JOURNAL OF ENGINEERING annals OF FACULTY OF ENGINEERING HUNEDOARA

IMPLANT SUPPORTED OVERDENTURES

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Abstract:

For decades, natural teeth have been retained in the mouths of debilitated patients to support/retain overdentures and preserve bone. In a similar manner, root form implants have also been successfully used to enhance the support, retention and stability of overdentures.

Keywords:

Overdenture, edentulous, retention

1. THE DEVELOPMENT OF THE OVERDENTURE

The loss of the remaining teeth can be an emotional experience for many. The loss of teeth is associated with ageing and this can be a depressing factor for many. One should not underestimate the emotions related to the oral area and their effect on the patient's body image.

Preserving natural teeth or their roots (for example the two canines on an arch) should be considered as often as possible because of the advantages of this treatment choice:

1. Psychological benefits to the patient;
2. Preservation of the edentulous ridge;
3. Tactile discrimination;
4. Improved stability and retention of the denture.

In situations where extracting the remaining teeth is the only option left, patients may wear conventional dentures which give them a feeling of "floating plastic" in their mouth and a much lowered chewing capacity or choose implant supported restorations in order to restore their functional and esthetic status.

2. AVAILABLE BONE AND ANATOMICAL LIMITATIONS

Bone loss is a major issue regarding the treatment choice of edentulous patients. Available bone describes the amount of bone available in the area considered for implantation. It is measured in height, width, length and angulation.

The height of the available bone is measured from the bone crest to the closest anatomical landmark. As a general guideline, 2 mm is maintained between the implant and any adjacent landmark. In the posterior regions, the opposing landmarks are the maxillary sinus and the mandibular canal. The anterior regions are limited by the maxillary nares or the inferior border of the mandible. The problem in implant dentistry is that the posterior regions impose the greatest limits for placing dental implants. In these regions, implants will be shorter or none at all, but forces in the posterior areas are greater, since this is where mastication is done and where natural teeth have two or three roots. By not placing dental implants in this area, the clinician is often in the situation of choosing an overdenture instead of a fixed prosthesis.

The width of the bone is measured between the facial and lingual crests at the site where the implant will be placed. A 3.75 mm diameter implant requires a bone width of at least 5 mm in order to obtain a predictable result.

The length of the bone is limited by the adjacent teeth or implants. For bone 5 mm wide or more, the minimum mesiodistal length for each implant is 5 mm. Lower bone widths require higher lengths for the available bone.

Bone angulation is another determinant for alveolar bone. It should be aligned with the oclusal forces and parallel to the clinical axis of the clinical crown of the prosthodonthic restoration.

3. SUCCESS, FAILURE AND COMPLICATION DATA

Implant overdentures are associated with more complications than any other type of implant prosthesis. However, the complications do not negate the benefits these prostheses provide for patients. Implant overdentures have been more successful in the mandible than maxilla.

4. IMPLANT LOSS

Several clinical studies provide data regarding implant loss in the maxilla. The mean loss of implants was found to be around 21%.

There are clinical studies that evaluate mandibular implant loss associated with overdentures. The mean loss of implants was found to be around 5%.

Studies also provide data regarding the time (preprosthetic or postprosthetic) when the implants were lost. Sixty percent of the implants were lost preprosthetically and forty percent were lost postprosthetically.

5. DESIGN PRINCIPLES

Number of Implants

The number of implants used with overdentures has included one midline implant, two individual implants, two implants connected by a bar, and 3 or more implants connected by a bar. Placing several implants in the maxilla (because of the higher maxillary implant loss data) that are connected by bars permits the prosthesis to continue functioning should there be loss of an implant. It has been proposed that maxillary overdentures be supported by at least 4 implants, evenly distributed around the arch and connected by a bar.

In the mandible, the use of 4 implants and a bar was compared with 2 implants and a bar [1]. The authors evaluated plaque, calculus, and bleeding scores, probing depths, gingival recession, implant percussion, and made standardized radiographs. No differences were noted in the clinical or radiographic parameters and the authors suggest that 2 implants may be sufficient in the mandible. However, they did theorize that 4 implants might be beneficial for patients with sore, painful mandibular ridges since more force would be supported by the implants and bar rather than the edentulous mucosa.

Individual versus connected (splinted) implants

Clinical studies have compared individual implants with implants connected by a bar. A study [2] of photoelastic stress patterns indicated that individual implants with ball/o-ring attachments transferred less stress to the implants than the design that used 2 implants connected by a bar. There were no biologic differences between the 2 designs but greater prosthesis retention was attained when the implants were connected by a bar.

Since no clear biologic advantages have been associated with the number of implants used in the mandible (individual or connected), the numerical decision should be based on retention requirements. For many patients, two individual implants with associated retentive mechanisms provide good patient satisfaction and the treatment is less costly than a bar overdenture. For patients where retention is a primary requirement (as evidenced by active oral musculature and functionally demanding eating expectations), the use of 3, 4, or more implants and interconnecting bars with multiple retentive mechanisms is recommended.

Location of the Implants

The implants should be located so they are contained within the normal form of the denture base. Their form and location should ideally not produce substantial changes in the dimensions of the denture base. The canine areas often serve as appropriate locations for

implants. It is important to determine the location of the prosthetic teeth and the size and form of the denture base prior to implant placement. These characteristics are identified through development of a wax trial denture using conventional complete denture procedures. Implants that support/retain overdentures are commonly located in the anterior area of the mouth and they should be centered beneath the prosthetic teeth or slightly lingual to the center of the prosthetic teeth. When the implants are located anterior to the teeth or substantially posterior to the teeth, the denture base has to be enlarged to encompass the implant and retentive mechanism. The enlarged base dimensions prolong the time it takes for a patient to adapt to the new prosthesis and can make the adaptation challenging.

There is another negative aspect of placing implants too far facially or lingually. With malaligned implants, efforts are commonly made to reduce the amount of resin base overcontouring and this process frequently leaves only thin areas of resin over the retentive mechanisms. The thin resin is more prone to fracture. When implants are placed posteriorly, they should be centered beneath the prosthetic teeth.

A 5-year study [3] of 90 mandibular overdenture patients measured the parallelism of the virtual implant axis or bar with the transverse horizontal axis (hinge axis). There was parallelism in 7 patients. The study failed to show any highly significant advantages of achieving parallelism between the implant axis and the opening-closing axis of the mandible.

Implant Alignment

Implants that are parallel to each other or have their long axes nearly aligned with each other facilitate the prosthodontic phase of treatment by allowing the use of standardized components. When individual implants will be used with o-ring retention, malalignment can make prosthesis placement more difficult and the o-rings are pinched more often during placement and removal, producing o-ring wear and earlier loss of retention.

The master casts of 41 patients who had received 2 implants and ball abutment/o-ring overdentures were measured [4] to determine the effect of implant alignment on the number of adjustments/repairs. When a perpendicular relationship of the implant to the residual ridges was used as a reference angulation, implants that were inclined about 6 degrees to the facial or lingual were associated with a significantly higher number of repairs.

When an implant is placed substantially out of alignment with other sources of retention, the fabrication of custom components may be necessary. To facilitate axial loading of the implants, it has been recommended that implants be aligned so their long axes are perpendicular to the occlusal plane.

6. IMPLANT COMPONENT/RETENTIVE MECHANISM HEIGHT ABOVE THE SOFT TISSUE

After development of the wax trial denture, it is important to assess base dimensions to determine the amount of space available for implant components and retentive devices. The height of implant components and retentive mechanisms should be reduced as much as possible since they weaken the prosthesis base. However, the height should be sufficient to allow bars to be fabricated in such a manner that some space is present beneath the bar. It is recommended that a 1-2 millimeter space be present between the underside of metal bars and the edentulous ridge mucosa. It is felt that the potential for adverse soft tissue responses is related to minimal spaces underneath a bar. It has also been suggested in one publication that adverse responses under bars occur more often when unattached mucosa is present. In contrast, a study of 62 patients [5] found that attached mucosa was not a prerequisite for the maintenance of healthy function.

Peri-implant soft tissue complications were more frequently encountered with maxillary implant overdentures and it has been suggested that the reason may be related to the reduced vertical space available in the maxilla. Mandibular resorption frequently creates more vertical space than occurs in the maxilla causing retentive bars to be placed closer to the soft tissue in the maxilla. It has been stated that good oral hygiene is the main factor in preventing adverse soft tissue responses.

A 5-year longitudinal study [3] investigated the effect of the retentive mechanism on periimplant parameters (plaque index, bleeding index, probing depth, and clinical probing

attachment level). The retentive devices included round bars (both straight and curved to follow the arch form), U-shaped bars with and without distal extensions, and individual ball abutments. The authors concluded that the type of retentive mechanism appears to have little or no influence on peri-implant parameters. Some peri-implant soft tissue complications are severe enough to require surgery.

Retentive mechanisms vary in incisocervical and faciolingual dimensions. For example, ball attachments for o-rings can be as small as 2 millimeters in diameter or as large as 3.5 millimeters in diameter. The height of ball attachments (including the height of the ball abutment and the overlying o-ring is about 5-6 millimeters. The same height is occupied by ball abutments and metal caps that snap over the ball. Bars and clips are frequently 2-4 millimeters occlusocervically and 2-3 millimeters faciolingually. Bars that accept snap type attachments (Ceka) are about 1.5 millimeters in height with a faciolingual dimension of 2-4 millimeters. The overlying attachment that snaps into the recess in the bar is 1.5 to 2.5 millimeters in height for a total of up to 5 millimeters.

It is advantageous to have 2 or more millimeters of resin thickness surrounding the retentive mechanism when possible. Available base thickness will help determine the type of mechanism that can be used.

In summary, all retentive mechanisms require an occlusocervical space of about 8 millimeters (including retentive mechanism, overlying base material, and space under bars). When there is not sufficient space available, a change in the type of retentive mechanism may be necessary or the base may have to be thickened. For diagnostic purposes, the wax trial denture can be duplicated in clear acrylic resin and used in conjunction with a wax pattern of the proposed retentive mechanism to assess available space.

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