Orientation of retentive matrices on spherical attachments independent of implant parallelism

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Traditionally, it has been advocated that implants planned for use as overdenture abutments be placed parallel to each other to obtain predictable attachment retention and complete seating of the restoration and to prevent premature wear of components. However, it is often difficult or impossible to place implants parallel to each other, and patients with implants that have already been placed in a variety of positions frequently are referred to restorative dentists. This article describes a technique for the fabrication of a matrix-paralleling device as well as 2 of its uses. The device allows proper orientation of the retentive matrices to establish a common path of withdrawal for the prosthesis and all attachments. Provided that the matrices are parallel to each other, spherical overdenture attachments can be used even when the implants are not parallel. (J Prosthet Dent 2001;86:434-7.)

The professional literature and instructions accompanying various prefabricated attachments have stressed parallelism of the matrix components. When these types of overdenture attachments are considered for nonparallel implants, there are concerns regarding incomplete seating of the prosthesis, unpredictable retention, and premature wear of the retentive matrices and/or patrixes. Because of the generally held belief that ball attachments cannot be used when the implants are not parallel, many restorative dentists revert to using angled abutments, flexible attachments, or bar and clip assemblies to compensate for these situations. This increases the cost and complexity of fabrication and maintenance.

Attachments without the ability for the matrix to rotate or pivot allow only 1 path of placement and withdrawal of the matrix (Fig. 1). It is reasonable to assume that the path of placement and withdrawal of a matrix that could be rotated 3-dimensionally on a spherical matrix would exhibit the same functional properties regardless of its orientation (Fig. 2). The following preliminary study was designed to test this assumption and to determine to what degree implants must be parallel to function with predictable retention and seating when attachments that can rotate or pivot are used.

A bar measuring 40 × 12 × 8 mm was fabricated from heat-polymerized acrylic resin. Two gold retentive matrices (Cendres Metaux, Bienne, Switzerland), paralleled on a flat surface, were attached with autopolymerizing acrylic resin into 6-mm diameter openings on the inferior surface of the bar. Two 10-mm ITI implants equipped with retentive anchors were snapped into the parallel matrices in the framework. The apices of the implants were rotated medially.

Fig. 1. Examples of attachments without rotational capability.

Fig. 2. Parallel orientation of retentive matrix attachments engage equivalent undercut on all 3 implant spherical abutments regardless of different implant orientations.
until resistance was felt; then the implants were embedded in dental plaster in this position (Fig. 3). An additional cast was made with implants parallel to each other. These casts were used to simulate implants with significant coronal divergence and with ideal parallelism.

The framework was placed on each cast to assess passivity of seating and retentiveness. Visual and tactile examination demonstrated that the framework seated completely and passively on each model. There was no discernable tactile difference in retention between the different casts. The angle of divergence between the 2 implants was measured with a protractor. The total coronal divergence was found to be 60 degrees.

From this preliminary study, complete seating and predictable retention of a removable prosthesis that uses ITI (Straumann) retentive anchors was determined to be possible for implants that varied as much as 60 degrees from parallel. Problems associated with incomplete seating may not be due to the lack of implant parallelism, but rather to the lack of retentive matrix parallelism. The same principle that enables 2 nonparallel implants to function for overdentures would also apply to multiple nonparallel implants as long as all retentive matrices were aligned parallel to each other. The Branemark (Nobel Biocare USA Inc, Yorba Linda, Calif.) and Astra (Astra Tech, Waltham, Mass.) 2.25-mm ball attachments have the same shape and use the same gold matrix as the ITI retentive anchor, allowing for the same maximum degree of divergence.

The amount of maximum possible divergence for a particular attachment system would depend on its design. Attachments such as those represented in Figure 1 do not have the ability to rotate or pivot and therefore would require parallelism of the retentive matrix. It was apparent that even a small amount of matrix nonparallelism could cause problems such as incomplete seating and premature wear when these attachment designs were used.

A greater undercut was engaged if retentive matrices were not positioned parallel to each other (Fig. 4). Even if implants were parallel, it seems reasonable that matrix flanges that were placed into too much undercut during processing would hinder removal or seating of the prosthesis (Fig. 5) and would be susceptible to increased potential for wear and fatigue. A paralleling device would be useful for proper orientation of the retentive matrix in establishing a common path of placement and withdrawal for the prosthesis and all attachments.

A technique for the construction of a simple paralleling device and 2 uses of this device are presented below. Many companies selling attachments use the same or a similar ball and retentive matrix; therefore, the paralleling mandrel could be used with several systems. This technique is applicable to implant or natural tooth overdenture fabrication. Retentive matrices...
should be aligned as parallel as possible to each other and to the path of removal/placement of the prosthesis even if paralleling devices are not available.

**TECHNIQUES**

**Construction of a retentive matrix paralleling device**

1. Raise the polyvinyl chloride (PVC) spacing ring to the top of the matrix.
2. Lubricate and add casting wax around the top of the matrix and down the length of the PVC ring, leaving the ends of the retentive matrix flange uncovered.
3. Place the waxed matrix (flange down) on a flat surface, parallel to the base of a surveyor.
4. Place a plastic sprue pin in a surveyor, and lower the surveyor arm until the sprue pin makes contact with the top of the waxed matrix. Connect these with wax.
5. Make a small hole from the top of the waxed matrix to the chamber containing the matrix. This hole will facilitate ejection of the matrix with an explorer tip if necessary.
6. Attach the waxed pattern (Fig. 6) to a sprue former. Retain the full length of the plastic sprue pin because it will be the sleeve of the paralleling device.
7. Remove the retentive matrix and PVC ring from the wax pattern.
8. Invest and cast in desired metal.

**Retentive matrix orientation during denture processing**

1. After wax elimination, place the flask containing the master cast with spherical retentive anchor analogs on a survey table, and determine the path of withdrawal/placement desired for the prosthesis.
2. Position the PVC ring flush with the lower edge of the matrix to cover the flange. This prevents acrylic resin from surrounding the retentive flange, which would inhibit its ability to flex. This also ensures that the retentive groove is exposed for acrylic resin attachment to the prosthesis. Place the retentive matrix in the paralleling device (Fig. 7).
3. Place the paralleling device in the surveyor, and lower the arm of the surveyor onto a perpendicular flat surface to ensure that the matrix is properly seated.
4. Lower the survey arm until the retentive matrix is completely seated on one of the retentive anchor analogs on the master cast.
5. Block out undercuts below the PVC rings and retentive matrices with plaster or a similar material that will stabilize the position of the matrices when the forces of denture processing are applied. The blockout also will prevent resin from getting into undercuts.
6. Raise the surveyor arm. The retentive matrix should remain on the retentive anchor.
7. Repeat steps 2 through 6 until all retentive
anchors have matrices seated and secured in the appropriate positions.
8. Finish processing the dentures.

Retentive matrix orientation for connection directly in the patient’s mouth
1. Ensure that adequate space is prepared in the prosthesis for all retentive matrices.
2. Position the PVC rings flush with the lower edges of each matrix.
3. Place the retentive matrices in paralleling devices, ensuring that they are properly seated. Two or more paralleling devices are required for this procedure.
4. Place the retentive matrices on the spherical anchors in the patient’s jaw.
5. Align the paralleling devices as appropriate to ensure parallelism with each other and the path of withdrawal and insertion of the denture. This will require the use of an initial blockout material such as calcium hydroxide (Dycal) or a fast-setting rigid vinyl polysiloxane to stabilize the retentive matrices.
7. Remove the paralleling devices.
8. Finish blocking out the retentive matrices. A weaker blockout material can be used with this direct technique because the forces of laboratory processing are not encountered.
9. Proceed with routine connection of the attachments to the prosthesis.

SUMMARY

A preliminary study demonstrated that, when substantial implant nonparallelism exists, some spherical attachment systems can allow predictable retention and seating of rigidly retained parallel retentive matrices. Attachments that are able to move freely on a retentive sphere can easily be made parallel by adjusting the position of the matrix with the aid of the paralleling device described in this article. Therefore, spherical attachments can be used successfully for restorative applications with nonparallel implants. Parallel implants with matrices not positioned parallel to each other, however, will not function properly. The amount of matrix divergence that a particular type of attachment can accommodate is related to the freedom of the matrix orientation available in the system. Attachment designs that do not permit ball-and-socket rotation within the matrix will not accommodate matrix divergence. Additional research is needed to further clarify these principles.

REFERENCES


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