylic resin for adequate strength.

- **Incisal edge position:** This is determined using the principles with complete denture fabrication. A diagnostic wax try-in is done without a flange. For fixed restorations, crowns should ideally end up at the soft tissue level. When a large vertical distance exists but the tooth-lip relationship is favourable, pink ceramic or acrylic may be used and a fixed restoration is still possible. When there is both a vertical and horizontal discrepancy and the tooth-lip relationship is not optimal, this may indicate the use of a removable prosthesis. The flange will provide adequate lip support and the teeth can be positioned appropriately to satisfy aesthetics.
- **Occlusal relationships:** An edentulous maxilla with large Class III malocclusion may be better suited with to overdenture rather than having large cantilevers from the anterior implants. In cases with severe bone resorption, this may also affect occlusal relationships with pseudo class III jaw relationship and very poor lip support.

Treatment planning factors - Fixed vs removable prostheses

A number of factors should be considered in the treatment planning process when considering fixed versus removable prostheses (Jivraj et al). These are discussed below and summarised in Table 3.

- **Aesthetics and patient desires:** Most patients prefer fixed over removable, due to the feeling that they are more like their own natural teeth.
- **Type of support:** This may depend on support gained from implants or combined with tissue support. A fixed bridge or a horseshoe denture that is implant supported may be indicated.
- **Amount of resorption and interarch space:** Patients with minimal to moderate resorption are candidates for fixed restorations providing that facial and lip support are satisfied. Patients that have advanced resorption may be better served with a removable overdenture that provides a flange that replaces lost structures. In the maxillary fixed implant bridge, patient pink porcealin/acrylic can be used to replace lost vertical height but may not provide sufficient lip and cheek support. If those patients with advanced resorption request a fixed restoration then they may require extensive grafting.
- **Number of implants:** total number of implants will determine a fixed or removable solution and is determined by:
  > quality of bone;
  > anticipated forces;
  > shape of the residual ridge and arch form; and
  > advanced resorption - a smaller arc of bone so number may be reduced and this may preclude a fixed restoration.
- **Location, splinting and distribution of implants:** This is critical in order to obtain correct aesthetics and for the patient to maintain adequate hygiene. With a fixed ceramo-metal restoration, it is very important to have implants emerging in their correct positions and not have them placed interproximally which will cause problems aesthetically. The distribution of the implants is important in a fixed case so that load can also be shared evenly with sufficient antero-posterior (AP) spread so that cantilever length can be minimised.
- **Economics:** Fixed restorations require more laboratory support and componentry therefore is more expensive to construct. This is also more costly to service and maintain in the long term. In a maxillary overdenture, the number of implants required often approaches that of a fixed prostheses and the design elements as complex, making the cost savings with an overdenture negligible, while in the mandible it is possible to have a reduced number of implants which reduces the cost for the patient. Neither removable or fixed prosthesis are immune to ongoing maintenance and patients must be made aware of these further costs.

It has been suggested that the standard of care for the edentulous mandible is an implant retained overdenture with two implants placed in the anterior mandible (Feine J et al 2002). The overdenture is more economical and very satisfactory for those patients who lack the muscular coordination to wear complete dentures but have no complaint of pain due to loading of the mucosa.

In a unique crossover study in which the same group of patients was allowed to use a removable prosthesis and a fixed prosthesis at different times (Heydecke et al, 2003), the overdenture prostheses received significantly higher satisfaction ratings than the fixed prostheses, with 69% choosing the overdenture prosthesis permanently.

Prosthetic failure rate with maxillary overdentures has been reported to be 27.6% over 3 years, which is nine times

the mandibular rate (Hutton et al, 1995). This may be due to the compromised bone and biomechanical factors as they are more often opposed by natural dentition, which may generate higher forces on the implants and care must be excercised during the planning of these procedures.

Fixed prostheses will provide almost normal function and require minimal post-operative adjustments and may be indicated for patients that psychologically cannot wear a removable appliance or are gaggers.

The patient's preference for fixed or removable prostheses must be considered along with a detailed and careful analysis of all the diagnostic factors related to the extra and intraoral exam. This is then discussed with the patient allowing the dentist to tailor the treatment plan to give the optimal solution for their individual case.

About the author

Dr Christopher Ho graduated in Dentistry with First Class Honours at the University of Sydney. He completed his Graduate Diploma in Clinical Dentistry (Oral Implants) and also attained his Masters in Clinical Dentistry (Prosthodontics) from Kings College London. He is a Faculty member of the Global Institute for Dental Education.

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