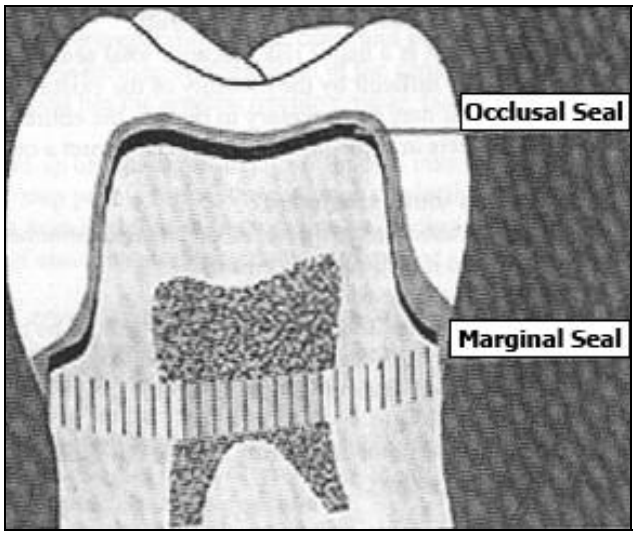
9. PROSTHODONTICS

Ralph B. Sozio, D.M.D.

Fixed Prosthodontics

1. What is the definition of "fit" for a full-crown restoration? What is the clinical acceptance of the fit of a full-crown restoration?

The fit of a full-ciown restoration is normally measured in relationship to two reference areas: (1) the occlusal'seat and (2) the marginal seal. The two areas are interrelated and affect each other. The ideal fit of a full crown (marginal discrepancy) is related to the film thickness of the cementing medium (normally 10—30 µ). The clinical acceptance of marginal discrepancy is approximately 80 µ.



Fit is a relationship between occiusal seal and marignal seal.

2. What is the best marginal tooth preparation?

There is no ideal marginal tooth preparation. The selection of the marginal design depends on many factors, including:

1. The material used in construction of the full crown:
   - All-ceramic restoration—shoulder or deep chamfer
   - Metal-ceramic with porcelain extended to marginal edge—shoulder or deep chamfer
   - Metal-ceramic with metal collars—shoulder with bevel or chamfer
   - Full gold crown—feathered edge, bevel, or chamfer
2. The amount of retention needed: beveled or feathered edge affords the most retention.
3. Seating resistance: shoulder preparation affords the least resistance.
4. Sealing capability: beveled or feathered edge affords the best seal.
5. Pulpal consideration: more tooth reduction is necessary with a shoulder preparation than with a chamfer; the feathered edge requires the least reduction.

3. How does one determine the number of abutments to be used?

There is no rigid rule. Determining factors include:

1. The greater the number of pontics, the greater the increase in loading forces on the abutments.
2. The position of the pontics affects the loading forces of the abutments: the more posterior the pontics, the greater the loading forces on the abutments.
3. The crown-to-root ratio of the abutments (bone support): a periodontally compromised mouth increases the abutment-to-pontic ratio.
4. Roots of the abutments that are parallel to each other distribute the loading forces down the long axis of the teeth. When the loading forces do not fall within the long axis of the tooth, the lateral forces on the abutments are increased. This situation necessitates the use of additional abutments.

4. In periodontally compromised patients, is splinting the entire dental arch with a onepiece, "round-house" fixed bridge the treatment of choice?

Splinting an entire dental arch with a round-house fixed bridge is far from the treatment of choice because it is fraught with potential problems:

1. All tooth preparations must be parallel to each other.
2. Impression taking and die construction are extremely difficult.
3. Accuracy of fit for the one-piece unit is extremely difficult.
4. Premature setting of the cement is a major risk, because total seating of the fixed bridge onto the abutments is made extremely difficult by the mobility of the existing teeth.
5. If one of the abutments fails, it may be necessary to replace the entire prosthesis.

It is better to split up the prosthesis in some fashion than to construct a one-piece unit.

5. Is the cantilever fixed bridge a sound treatment?

A cantilever fixed bridge places more torquing forces on terminal abutments than desirable. Certain guidelines should be followed if a cantilever is used:

1. Cantilever pontics are limited to one per fixed bridge.
2. If the cantilever is replacing a molar, the size of the pontic should be the same as for a bicuspid, and at least one more abutment unit should be incorporated than in a conventional bridge. In addition, there should be no lateral occlusal contact on the pontic, and the bridge should be cemented with a rigid medium.
3. If the cantilever pontic is anterior to the abutments, the mesial aspect of the pontic should be designed to allow some interlocking effect.

6. Can a three-quarter crown be used as an abutment for a fixed bridge?

A three-quarter crown can be used successfully as an abutment for a fixed bridge if certain guidelines are followed:

1. Because there is less tooth reduction than with a full crown, retention may be compromised. Internal modifications, such as grooves or pins, must be used to compensate for potential loss of retention.
2. Proper tooth coverage is necessary for a three-quarter crown abutment:
   - Anterior: linguoincisal
   - Posterior/upper: linguoocclusal
   - Posterior/lower: linguoocclusal plus coverage over the buccal cusp tips
3. A three-quarter crown should be made only of metal; therefore, esthetics may be compromised.

7. Must a post and core be constructed for an endodontically treated tooth that is to be used in a fixed bridge?

An endodontically treated tooth is generally more brittle than a vital tooth. Because of the tooth reduction for the full-crown restoration and preparation of the access cavity for the endodontic procedure, the remaining coronal tooth structure is likely to be small. Therefore, a post and core is more likely to be necessary in the anterior and bicuspid region. If the access cavity is small and sufficient tooth structure remains after tooth preparation in the molar region, a post and core may not be necessary. In this instance, the coronal chamber should be filled, preferably with a bonded material.

8. What is the proper length for the post? Should a post be made for each canal in a multirooted tooth?

In general, the length of a post should be such that the fulcrum point, determined from measuring the height of the core to the apex of the tooth, is in bone. This guideline normally places the post approximately two-thirds into the root length. Improper length allows a potential for root fracture. It is not necessary to construct a post for each canal in a multirooted tooth, provided that the dominant root (i.e., palatal root of maxillary molar) is used and proper length has been established. If proper length cannot be obtained, it is necessary to place posts in at least one of the other remaining roots.

9. Can one use the preformed, single-step post and core in place of the two-step cast post and core?

A preformed, single-step post and core can be used in fixed prosthodontics, but the potential for failure is greater with many of the single-step systems than with a cast-gold post and core for the following reasons:

1. The canal preparation must be shaped to the configuration of the preformed post. This requirement may lead to overpreparation of the canal and potential root perforation. In contrast, a cast post is made to fit the existing configuration of the canal.

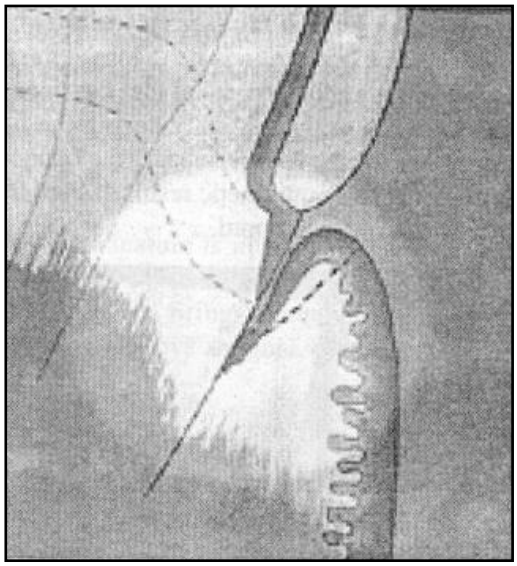
2. A screw-type post has the greatest retentive value, but it also has the greatest stress forces during insertion.

3. The core build-up of the single-step post and core may not be as stable as a cast-gold core.

4. If the single-step post is metal, the modulus of elasticity is normally much higher than that of the root. This may lead to root fracture during loading. In contrast, a type-three cast-gold post has a modulus of elasticity similar to that of the root.

10. Where should a crown margin be placed in relationship to the gingiva: supragingivally, equigingivally, or subgingivally?

It is better for gingival health to place a crown margin supragingivally, 1—2 mm above the gingival crest, or equigingivally at the gingival crest. Such positioning is quite often not possible because of esthetic or caries considerations. Subsequently, the margin must be placed subgingivally. The question then becomes whether the subgingival margin ends slightly below the gingival crest, in the middle of the sulcular depth, or at the base of the sulcus. In preparing a subgingival margin, the major concern is not to extend the preparation into the attachment apparatus. If the margin of the subsequent crown is extended into the attachment apparatus, a constant gingival irritant has been constructed. Therefore, for clinical simplicity, when a margin is to be placed subgingivally. it is desirable to end the tooth preparation slightly below the gingival crest.



The subgingival margin should not impinge into the attachment apparatus.

MATERIALS

11. What materials are employed in the construction of a full crown?

Gold alloy
Nongold alloy
Acrylic resin
Acrylic resin with a metal alloy
Composite resin
Composite resin with a metal alloy
Ceramic with a metal alloy
All ceramic

12. Are the same materials used in the construction of a fixed bridge?

In general, a fixed bridge needs a metal support for strength. The veneer coating may be acrylic, composite, or ceramic. Newer ceramic materials, including alumina and zirconium, have increased strength that in some cases may eliminate the metal substructure.

13. What are the major advantages and disadvantages of the metal-ceramic crown?

In general, the metal-ceramic crown combines certain favorable properties of metal in its substructure and of ceramic in its veneer coating.

Advantages

1. The metal substructure gives high strength that allows the materials to be used in fixed bridgework and for splinting teeth.
2. The fit of a metal casting can also be achieved with the metal-ceramic crown.
3. Esthetics can be achieved by the proper application of the ceramic veneer.

Disadvantages

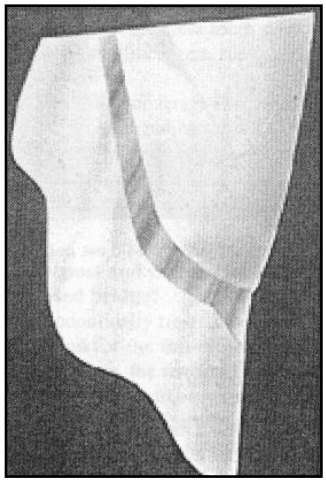
1. To allow enough space for the metal-ceramic materials, adequate tooth reduction is necessary (1.5 mm or more). The marginal tooth preparation is critical in relation to the design of the metal with the ceramic.
2. The fabrication technique is complex. The longer the span of bridgework, the greater the potential for metal distortion and/or porcelain problems.

14. What tooth preparation is necessary for the metal-ceramic crown?

The amount of tooth reduction necessary for the metal-ceramic crown depends on the metal and ceramic thickness. The necessary thickness of the metal is 0.5 mm, whereas the minimal ceramic thickness is 1.0—1.5 mm. Therefore, the tooth reduction is approximately 1.5—2.0 mm. With this porcelain-metal sandwich, a shoulder preparation is generally necessary for adequate tooth reduction.

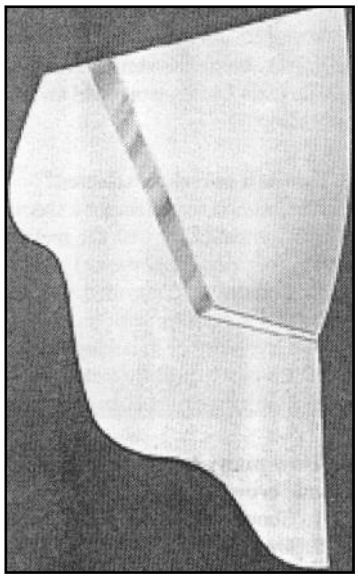
15. What happens if tooth preparation or reduction is inadequate in the marginal area?

If the tooth reduction is < 1.5 mm at the marginal area, only metal can be present in that area. If porcelain is applied on metal that has been reduced in thickness because of lack of space, marginal metal distortion is likely during the firing cycle. If the porcelain thickness is reduced to compensate for the reduced space, the opaque porcelain layer is likely to be exposed or to dominate, leading to an unesthetic result. If both the porcelain and metal have adequate thickness, then the crown is overcontoured.



Margin tooth reduction (1.0—1.5 mm) is necessary for acceptance of porcelain to cover metal.

16. Can the marginal area of a metal-ceramic crown be constructed in porcelain without metal?



There are many techniques with which to construct a porcelain margin with optimal esthetics, proper fit, and correct contour (emergence profile).

17. If the tooth preparation is sufficient to accept the porcelain edge of the metal without distortion, why is it necessary to construct a margin in porcelain solely for esthetic reasons?

It is possible to cover the metal correctly with porcelain in the marginal area, but most often the esthetic results fall short of expectation in the most critical area. Incident light that transmits through the porcelain and reflects from the metal often creates a shadowing effect. If porcelain is present only at this marginal area, light transmission and reflection through the porcelain and the tooth create the proper blend between the marginal aspect of the crown and the tooth.

18. For a successful porcelain marginal construction, how far should the metal extend in relation to the shoulder?

Originally the metal was finished slightly shy of the edge of the shoulder, with porcelain extending to the edge. Another technique finished the metal at the axiocaval line angle of the preparation, creating a porcelain margin that totally covers the horizontal shoulder. With both techniques, however, shadowing was still present. To create proper light transmission and reflection of the porcelain/tooth interface, the metal should be finished to about 1—2 mm above the axiocaval line angle of the shoulder.

19. What are noble alloys?

Noble alloys in general do not oxidize on casting. This feature is important in a metal substrate so that oxidation at the metal-porcelain interface can be controlled by the addition of trace oxidizing elements. If oxidation cannot be controlled on repeated firings, porcelain color may be contaminated and the bond strength may be weakened. Noble alloys are gold, platinum, and palladium. A silver alloy that oxidizes is considered semiprecious.

20. What is a base metal alloy? Can it be used in the construction of a metal-ceramic crown?

The base metal or nonprecious alloys most often used in the construction of a metal-ceramic crown are nickel and chromium. Because such alloys readily oxidize at elevated temperatures, they create porcelain-to-metal interface problems. The oxidation must be controlled by a metal- coating treatment, which

is somewhat unpredictable. Casting and fitting are also difficult. Authorities agree that a noble alloy is preferable.

21. What are the criteria for selecting a specific alloy?

1. Compatibility of the coefficient of thermal expansion with the selected porcelains
2. Controllability of oxidation at interface
3. Ease in casting and fabrication
4. Fit potential
5. High yield of strength
6. High modulus of elasticity (stiffness) to avoid stress in the porcelain

22. How does porcelain bond to the alloy?

Ceramic adheres to metal primarily by chemical bond. A covalent bond is established by sharing 0_2 in the elements in the porcelain and the metal alloy. These elements include silicon dioxide ($Si0_2$ in the porcelain and oxidizing elements such as silicon, indium, and iridium in the metal alloy.

23. How is a porcelain selected?

The criteria for selecting a specific porcelain include:

I. Compatibility with the metal used in regard to their respective coefficients of thermal expansion (of prime importance)

2. Stability of controlled shrinkage with multiple firings
3. Color stability with multiple firings
4. Capability of matching shade selection with various thicknesses of porcelain
5. Ease of handling (technique-sensitive)
6. Full range of shades and modifiers

24. How many layers or different porcelains can be applied in the buildup of a metal-ceramic crown?

1. Shoulder
2. Opaque
3. Opacious dentin
4. Body
5. Incisal
6. Translucent
7. Modifiers in every layer
8. External colorants

25. What is the function of the opaque layer?

The elements in the opaque layer create the chemical bond of the porcelain to the metal substrate. The opaque layer masks the color of the metal and is the core color in determining the final shade of the crown.

26. What is opacious dentin?

Opacious dentin is an intermediary modifying porcelain that affords better light transmission than the opaque layer, in part because of its optical properties.

Opacious dentin is less opaque than the opaque layer but less translucent than the body (dentin) porcelain. It is also used for color shifts or effect properties.

27. What differentiates shoulder porcelain from dentin (body) porcelain?

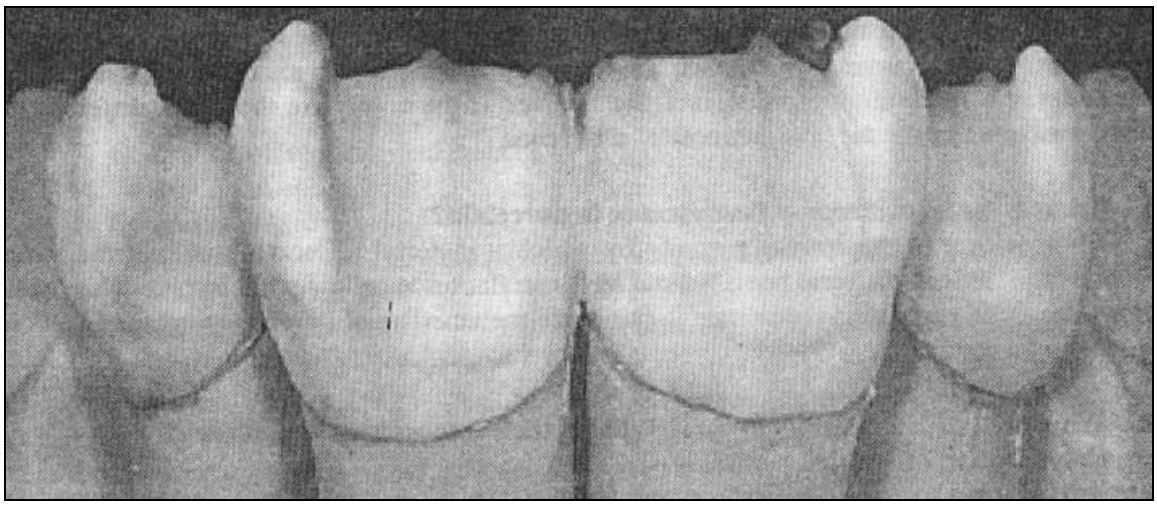
The principal difference between shoulder and body porcelain is the firing temperature. Because the shoulder porcelain is established before the general build-up, its color and dimen sion must remain stable during subsequent firings. Therefore, the shoulder porcelain matures at a higher temperature than the subsequent body porcelain firings.

28. What is segmental build-up in the construction of the metal-ceramic crown?

Segmental build-up refers to the method of applying the porcelain powders in incremental portions horizontally. Each increment differs from the others in either opacity and translucency or hue, value, or chrome. This technique is used to construct a crown that attempts to mimic the optical properties of a natural tooth. (See figure, top of next page.)

29. What is the coefficient of thermal expansion? What is its importance in prosthodontics?

The coefficient of thermal expansion is the exponential expansion of a material as it is subjected to heat. The coefficient is extremely important during joint firing of two dissimilar materials. For example, the coefficient of thermal expansion should be slightly higher (rather than the same) for the metal substrate than for the porcelain coating. This slight difference results in compression of the fired porcelain coating, which gives it greater strength.



Segmental build-up to Construct a porcelain crown.

30. What is the proper coping design for the metal-ceramic restoration?

The purpose of the metal coping is to ensure the fit of the crown and to maximize the strength of the porcelain veneer. The metal must have the proper thickness so as not to distort during the firing. The coping should be reinforced in load-bearing areas, such as the interproximal space, and can be strengthened in areas where metal exists alone, such as the lingual collar. To maximize the strength potential of the porcelain, uniform thickness should be attempted in the final restoration. This thickness can be obtained by designing the wax-up of the framework to accommodate the porcelain layer.

31. How does the marginal tooth preparation affect the design of the metal-ceramic crown?

The marginal tooth preparation determines the marginal configuration of the metal-ceramic crown. The three options are:

1. Beveled or feathered edge: the preparation is covered only in metal.
2. Chamfer: if the depth of the chamfer is at least 1 mm, the porcelain can extend over the metal and a supported porcelain margin can be constructed.
3. Shoulder: the preparation must be 1 mm for the porcelain to cover the metal.

32. Is the design of the metal framework of a fixed bridge different from the design of a single unit?

The design of the metal framework must incorporate four basic interrelationships: strength, esthetics, contour, and occlusion. In fixed bridgework, however, strength of the substrate plays the dominant role. Therefore, greater attention must be paid to reinforcement of the framework than of a single unit.

33. How do design problems of the metal framework influence the function of the metal- ceramic restorations?

1. The color of the porcelain is compromised between abutments and pontics if the thickness of the porcelain varies.
2. If the porcelain veneer is too thick (> 2 mm) because of improper framework design, much of the strength of the interface bond is lost.
3. If the porcelain veneer is too thin (≤ 0.75 mm), the esthetic effect is compromised.
4. The metal framework is designed to resist deformation. If strut-type connector design is not used in the fixed bridgework, the bridge may flex and result in porcelain fracture.

34. What is metamerism? How does it affect the metal-ceramic restoration?

Metamerism is the optical property by which two objects with the same color but different spectral reflectance curves do not match. This property is important in matching the shade of the metal-ceramic restoration to the natural

tooth. Even if the colors are the same, different reflectance curves create the "just noticeable" difference.

35. What is the importance of fluorescence in porcelain?

Fluorescence is the optical property by which a material reflects ultraviolet radiation. Fluorescence reflects different hues. Natural teeth can fluoresce yellow-white to blue-white hues. Fluorescence in porcelain is important to minimize metamerism of porcelain to natural teeth in varying light conditions.

36. What are hue, value, and chroma? What is their importance in dentistry?

Color consists of three properties:

1. Hue refers to color families (e.g., red, green).
2. Value refers to lightness or darkness as related to a scale from black to white.
3. Chroma refers to the saturation of a color at any given value level.

The properties have a practical use in ordering color.

37 What is opalescence?

Opalescence is the optical property seen in an opal during light transmission and light reflection. During transmission, the opal takes on an orange-white hue, whereas during reflection it takes on a bluish-white hue. This phenomenon also occurs in the natural tooth as a result of light scattering through the crystalline structure of the opal. The structure size is in the submicron range (0.2—0.5 II). A porcelain restoration can demonstrate the opal effect by incorporating submicron particles of porcelain into the enamel (incisal) layer.

38. How do you select a shade to match the natural teeth?

There is no truly scientific method to analyze the shade of a natural tooth and to apply this information to the selection of porcelain and fabrication of the crown. Attempts to establish such a technique have met with limited success. At present, shade determination is designed to match natural teeth with a man-made replication (shade guide) that results in a range of acceptability rather than an absolute match.

39. Can you change a shade with external stains?

External stains or colorants are frequently used to minimize the differences between natural and ceramic teeth. They should be used rationally rather than empirically. An understanding of the color phenomenon is necessary in all aspects of shade control and is essential if extrinsic colorants are to be used correctly. Extrinsic colorants follow the physical laws of substractive color.

40. What guidelines derived from the color phenomenon apply to the use of external colorants?

The understanding of hue, value, and chroma and their effect on external staining of a crown are essential. The major guidelines are as follow:

Hue: drastic change of the shade of the ceramic restoration by use of external colorants is quite often impossible. Slight changes in shade may be accomplished (e.g., orange to orange- brown).

Value: external colorants can be used to lower the value of the ceramic. The complementary color of the shade to be altered may have a darkening effect. It is almost impossible to increase the value or shade of the ceramic.

Chroma: chroma can be successfully increased by external colorants, most frequently in the gingival or interproximal areas.

41. What effects can be created with surface stains?

1. Separation and individualization with interproximal staining
2. Coloration of a cervical area to emulate root surface and to produce the illusion of change of form
3. Coloration of hypocalcified areas
4. Coloration of check lines
5. Coloration of stain lines
6. Neutralization of hue for increase of apparent translucency (usually violet)
7. Highlighting and shadowing
8. Incisal edge modifications—emulated opacities, high cifrome areas, stain areas
9. Synthetic restorations
10. Aging

42. Are external colorants stable in the oral cavity?

External colorants are metallic oxides that fuse to the ceramic unit during a predetermined firing cycle. Although quite stable in an air environment, they are susceptible to corrosion when subjected to certain oral environments. Depending on the stain and the pH of the oral fluids, external colorants may be lost from the ceramic unit over a long period of time.

43 What is the most important factor in determining the strength of a ceramic?

The most important factor in the strength of a ceramic material is control of small flaws or microcracks, which often are present both at the surface and internally. In most cases, the strength of the ceramic depends on surface flaws rather than porosity within the normal range.

44. Should porcelain be used on the occlusal surface of a metal-ceramic crown?

In general, the surface hardness of dental porcelains is greater than that of tooth structure, metal alloys, and all other restorative materials. This may lead to

excessive wear of the opposing dentition if certain occiusal guidelines are not followed. In the best scenario, the opposing material is porcelain, but results are good if the occlusal loads have good force distribution. Porcelain is contraindicated in patients who indulge in bruxism or parafunctional activities in which occlusal overloading may occur.

45. Can a porcelain fracture of a metal ceramic restoration be repaired?

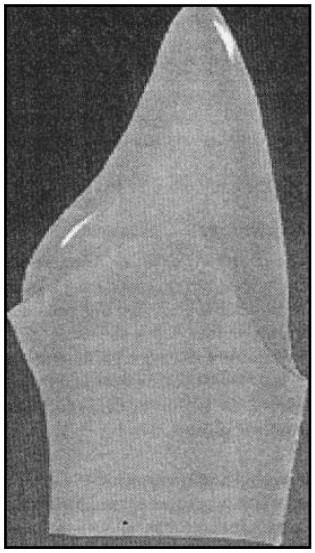
It is now possible to bond composite or ceramic materials to a fractured restoration. The bond, which may occur on porcelain or on the metal substrate, is sufficiently strong to be resistant in a non— or low stress-bearing area. However, if the fracture occurs in a stress-bearing area. the probability of a successful repair is low.

46. On what basis do you choose between an all-ceramic or a metal-ceramic crown?

In recent times all-ceramic crowns have been frequently used. As with their predecessor, the porcelain jacket crown, which was introduced at the turn of the century, the main reason for their use is superior esthetics. Unlike the metal-ceramic crown, which is hindere substrate, the all-ceramic crown has the capability to mimic the optical properties of the natural tooth. However, all other factors—including strength. fit, ease of fabrication, and tooth selection and preparation—may inhibit its use.

47. Is tooth preparation the same for an all-ceramic crown and a metal-ceramic restoration?

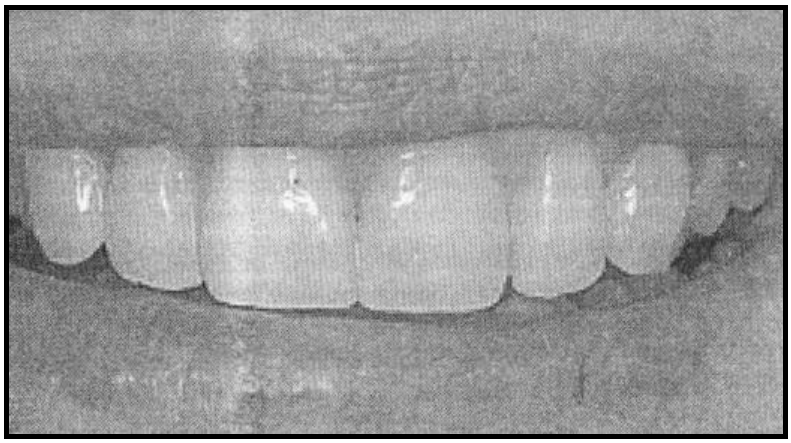
The same amount of overall tooth reduction is needed for a metal-ceramic restoration as for an all-ceramic crown (1 .0—1.5 mm labially, lingually, and interproximally). However, unlike the metal-ceramic restoration, which will accept any marginal design, marginal tooth preparation for the all-ceramic crown must be a shoulder or deep chamfer (minimum of 1.0 mm tooth reduction). (See figure, below.)



Tooth preparation for an all-ceramic crown.

48. Can the newer all-ceramic materials with high strength values be used in place of metal-ceramic restorations?

Some manufacturers claim that the newer ceramic materials with high theoretical strength values can be used in place of metal-ceramic restorations for any tooth and for small-unit, anterior fixed bridges. However, the guidelines for usage, such as tooth preparation, are more critical and in general more complicated than for metal-ceramic restorations. It is advisable, therefore, to use the all-ceramic crown in the anterior segment, where esthetics is the dominant factor.



All-ceramic crowns on maxillary anterior segment (teeth 6—11).

49. What are the different types of all-ceramic crowns?

All-ceramic crowns may be categorized by composition and method of fabrication:

Composition

1. Feldspathic porcelain, such as a conventional porcelain jacket crown.
2. Aluminous porcelain: Vitadur, Hyceram, Cerestore, Procera, Inceram
3. Mica glass: Dicor, Cerapearl
4. Crystalline-reinforced glass; Optec, Empress

Method of fabrication

I. Refractory die technique: Optec, Mirage, Hyceram, Inceram
2. Casting: Dicor
3. Press technique: Cerestore, Procera, Empress

50. What is crystalline-reinforced glass?

A crystalline-reinforced glass is a glass in which a crystalline substance such as leucite is dispersed. This composition is used in the Optec or Empress systems. Strength is derived from the crystalline microstructure within the glass matrix. The higher concentration of leucite crystals in the matrix limits the progress of microcracks within the ceramic.

51. What is the importance of alumina in an all-ceramic restoration?

Alumina (Al_2O_3) is a truly crystalline ceramic, the hardest and probably the strongest oxide known. Alumina is used to reinforce glass (as in Hyceram). The

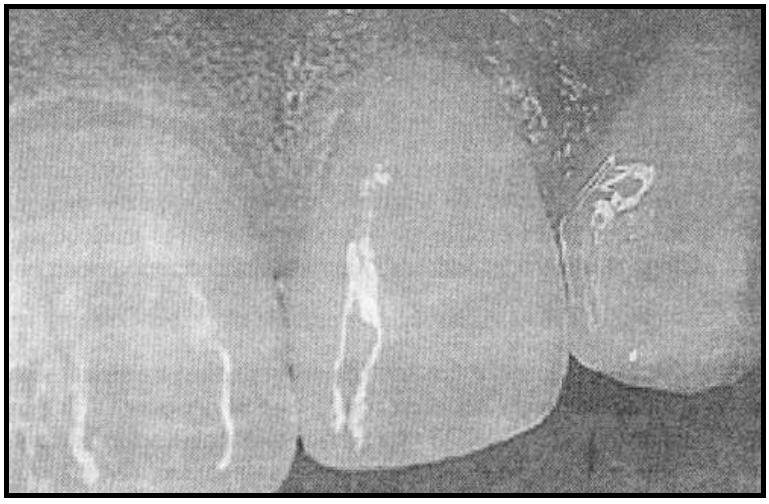
strength is determined by the amount of alumina reinforcement. Alumina is also used in total crystalline compositions (Cerestore, Procera, Inceram), which may serve as the substructure much like metal coping. With this technique, the ceramic has high strength.

52. Is the cementing of an all-ceramic crown different from the cementing of a metal-ceramic crown?

The major difference is that a trial cement is not recommended for the all-ceramic crown, which obtains much of its strength from the underlying support of the tooth. If the cement washes out, the unsupported crown is susceptible to fracture. In general, all rigid cements can be used, but a bonded resin cement is highly recommended to maximize the underlying support.

53. Can all of the all-ceramic materials be bonded to the tooth preparation?

It is important that the ceramic material be chemically etched for bonding to a tooth. If the ceramic material cannot be properly etched, alumina is used in the substrate.



Ceramic veneer (tooth 10) bonded to tooth.

54. What is the significance of the refractory die?

A refractory die is used in many techniques for the construction of different types of all-ceramic crowns and veneers. Basically it is a secondary die obtained by duplicating the master die. The ceramic material is applied on the refractory die for the firing cycles. Once the cycles have been completed, the refractory die is removed, and the ceramic piece is returned to the master die. Refractory die material must have the following properties:

1. Compatibility with impression materials
2. Dimensional stability for measurements
3. Tolerance of high-heat firing cycles

4. Compatible coefficient of thermal expansion with the ceramic material used

5. Easy removal from the ceramic piece

55. What determines the design of the pontic?

The design of the pontic is dictated by the special bouhdaries of (1) edentulous ridge, (2) opposing occlusal surface, and (3) musculature of tongue, cheeks, or lips. The task is to design within these boundaries a tooth substitute that favorably compares in form, function, and appearance with the tooth it replaces. The tooth substitute must provide comfort and support to the adjacent musculature, conformity to the food-flow pattern, convenient contours for hygiene, and cosmetic value, if indicated.

56. How should the contact area of the pontic on the edentulous ridge be designed?

Three concepts in pontic design are currently popular:

1. The sanitary pontic design leaves space between poetic and ridge.

2. The saddle pontic design covers the ridge labiolingually. Total coronal width is usually concave.

3. The modified ridge design uses a ridge lap for minimal ridge contact. Labial contact is usually to height of the ridge contour (straight emergence profile).

The selection of the design depends on the following factors:

1. Spatial boundaries

2. Shape of edentulous ridge (normal, blunted, or excessive resorption)

3. Maxillary or mandibular posterior arch (in contrast to the mandibular posterior pontic, the maxillary edentulous ridge is usually broad and blunted and has superior cosmetic effects)

4. Anterior pontic (the overriding cosmetic requirement is that form and shape reproduce the facial characteristics of the natural tooth)

57. What is the emergence profile? What is its importance?

The emergence profile is the shape of the marginal aspect of a tooth or a restoration and relates to the angulation of the tooth or restoration as it emerges from the gingiva. This gingival contour is extremely important for tissue health after placement of a crown.

The most obvious error of the emergence profile of a crown is overcontouring, which creates abnormal pressure of the gungival cuff and leads to inflammation in the presence of bacteria. Overcontouring and poor emergence profile are due primarily to (1) inadequate tooth preparation, (2) improper handling of materials, and/or (3) inadequate communication between the dentist and the technician.

58. After periodontal therapy, when can the dentist complete the marginal tooth preparation?

A certain waiting time is necessary between completion of periodontal therapy and completion of the marginal tooth preparation both to establish and to stabilize the attachment apparatus on the root surface. If this waiting time is not observed, impingement of the restoration into the attachment apparatus quite frequently occurs. The result is an iatrogenic gungival inflammation. The amount of waiting time necessary depends on the aggressiveness of the gingival procedure. A reasonable guideline, however, is to wait at least 6 weeks for tissue resolution.

59. What is a biologically compatible material?

A biologically compatible material elicits no adverse response either in the tissue or systemically. Adverse tissue response may be due to any of the following:

I. Allergic reaction
2. Toxic response
3. Mechanical irritation
4. Promotion of bacterial colonization

In general, highly polished noble alloys and highly glazed porcelains are the most biologically compatible materials.

60. Is any material used to construct crowns suspected of biologic incompatibility?

In general, most materials used in the construction of crowns are biologically compatible. Adverse reactions have occurred to some materials, primarily because of unpolished metal or unglazed porcelain surfaces. However, reports in the literature indicate that nickel-chrome alloys used in castings may be biologically incompatible. An allergic response may occur in 10% of women and 5% of men.

REMOVABLE PARTIAL DENTURES

61. What is the most important factor in determining the success of a bilateral, free-end mandibular removable partial denture (RPD)?

The most important factor in determining success is proper coverage over the residual ridge. Coverage should extend over the retromolar pad to create stability of the RPD and to minimize the torquing forces on the abutment teeth.

62. When clasps are to be used on the abutment teeth, what important factors must be considered?

When clasps are used, it is important to design the prosthesis so that the path of insertion is parallel to the abutment teeth. This factor is important in eliminating torquung forces on the abutment teeth during insertion and removal of

the partial denture. If the planes are not parallel, then the abutment teeth must be adjusted. The abutment teeth also must be evaluated for placement of the retentive clasps and the reciprocal bracing arm. The abutment teeth are then shaped to accept the clasps. The proper positioning of occiusal rests on the abutment teeth is extremely important, and the teeth are prepared to optimize positioning.

63. What are the advantages and disadvantages of the cingulum bar as a connector?

Advantages

1. Space problems for bar placement seldom exist unless anterior teeth have been worn down by attrition.
2. No pressure is exerted on the gingival tissues with movement of the RPD.
3. The major connector forms a single unit with the anterior teeth, thus contributing to comfort of the RPD.
4. Indirect retention is provided.
5. Repair of the RPD is simple when natural anterior teeth are lost.

Disadvantages

1. The metal bar situated on the lingual surface of the anterior teeth is relatT bulky, especially where crowding is present.
2. Esthetics are compromised if spacing exists.
3. Marked lingual inclination of the anterior teeth precludes use of the bar.

64. What laboratory requirements should be implemented when a cingulum bar is used?

1. For sufficient rigidity, a minimal height of 4 mi and a thickness of 2.5 mm are necessary. These dimensions should be increased when the cingulum bar traverses more natural teeth.
2. No notches should be made in the metal to stimulate tooth contour because they weaken the bar. In the presence of reduced height, the bar is placed more gingivally and made thicker to provide rigidity.
3. The junction of the bar to the denture base must be sufficiently strong. The bar can cover the lingual surfaces of premolars, if present. The contour of the teeth should be adapted to the path of insertion of the RPD.

65. Are indirect retainers necessary in the construction of an RPD? If so, where should they be placed?

The function of an indirect retainer is to prevent dislodgement of the RPD toward the occlusal plane. In a total tooth-bearing RPD, it is unnecessary to include indirect retainers. However, when the RPD has a free-end saddle portion, it is advisable to include indirect retention to prevent vertical dislodgement.

The ideal positioning of the indirect retainer is at the furthest point from the distal border of the free-end saddle. For example, if the free-end saddle is on the lower right quadrant, the indirect retainer is placed on the lower left canine.

66. Is it advantageous to place stress-breaking attachments adjacent to a free-end saddle in an RPD?

The advantage of constructing a stress-breaking attachment next to a free-end saddle is to re lieve torquing forces on abutment teeth that have been periodontally compromised. However, further displacement of the free-end saddle toward the underlying ridge may cause an acceleration of resorption of the residual ridge. It is preferable, therefore, to compensate for torquing forces on the abutment teeth by the proper extension of the saddle area.

67. Is it necessary to use clasps around abutment teeth in a RPD?

Clasps may be eliminated around abutment teeth if the teeth are restored with a partial or full crown containing some form of attachment that replaces the functions of the clasps. These functions include:

1. Guide planes for the RPD
2. Prevention of vertical displacement toward the ridge by the occlusal and cingular rest
3. Retentive function from the retentive arm
4. Bracing function from the reciprocal arm

Depending on the type of attachment, all or part of these functions may be replaced. With partial replacement, the remaining functions are incorporated into the RPD.

68. What is the difference between a precision and a semiprecision attachment?

A **precision attachment** is preconstructed with male and female portions that fit together in a precise fashion with little tolerance. Normally, there is no stress, and retention can be adjusted within the attachment. The attachment parts, constructed of a metal that can be placed into the crown and the RPD, normally are joined by solder. In general, no other clasps are necessary.

A **semiprecision attachment** is cast into the crown and the RPD. The female portion is normally made of preformed plastic that is positioned into the wax form and then cast. The male portion is cast with the RPD framework. The female and male parts fit together with much more tolerance than in the precision attachment, resulting in less retention. Secondary retentive clasping is necessary. Less torque is induced on the abutments with a semiprecision than with a precision attachment.

69. Do unlike metals in the male and female portions of the semiprecision attachment pose a problem?

The female portion of the attachment is cast with the crown and is made of the same metal as the crown. The male portion is cast into the RPD. The male portion is made of a harder metal than the female portion, which thus is subjected to greater wear. The wear pattern normally occurs on the vertical walls rather than on the occlusal seat. This creates a loosening of the attachment but no

significant vertical displacement of the RPD. The result is the need for an adjustable retentive clasp.

70. What is the difference between an intracoronal and an extracoronal attachment?

An intracoronal attachment is placed within the body of the crown, whereas the extracoronal attachment is attached to the outer portion. The selection of one over the other depends on many factors; if designed properly, both types can be used successfully.

71. What are the advantages and disadvantages of an intracoronal attachment?

Advantages

1. Placement of torquing forces near the long access of the tooth, thus minimizing these forces
2. Elimination of clasps
3. Parallel guide planes for proper RPD insertion
4. Capability to establish proper contour at the abutment-RPD interface

Disadvantages

1. More tooth reduction
2. Need for adequate coronal length
3. Lack of stress-bearing capability
4. Difficulty in performing repairs

72. What are the advantages and disadvantages of an extracoronal attachment?

Advantages

1. Same amount of reduction of the abutment tooth and conventional restoration
2. Elimination of clasps
3. Incorporation of stress-breaking into attachment
4. Ease of replacing parts
5. Improved esthetics

Disadvantages

1. The attachment is positioned away from the long axis of the tooth, creating a potential for torquing forces on the abutment tooth.
2. Adequate vertical space is necessary for placement of the attachment.
3. Interproximal contour at the crown-attachment interface is difficult to establish correctly.

73. Is the unilateral RPD an acceptable treatment modality?

In general, a unilateral RPD is not an ideal treatment modality because cross-arch stabilization is necessary for success. A unilateral RPD may be used,

however, when a single tooth is replaced and abutment teeth are on either side of the replacement tooth (Nesbitt appliance).

FULL DENTURES

74. What is the best material for taking a full-denture impression?

In taking a full-denture impression, it is important to understand that the topography of an edentulous arch includes soft, displaceable tissue with undercut areas. An impression material must not distort the tissues. Therefore, the material must be low in viscosity and elastomeric so that it can rebound in the undercut areas.

75. Is border molding necessary for a full lower denture?

Unlike a full upper denture, a lower denture does not rely on a peripheral seal for retention. Thus one may assume that border molding is an unnecessary procedure during impression taking. This assumption is incorrect because inadvertent overextension can greatly reduce denture stability as well as irritate tissue. Underextension of the peripheral border decreases tissue-bearing surfaces, thereby affecting denture stability.

76. What is the importance of the posterior palatal seal? How is its position determined?

The posterior palatal seal is an important component because it completes the entire peripheral sealing aspect of a maxillary denture. Anatomically, the seal is located at the juncture of the hard and the soft palate and joins the right and left hamular notches. If the seal is positioned more posteriorly, then tissue irritation, gagging reflex, and decreased retention can result. If the seal is positioned more anteriorly, tissue irritation and decreased retention can result. Manual palpation and phonetics (the "ah" sound) are the best ways to determine the anatomic position for the palatal seal.

77. What are the critical areas in the border-molding procedure of taking impressions for a maxillary arch?

The most critical area to capture in an impression is the mucogingival fold above the maxillary tuberosity area. Proper three-dimensional extension of the final prosthesis is extremely important for maximal retention. Other critical areas are the labial frena in the midline and the frena in the bicuspid area. Overextension in these areas often leads to decreased retention and tissue irritation.

78. Should an impression be taken under functional load or passively at one static moment?

The answer to this question has been debated for years. Soft tissue constantly changes, and a static impression captures the tissue at one point in

time. On the other hand, a functional impression is taken with abnormal masticatory loads. Therefore, there is no absolute method of taking the impression. Denture stability with occlusal forces and periodic tissue evaluation, however, are critical with both methods.

79. What are the critical areas to capture in an impression of a mandibular arch?

Mandibular dentures do not rely on suction from a peripheral seal for retention but rather on denture stability in covering as much basal bone as possible without impinging on the muscle attachments. Movement of the tongue, lips, and cheeks greatly affects the amount of tissue-bearing area. Therefore, apart from identifying and covering the retromolar areas, the active border molding performed by the lip, cheeks, and tongue determines the peripheral areas of a mandibular arch, thus establishing maximal basal bone coverage.

80. How do you determine the peripheral extent of a denture?

For a peripheral border impression, a moldable material should be used around a well-fitting tray. The material should have moderate or low viscosity so as not to displace tissue and should set in a brief period of time. The lips, cheeks, and tongue dictate the extent of the peripheral impression. The impression is captured by exaggerated movements of the anatomic structures made by the patient or manipulated by the dentist.

81. If an impression does not capture everything that is intended, can you realign the exist ing impression?

One must always bear in mind that an edentulous ridge has soft, displaceable tissue. Thus it is important to relieve the pressure before relining an existing impression. If this is not done, tissue is compressed, and dimensional stability of the final impression is compromised. This inevitability leads to an undersized, ill-fitting denture.

82. How is vertical dimension established in a totally edentulous mouth?

Vertical dimension is established with the aid of bite rims. The most important aspect of vertical dimension is to establish the freeway space. The minimal opening in freeway space, which is determined phonetically (the "s" sound), is normally 1—2 mm.

83. How are overlap and overjet established?

Overlap and overjet are established by the maxillary bite rim, which also establishes the occlusal plane. The bite rim is adjusted by its position relative to the lip and cheek.

84. Is the bite registration taken in the centric relation or centric occlusion position?

This controversy has been argued for years and remains unresolved. However, certain principles are generally accepted:

1. A centric relation position may be duplicated.
2. Centric relation is the same position in various openings of the vertical dimension.
3. Centric relation should be an unstrained position.
4. Centric occlusion may be employed if the bite registration is done without increasing the vertical dimension.

85. Is it necessary to take multiple bite registrations?

It is not necessary to take multiple bite registrations to capture a maxillary/mandibuIar relationship. However, because tissue displacement makes it difficult to obtain a stable bite with wax rims, a single accurate bite registration is unlikely. It is advisable, therefore, to take multiple bite registrations throughout the fabrication procedure and even after insertion of the final dentures.

86. What does the tooth try-in appointment accomplish?

The most obvious reason for the try-in appointment is to visualize the esthetics of the final teeth in regard to lip line, overbite and overjet, shape, and arrangement. The try-in appointment can also determine the fullness of the labial flanges in relationship to the cheeks and lips. Occiusal relationship can be checked and verified, and a new bit registration can be performed. Above all, the try-in appointment affords both the dentist and the patient a preview of the final completed denture.

87. How is posterior occlusion selected with regard to tooth morphology?

Posterior occlusion can range from monoplane (flat plane) to steep anatomic occlusal cusps. In general, the more anatomic the occlusion, the more efficient its function. However, it is more difficult to establish balanced occlusion with a steep anatomic denture, and lack of balance leads to denture instability. It is, therefore, easier to establish occiusal harmony with monoplane teeth. Overbite and overjet of the anterior teeth also affect selection of the posterior teeth.

88. How do overbite and overjet affect the selection of cuspid inclines of the posterior teeth?

Overbite and overjet of the anterior teeth affect selection of the cuspid inclines of the posterior teeth when balanced occlusion is to be achieved in lateral and protrusive movements:

Steep overbite—steep cuspal incline
Small overbite—monoplane
Wide overj ct—monoplane

Narrow overjet—steep cuspal incline

89. Of what materials are denture teeth composed? How are they selected?

Denture teeth are made from basically three materials: porcelain, acrylic, and composite-filled resin. All three materials afford excellent esthetic capabilities.

Porcelain teeth afford the greatest degree of hardness and best withstand wear. However, they are brittle and difficult to change or adjust; they also have a low mechanica1. strength to the resin base.

Acrylic teeth, on the other hand, are the softest of the materials and therefore the least resistant to wear. They are, however, easy to use, they can be easily changed or adjusted, and they have the best bond strength to the denture base.

Composite-filled resin teeth have hardness and strength values between porcelain and acrylic; they bond well to denture base and can be adjusted easily.

90. What procedure should be followed for insertion of a full upper and full lower denture?

During the processing of the denture base, the probability of dimensional change is high. Dimensional change affects the adaptation of the base to the tissue-bearing area and also affects the occlusion. It is advisable, therefore, to verify the adaptation of the dentures to the tissuebearing areas. This procedure can be accomplished by placing some type of pressure-indicating material inside the denture. The extension of the peripheral borders, especially in the frenum area, should be evaluated. Once the individual bases are adjusted, the occlusal balance should be carefully checked and adjusted. A remount procedure is recommended for this equilibration.

91. When the treatment plan calls for an immediate (transitional) denture, what are the expectations?

If the anterior teeth are to be extracted at the time of denture insertion, the patient should be informed that the denture teeth can be placed in the same position as the existing teeth. However, facial appearance will change because of the presence of the labial flange, which affects the fullness of the lip. The patient also should be made aware of the necessary process of adaptation to the palate and of the increase in salivary flow that over time will become normal. Finally, the patient should be told that most people adapt well to such oral changes.

92. Is the impression procedure the same for a transitional denture as for a conventional denture?

The impression procedure is approximately the same for establishing the peripheral border. The major concern in taking an impression around existing teeth and exaggerated undercut area is to select a material that has the lowest

viscosity and is nonrigid after setting. These properties are important to avoid damage of existing teeth during the removal of the impression.

93. How is vertical dimension established in the construction of a transitional denture?

It is important to use the existing teeth to establish the centric occlusal position, regardless of the amount and position of the teeth. At the bite registration phase, a bite rim is constructed in the edentulous space adjacent to the existing teeth, and the teeth with the wax rim are used to capture the occlusal relationship.

94. If the master casts are altered in a transitional denture procedure (e.g., elimination of gross tissue undercuts), how is the surgical procedure altered?

It is necessary during the surgical procedure to know exactly how the master cast has been altered. This knowledge is critical for successful insertion of the transitional denture. It is advisable to construct a second denture base that is transparent. This surgical stent is placed over the ridge after the teeth are extracted. Pressure points and undercuts are readily visible, and surgical ridge correction can be performed.

95. When a transitional denture is inserted, what procedures should be followed?

It is always beneficial to have a surgical stent available to ascertain the fit of the denture base. Because many soft-tissue undercut areas may be present, it is critical to establish a single path of insertion of the denture. Gross removal of areas inside the dentures may lead to poor adaptation of the denture base and instability. In this situation an immediate soft-lining material is indicated.

96. During the healing phase, what procedures should be followed?

The patient should be instructed not to remove the denture and to return after 24 hours. At that time, tissue irritation and occlusion are checked, and the denture is adjusted. Then the patient is instructed about insertion and removal of the denture and told that as the ridges heal, resorption will occur. Each case varies, but in general resorption leads to a loosening of the denture. Therefore, transitional soft-lining procedures should be performed throughout the healing phase, on approximately a monthly basis. The final healing may take from 3—6 months, at which time a permanent lining in the existing denture or a new denture is constructed.

97. Is a face-bow transfer necessary in jaw registration in the full-denture construction?

It is advisable to take a face-bow transfer in the construction of a full denture. The purpose of the registration is to relate the maxillary bite rims to the

temperomandibular joint and facial planes. This registration aids in determining not only esthetic factors but also the type of occlusal plane.

98. Is it necessary to take eccentric bite registrations in the construction of full dentures?

Although eccentric bite registrations are not essential, they aid in establishing a balanced occlusion. A stable occlusion is important for the retention and stability of dentures as well as for functional efficiency.

99. What is the neutral zone? How does it relate to the alveolar ridge?

The neutral zone is the potential space between the lips and cheeks on one side and the tongue on the other. Natural or artificial teeth in this zone are subject to equal and opposite forces from the surrounding musculature. The alveolar ridge, which normally dictates the position of the denture teeth, may conflict with the neutral zone. Therefore, the neutral position zone also should be considered when denture teeth are positioned.

100. Are there any advantages to retaining roots under a denture apart from retention properties?

Retention is a critical aspect in root-retained dentures. Of equal importance, however, retained roots help to prevent resorption of the residual ridges. Retained roots also afford the patient some proprioceptive sense of "naturalness" in function of dentures.

101. What is the ideal type of attachment in a root-retained denture?

The ideal type of attachment affords maximal retentive forces for the denture with minimal torquing forces to the roots. Because these ideal properties cannot be totally obtained, a compromise is necessary. Many factors determine how much retention a tooth can withstand without subjection to harmful forces, including:

1. The amount of supportive bone around the retained roots
2. The number of existing roots
3. The type and amount of occlusal forces
4. The type of attachment (i.e., intra- or extraradicular, rigid or stress-bearing attachments)
5. Splinting or nonsplinting of roots

102. In a root-retained denture, which is better—intraradicular or extraradicular attachment?

Both attachments can be equally retentive, but the intraradicular attachment places the fulcrum forces more deeply into the bone than an extraradicular attachment and thus helps to withstand deleterious torquing forces. The intraradicular attachments, however, are more difficult to implement because

of (1) length of existing root, (2) width of existing root, (3) paralleling to other roots, (4) inability to splint, and (5) difficulty in hygiene.

103. Is splinting a preferred treatment in a root-retained denture?

The main purpose of splinting roots in a tooth-borne denture is to dissipate the forc thus minimizing the torque on the existing roots. Splinting does not necessarily result in increased denture retention, but it creates a more difficult construction procedure. Splinting should be attempted after certain aspects are evaluated, such as (I) paralleling, (2) amount of freeway space, (3) placement of bar to ridge, and (4) type of bar.

104. What is the difference between a rigid and a stress-breaking attachment?

In rigid attachment the male and female components join in a precise fashion, allowing almost no movement between the two parts. This creates a rigid, nonflexible attachment that affords the greatest amount of retention but also produces the greatest amount of torque on the retained roots. A rigid attachment is not recommended on periodontically compromised teeth.

A **stress-bearing attachment** affords movement between the male and female components, thereby relieving torque. In most cases, a stress-bearing attachment is recommended.

105. How many roots must be retained to construct a root-retained denture?

There is no fixed rule. A root-retained denture can be constructed with only one root. The fewer the roots, the less the retentive force that should be applied to them. The ideal distribution of retained roots would be both cuspid regions and bilateral molar regions.

106. Is it necessary to place attachments or to cover the roots of a root-retained denture?

It is not always necessary to cover a root beneath an overdenture. Retention is not the only goal of this treatment modality. Equally important is preservation of the residual ridge by retaining the roots. However, if a root is not covered, the exposed surfaces are highly susceptible to decay. Oral hygiene must be stringently maintained.

107. Are the principles the same for a maxillary as for a mandibular overdenture?

Many of the principles for root-retained dentures are the same for the maxillary arch as for the mandible, including (1) selection of roots to be retained with regard to position and stability, (2) types of attachments, (3) paralleling, and (4) splinting. One aspect that may differ is related to morphologic differences of the residual ridges. The maxillary arch has a greater probability of undercut areas

in the anterior region above the roots. This difference is quite apparent in the canine area. It is necessary to design the path of insertion to take the undercuts into consideration. Therefore, attachment selection may have to be altered, and the peripheral border of the denture may have to be reduced or eliminated.

108. Can the palate be eliminated in a root-retained maxillary denture?

If retention is adequate from the retained roots with their attachments, it is possible to eliminate the palate. It must be remembered that the palatal area affords the denture the greatest bearing area and also creates cross-arch stabilization.

109. What are the causes of denture stomatitis? How can it be treated?

Denture stomatitis is caused by trauma from poorly fitting dentures, by poor oral and denture hygiene, and by the oral fungus Candida albicans. Denture stomatitis can be treated by using resilient denture liners that stabilize ill-fitting dentures, thereby treating the inflamed tissue. Some liners may also inhibit fungal growth.

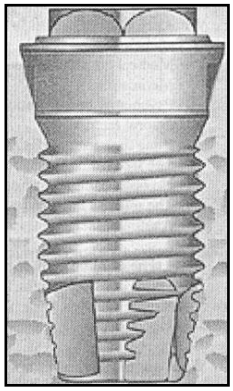
IMPLANTS

110. What types of implants are most commonly used for prosthetic replacement of the tooth?

1. **Endoseal implants:** blades, screws, or cylinders are implanted into the maxilla or mandible. These implants support the dental prosthesis.
2. **Subperiosteal implants:** a metal framework is inserted on top of the maxillary or mandibular bone. Vertical posts attached to the framework protrude the soft tissue and support the dental prosthesis.

111. What is an osseointegrated implant?

An osseointegrated implant is a cylinder or screw constructed of a biocompatible material that is precisely imbedded into the ridge of the maxilla or mandible (see figure, top of below). The fixture is allowed to integrate with the bone without any loading forces for a certain period. Histologically, the bone cells grow tightly around this anchor with no membrane attachment at the interface (unlike natural tooth-bone interface).

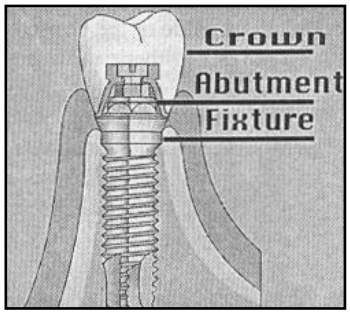


Osseointegrated implant. (Courtesy of NobelBiocare, Westmont, IL.)

112. Describe the components of an implant and the clinical procedures used with each.

The technique and the biocompatible materials used in the osseointegrated implant were developed by Per-Ingvar Branemark, an orthopedic surgeon, more than 50 years ago. Branemark identified the biocompatible material, titanium, and described the following components:

1. **Fixture:** the anchor imbedded into the edentulous ridge. It is constructed of titanium and may be coated with biocompatible, bone-regeneration materal such as hydroxyapatite. The fixture is carefully imbedded into precision-drilled holes and allowed to integrate with the bone undisturbed for 3—6 months.
2. **Abutment:** the transitional piece that connects the fixture to the prosthesis. The abutment is normally attached to the fixture after a second surgical procedure.
3. **Dental prosthesis:** the dental prosthesis can then be constructed and attached to the abutment. This stage may begin a few weeks after the second surgery.



Components of an implant. (Courtesy of NobelBiocare, West-mont, IL.)

113. What is the success rate of an osseointegrated implant prosthesis?

Many factors affect the success rate of an implant prosthesis; however, studies for longterm predictability have demonstrated a success rate of more than 90%.

114. What factors affect the success rate of the implant?

- Careful patient selection
- Exacting diagnostic records
- Integrated treatment planning
- Precise clinical procedures

115. What are the important factors in patient selection?

1. Patient's general health
   - Medical considerations
   - Medications
   - Psychiatric considerations
2. Intraoral factors
   - Bone tissue site of fixture installation is free from pathologic conditions (e.g., cysts)

• Site free from unerupted or impacted teeth, root remnants, or any other foreign bodies
• No open communication between the bone and oral cavity
• The mucosa must be healthy and free from ulceration
• Anatomic factors

116. What type of bone is important to osseointegration?

Good bone consists of a thick layer of compact bone surrounding a core of dense trabecular bone of favorable strength. Poor bone consists of a thin layer of cortical bone surrounding a core of low-density trabecular bone.

117. What anatomic factors are important to consider for implant replacement?

• Transverse shape of the jaw bone
• Degree of resorption
• Maxilla—location of sinuses, nasal cavity, and incisive canal
• Mandible—mental foramen, inferior alveolar nerve, and blood vessels

118. How is the intraoral condition evaluated?

The intraoral condition is determined through radiographic evaluation:
• Intraoral radiograph of proposed site
• General view of the jaws (an orthopontomogram reveals any pathologic processes)
• Lateral cephalometric radiograph (to show relationship between jaws)
• Tomographic records (valuable information about the width of the alveolar crest and the location of important anatomic structures)

119. How do you plan for the proper treatment modality?

Planning the actual course of therapy is essential to success. Before the surgery, an evaluation should be made of the desired prosthetic results. This evaluation dictates the following:
• Type of prosthetic replacement
• Number of implants
• Placement of fixtures
• Models of the jaw mounted on an articulator, if necessary. Set-up of teeth on these models determines the prosthesis and helps the dentist performing the surgery to visualize the proposed prosthesis. The surgeon also may be guided for implant placement by the use of a surgical template.

120. What are radiographic and surgical stents?

Radiographic and surgical stents are templates constructed on the diagnostic models that aid in the position and placement of the implants. A stent with metal markers over the proposed fixture sites should be used to aid in the

evaluation of radiographs. A surgical sterfl is also useful when the fixtures are implanted. The optimal position from a prosthetic point of view can be visualized.

121. What are the treatment modalities for a totally edentulous jaw?

- Overdenture supported by implants
- Fixed "high-water" prosthesis
- Conventional fixed crown and bridges using implants

122. Describe the concept of implant-supported overdenture.

An implant-supported overdenture is supported both by the implants and the edentulous ridge covered by resilient mucosa. The surgeon must accommodate for this resiliency in the attachments of the implants to permit small rotational movements.

123. What are the indications for the overdenture treatment?

This treatment modality is a comparatively simple procedure with relatively low cost and meets the demands imposed by many patients. The most common indications are:

- Retention of denture
- Compromised hygiene skills (i.e., reduced dexterity, as with elderly people)
- Interarch positions (difficulty ir placing proper interdental relationships with fixed restorations)
- Phonetics/esthetics (especially in the maxilla, an overdenture may improve esthetic and/or phonetic results compared with an implant-supported fixed prosthesis).

124. How many implants are necessary to support the overdenture?

The number of implants ranges from a minimum of two fixtures to an ideal of four. It is also important to consider the loading forces on the implant.

125. What is the effect of loading forces on implant-supported overdentures?

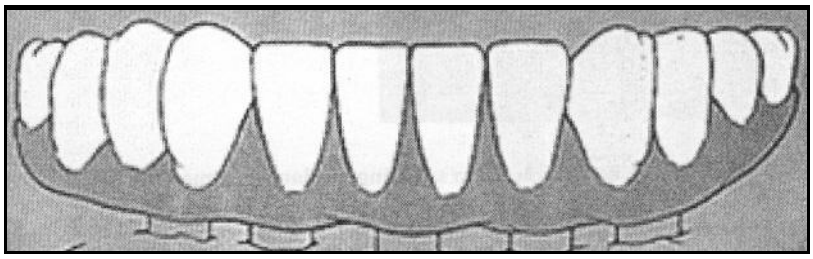
The loading forces are important to fixture survival because overloading can lead to implant failure. To reduce improper loading conditions, the following points should be considered:

1. The implants should be positioned as perpendicular to the occlusal plane as possible.
2. Shear loads and bending movements are reduced if leverages are shortened by using short abutments and low attachments.
3. Resilient attachments reduce bending movements. Occlusal forces are shared between fixtures and overdenture-bearing mucosa.
4. Extension bars represent a potential risk of overloading.

126. What is the fixed "high-water" prosthesis on an edentulous arch?

The fixed prosthesis supported by implants on an edentulous arch was first developed and investigated by Branemark in the l960s:

- Placement of fixtures with transmucosal abutments as parallel as possible to each other
- Cast metal frameworks that fit precisely on the abutments and support the prosthesis
- Denture teeth and processed denture material on the metal framework



High-water prosthesis. (Courtesy of NobelBiocare, Westmont, IL.)

127. What does "high water" mean?

High water refers to the design of an implant-supported prosthesis. The implants support the prostheses without the aid of the mucosal edentulous ridge, which is utilized in the implant-supported overdenture. Space between the prosthesis and the mucosa is necessary for proper hygiene, thus leading to the descriptive term "high water."

128. What happens when the fixtures are not parallel in a fixed prosthesis?

A precise prosthesis fit is necessary for osseointegrated rigid fixtures; therefore, relative paralleling is required. Lack of parelleling, however, can be compensated with proper abutment selection. The divergence of axial fixtures can differ up to 40°.

129. How many fixtures are necessary to support a high-water fixed prosthesis?

Many factors determine the number of fixtures necessary to support a fixed prosthesis, including quality of bone, placement and length of fixture, and loading of fixtures. In general, however, 4—6 fixtures are sufficient to support a fixed high-water prosthesis.

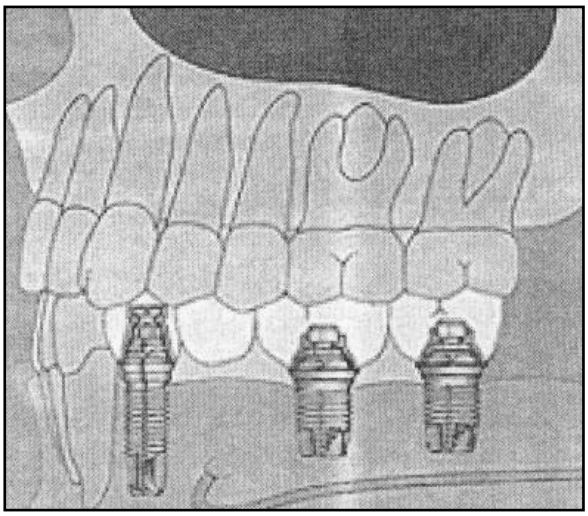
130. Can conventional fixed bridgework be used over implants to restore a totally edentu bus arch?

Conventional fixed bridgework rather than the high-water prosthesis can be used with implants to restore a totally edentulous arch. However, fixture positioning, loading forces, and esthetic and phonetic considerations are more

critical. In addition, more fixtures are necessary to support the prosthesis (minimum of 6).

131. Should an implant prosthesis be considered in partially edentulous patients?

The partially fixed implant-supported prosthesis is a viable treatment and should be considered as the treatment of choice when the only alternatives are a removable partial denture or a fixed bridge attached to previously untouched teeth, or if the proposed abutments are periodontally compromised. Conventional bridgework may be the appropriate treatment of choice when the proposed abutment teeth are periodontally sound but need extensive restorative work.



Fixed implant-supported prosthesis. (Courtesy of NobelBiocare, Westmont, IL.)

132. What aspects should be considered in selecting implant treatment for partially edentulous patients?

1. Implant placement is limited and defined by existing edentulous space; therefore, fixture placement may be near sensitive structures such as nerves and blood vessels.
2. Good esthetic results may be difficult to achieve.
3. Greater horizontal loading forces place high demands on the anchorage of the fixture.
4. Topographic conditions of the existing bone and its relationship to the remaining teeth must be considered.
5. Occlusal considerations are essential (i.e., when canines and premolar teeth are replaced in a cuspid-protected articulator with a deep overbite).
6. Periodontal disease on remaining teeth creates a pathologic condition that may contraindicate implantation.

133. What factors influence abutment selection?

The abutment selection is an important prosthodontic phase of treatment because it may determine the final prosthesis design. Factors for abutment selection should include the following:

1. Articulated casts with diagnostic wax-up of the proposed prosthesis aid in size and angulation of the abutment.

2. Type of abutment depends on whether the prosthesis is to be screwed to the implant or cement-retained.

3. Transmucosal space should be determined because it affects the height selection of the abutment.

4. Esthetic/phonetic considerations also affectthe selection of abutment.

134. What diagnostic procedure may be used for abutment selection?

To determine the proper abutment angulation height, esthetic factors, and occlusal considerations, it is necessary to know the position of the fixture to the bone in relation to the gingival mucosa and interarch space between the fixture and the opposing dentition. Fixture angulation and transmucosal height can be measured intraorally with diagnostic gauges. However, a more precise method is the following:

I. Obtain an impression of the arch with the fixtures.

2. Construct a cast that contains replicas of the fixtures with its relationship to the mucosa.

3. Articulate this model to the opposing dentition. This method facilitates proper abutment selection and fabrication.

135. What is an angulated abutment?

An angulated abutment is positioned in an angulated direction from the axial position of the fixture. This angulation may vary up to 30°. Angulated abutments are used when the fixtures have been installed with an unfavorable inclination in relation to the desired position of the prosthesis.

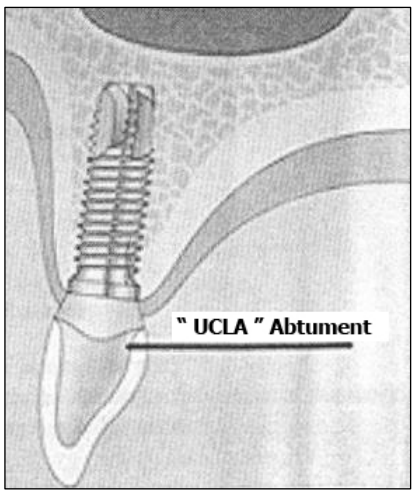
136. Is an angulated abutment clinically safe?

In vitro studies have shown that as abutment increases, compressive and tensile strains around the implant also increase. A 3-year clinical evaluation by Balshi et al., however, showed that angulated abutments do not necessarily promote periimplant mucosal problems. The success rate is comparable to that of the standard abutment.

137. What is the UCLA type abutment?

The UCLA abutment is custom-fabricated on the fixture replica. Normally, the fabrication is done so that the final abutment appears like a full-crown preparation on which the prosthesis is cemented. It also may be screw-retained. This customized fabrication technique allows control of angulation, transmucosal shape and height, esthetic considerations, and interocclusal space.

(Courtesy of NobelBiocare, Westmont, IL.)



138. Can an implant be used for single-tooth replacement?

Yes. However, careful patient selection and presurgical analysis are critical so that function

and esthetics approximate the natural tooth.

139. Can implants and natural teeth be used together to support a final prostheses?

Natural teeth are suspended in bone by the periodontal membrane. This situation allows tooth movement in relationship to bone. An osseointegrated implant, which is fixed rigidly to the bone, allows no movement at its interface. Joining a movable natural tooth and rigid in with a fixed prosthesis may cause support problems that lead to failure. It is better to separate the prosthesis if possible (implant with implant, natural tooth with natural tooth). This strategy may not always be possible. If the prosthesis calls for joining natural teeth, provisions should be made in the prosthesis to allow movement of the natural tooth abutment. This goal is quite often accomplished with a nonrigid interlocking attachment.

BIBLIOGRAPHY

1. Balshi I, Ekfeldt A, Stember T, Vrielinck L: Three-year evaluation of Branemark implants connected to angulated abutments. mti Oral Maxillofac Implants 12:52—58, 1997.
2. Chiche GJ, Pinault A: Esthetics of Anterior Fixed Prosthodontics. Chicago, Quintessence, 1993.
3. Lucia VO: Treatment of the Edentulous Patient. Chicago, Quintessence, 1986.
4. Magnussen S, Nilson H, Lindh T: Branemark Systems: Restorative Dentist's Manual. Gothenburg, Sweden, Nobel Biocare AB, 1992.
5. McLean JW: The Science and Art of Dental Ceramics, vol. I. Chicago, Quintessence, 1979.

6. McLean JW: The Science and Art of Dental Ceramics, vol. II. Chicago, Quintessence, 1980.
7. Morrow RM, Rudd KD, Rhoads JE: Dental Laboratory Procedures: Complete Dentures, vol. I, 2nd ed. St. Louis, Mosby, 1986.
8. Phillips R: Skinner's Science of Dental Materials, 9th ed. Philadelphia, W.B. Saunders, 1991.
9. Rudd KD, Morrow RM, Rhoads JE: Dental Laboratory Procedures: Removable Partial Dentures, vol. 3. St. Louis, Mosby, 1986.
10. Shillingburg HT Jr, et al: Fundamentals of Fixed Prosthodontics, 2nd ed. Chicago, Quintessence, 1981.
11. Smith R, Kournjian J: Understanding Dental Implants. San Bruno, CA, Kramer Communications, 1989.
12. Yamamoto M: Metal Ceramics: Principles and Methods of Makoto Yamamoto. Tokyo, Quintessence, 1990.