

Chrome Steel Crowns: A Simplified Self-Assessment Technique

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The chrome steel crown was introduced to dentistry in the early 1950's and has proven to be an extremely valuable, economical, durable and functional restoration that has many uses in pediatric dentistry. If improperly handled, however, this restoration will be inadequate, as is true of any restorative material used in dentistry. The steel crown may be used on either primary or permanent teeth. Some of the indications for its use are:

1. The restoration of deciduous or young permanent teeth with extensive dental caries. Included in this category may be any primary tooth requiring an M-O-D amalgam and lower first primary molar teeth with extensive carious involvement that would make retention of an amalgam restoration doubtful, or a primary tooth that has a rather extensive amalgam restoration which needs to be replaced because of faulty margins and leakage.
2. Multiple large carious lesions or hypoplastic teeth in a child indicating a very high degree of caries susceptibility, such as the preschool child with "bottle baby" caries.
3. The restoration of primary and young permanent teeth with congenital malformations such as amelogenesis imperfecta and dentinogenesis imperfecta. It is frequently impossible to place amalgams in such teeth, even if they are non-carious, because they are rapidly worn away as a result of the malformation of the tooth structure.
4. Handicapped patients whose oral hygiene is extremely poor, in whom the failure of other restorative materials is likely.
5. Following pulp therapy in either primary or young permanent posterior teeth, there is an increased danger of fracture in the weakened tooth structure. A chrome steel crown is the restoration of choice as it lends good sup-

port to the pulp-treated tooth and eliminates the possibility of coronal fracture and ultimate unnecessary loss of the tooth.

6. When the crown is to be used as a means of attachment for a space maintainer or as an abutment or pontic for a fixed partial denture.
7. For the temporary restoration of fractured anterior teeth, the facial surface of the anterior crown may be removed and the fractured area filled with an acrylic restorative material in order to obtain more acceptable esthetics.

The adaptation of the crown must be done carefully to re-establish the normal occlusal height, embrasures and the contact areas. It must also be carefully adapted at the gingival margin to avoid a local periodontal condition. Proper contour and adaptation are also necessary so that the stainless steel crown will not interfere with the eruption of adjacent teeth. This is especially critical when the crown is placed on a second primary molar before the eruption of the first permanent molar.

The chrome steel crowns for posterior teeth which are most widely used at present are manufactured by Unitek, Ormco and the Rocky Mountain Corporation. A new type is the ION crown manufactured by 3M Corporation. These crowns are pre-formed and pre-festooned at the gingival margin, and have a broad occlusal table with shallow anatomy, thereby permitting a minimum of occlusal reduction of the tooth. These features are especially advantageous for establishing occlusal relations when the occlusal anatomy of the tooth has been obliterated, either by caries or congenital malformation, and the bite is closed posteriorly. Interference during lateral excursions is also minimized with this design. The contour of the proximal surface of the crown is relatively straight and allows easy adaptation to our recommended preparation of the tooth.

Six sizes of crowns are available for each tooth and each has an identifying number. It is useful to record the number of the crown used for future reference in the event that the crown becomes dislodged or lost or to aid in selecting a crown for the contralateral tooth, should it also require a crown.

Instruments Needed

The following instruments are recommended for efficient operation in the preparation and restoration of a tooth with a chrome steel crown (Fig. 1):

1. Chrome steel crown assortment
2. Dividers (optional, to measure M-D crown size)
3. Large #6 or #8 round bur
4. Diamond Flame bur, e.g., #179-9P or #169-L tapered fissure bur
5. Mouth mirror
6. Shepard hook explorer
7. Curved crown and bridge scissors
8. Contouring pliers #114
9. Belling pliers #112, Abel
10. Periodontal scaler (Jaquette or Sickle)
11. Mounted torpedo green stone
12. Burlew rubber wheel
13. #11 soft mounted Robinson bristle brush
14. Wooden tongue blade
15. Carboxylate cement (Durelon)
16. Dental floss

Anesthetization of the Tooth and Application of the Rubber Dam

Practically all of the preparation should be performed with the rubber dam in place. In the mandibular arch, the use of the dam is especially valuable in keeping the tongue

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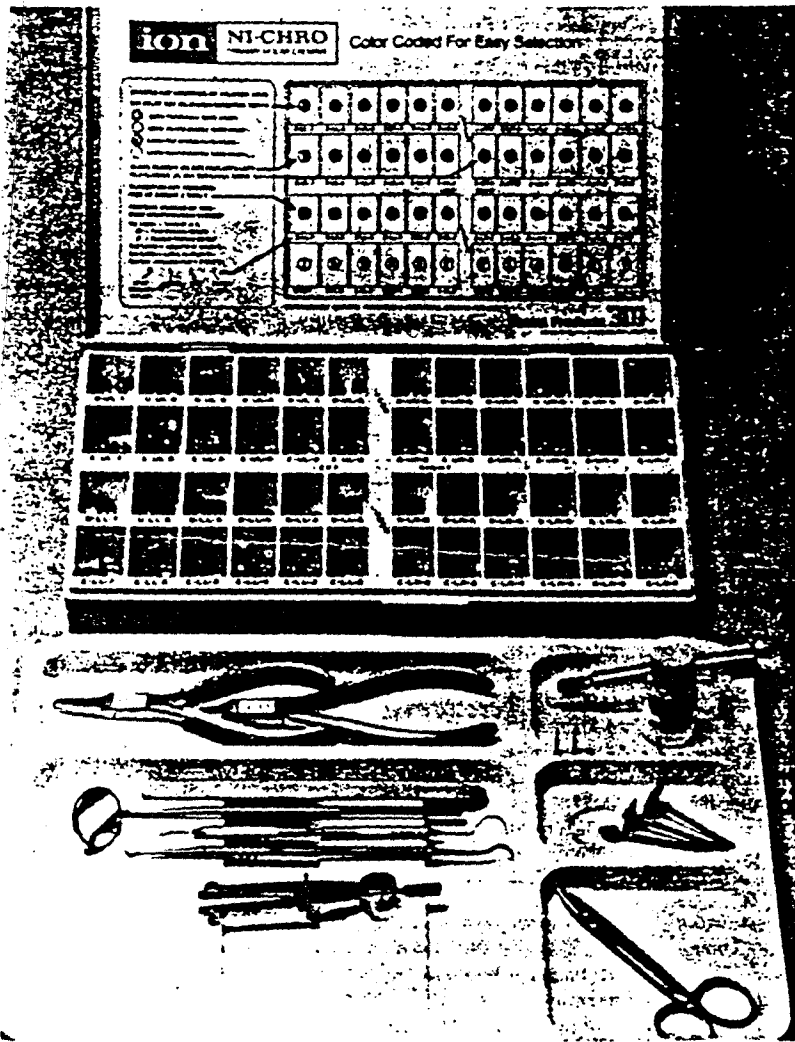


Fig. 1

from the operating area. Whenever possible, one tooth distal to the tooth being prepared and one mesial should be isolated with the dam. These teeth serve as guides to the amount of occlusal reduction required and the dam provides a more accessible working area. Care must be exercised when the rubber dam clamp is on the tooth to be prepared because the clamp will depress the gingiva and will increase the amount of crown visible. The larger exposure of the crown may lead to over-reduction of the occlusal surface. Wooden wedges may be placed interproximally to keep the rubber dam out of the operator's way during the preparation of the proximal surfaces. These wedges may be cut during the preparation of the surfaces, if necessary to prepare the proximal surfaces properly.

Measurement of Tooth and Crown Size

Before any operative procedures, examine the tooth to be crowned and determine its size. The sizes of the stainless steel crowns

are determined by their mesio-distal measurement. This mesio-distal measurement may be determined either by estimation or, for the more inexperienced operator, with a divider. Be sure that the correct crown size is available before initiating any operative procedure or tooth reduction. Patients with either large or small teeth may require the use of crowns that are not within the range of manufactured sizes. On some occasions it may be necessary to interchange the use of permanent molar crowns for large second deciduous molars. Similarly, it may be necessary to use crowns designed for second primary molars on small first permanent molars. If the crown has been too extensively destroyed by caries, the mesio-distal space between the approximating teeth may be measured to determine the correct crown size.

The following is presented to facilitate the preparation, adaptation and cementation of posterior chrome steel crowns. The information is meant primarily for inexperienced individuals. The left column is a description of

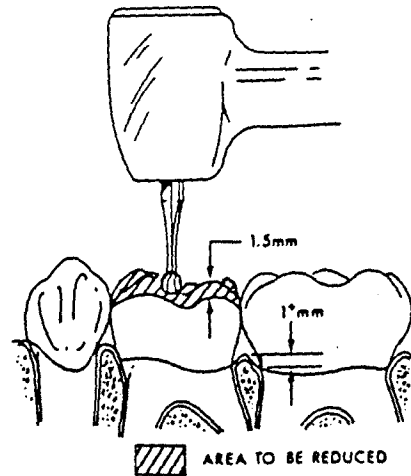


Fig. 2

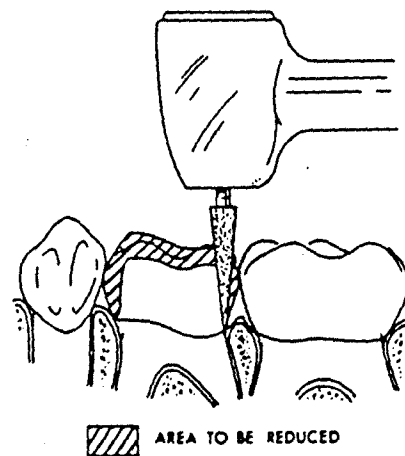
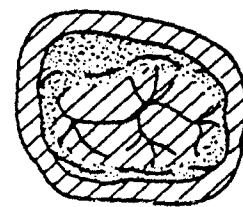


Fig. 3



AREA TO BE REDUCED

OCCLUSAL BEVAL

Fig. 4

a step in the total task of the restoration of a tooth with a chrome steel crown. The right column is a series of criteria for evaluation of performance of the task described in the left column. Additional comments, references and rationale are included as subheadings in the right column.

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Step Description	Performance Criteria and Rationale
Preparation of the Tooth	
Caries Removal	
<ol style="list-style-type: none"> 1. Remove all evidence of caries. <ol style="list-style-type: none"> A. If caries were extensive and gross removal of tooth structure was necessary, place a thick, quick setting ZnO&E base. B. If any pulp therapy is indicated, it should be accomplished before proceeding any further. 	<p>No soft carious dentin should remain.</p> <p>Shape any base material to conform to the general contour of the tooth.</p>
Occlusal Reduction	
<ol style="list-style-type: none"> 2. Using a large round bur (#8), reduce the occlusal surface approximately 1 mm (Fig. 2). 	<p>The central fossa should be the lowest point of the preparation, with the highest point 1 mm. out of contact with the opposing tooth.</p> <ol style="list-style-type: none"> A. The approximate amount of reduction necessary may be determined by comparing the prepared tooth with the adjacent teeth.
Proximal Reduction	
<ol style="list-style-type: none"> 3. Using a flame diamond (179-9P) or a fine, long tapered fissure bur (#169L), and starting from the lingual and cutting toward the buccal, hold the bur at a slight angle away from the adjacent tooth and carefully cut to below the contact point about 1 mm. below the gingival crest. This should be accomplished with a single slicing motion. Remove the proximal contact areas to a feather edge, just below (1 mm.) the free margin of the interproximal gingiva (Fig. 3). <ol style="list-style-type: none"> A. The proximal slices should be flattened, follow the proximal contour of the tooth and converge slightly from buccal to lingual and toward the occlusal. 	<p>There should be no ledge at the gingival margin of the preparation. The proximal reduction should allow for easy passage of an explorer between the preparation and the approximating teeth.</p> <ol style="list-style-type: none"> A. Cutting from lingual toward buccal makes it easier to produce a feather edge margin, whereas cutting in an occlusal-gingival direction tends to produce ledges and wear out the tip of the diamond bur. B. Parallel slices will not permit proper interproximal contouring and seating of the chrome steel crown form. <p>The most common error when preparing the proximal slices is production of an unwanted shoulder. Gingival proximal margins should be shoulderless.</p>
<ol style="list-style-type: none"> 4. With the tapered diamond, remove an amount of tooth structure equal to at least the thickness of the steel crown (0.5 mm.) from the buccal and lingual surfaces. This reduction should extend to the crest of the gingiva and taper slightly toward the occlusal (Fig. 4). 	<p>The newer crowns will be much easier to adapt to the tooth if the buccal and lingual bulges are reduced. The large buccal bulge in permanent teeth frequently hinders the proper cervical adaptation of the crown. Its reduction will enable the operator to obtain a more oval preparation which approximates that of the crowns.</p>
<ol style="list-style-type: none"> 5. With the tapered diamond, round off the occlusal $\frac{1}{2}$ of the buccal and lingual surfaces. 	<p>Rounding these line angles will facilitate the seating of the steel crown form.</p>
<ol style="list-style-type: none"> 6. With the tapered diamond, round off any remaining line or point angles in the preparation. 	<p>The flattened proximal surfaces combined with the rounded line angles should form a somewhat oval preparation. This greatly aids in rapid crown adaptation because of the oval shape of the steel crown forms.</p>
<ol style="list-style-type: none"> 7. Remove the rubber dam, and with an explorer and mirror, check the preparation to see if it meets all of the criteria listed: 	<p>Tooth Preparation Criteria</p> <ol style="list-style-type: none"> 1. The occlusal clearance should be 1 mm. 2. The proximal slices should converge toward the occlusal and toward the lingual and follow the normal proximal contour. 3. An explorer can be passed between the prepared tooth and the approximating tooth at the gingival margin of the preparation. 4. The buccal and lingual should be reduced 0.5+ mm., with the reduction ending in a feather edge at the crest of the gingiva. 5. The buccal and lingual surfaces should converge slightly toward the occlusal. 6. The occlusal $\frac{1}{2}$ of the buccal and lingual surfaces are gently rounded. 7. All point and line angles in the preparation are rounded and smooth.

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8. Select the crown closest in mesio-distal size to the measurement recorded prior to beginning the preparation.

Prior to trying the crown form on the preparation, be certain to position the patient in an upright position to prevent aspiration or swallowing of the crown should it slip loose during fitting. It is often advisable to cut the rubber dam and leave it in position during the initial fitting of the crown.

Initial Fit and Adaptation of Crown

9. Try the selected, uncountoured crown on the preparation:
- Seat the crown from lingual toward the buccal with finger pressure.
 - If the crown does not fit snugly, select the next smaller crown size.
 - If there is difficulty in seating the crown, select the next larger crown.

The crown should fit snugly with light friction and should be removable with finger pressure.

- The crown is seated from lingual to buccal
 - because the larger size of the lingual embrasure permits greater access and
 - because of the greater slope on the buccal.
- If a snug fit cannot be obtained with the sizes available, reduce the tooth slightly until a snug fit can be obtained with the smaller size crown.

10. Using a mirror and explorer, check that the cervical of the crown, on the mesial and distal surfaces, conforms to the contour of the tooth preparation.

The crown should be in contact with the prepared tooth and the explorer tip should not pass between the crown margin and the tooth.

11. If the cervical is not well adapted, remove the crown from the tooth and contour the gingival third of the mesial and distal areas, using the #114 contouring pliers. Hold the crown steady and rapidly snap the pliers open and shut, moving them continuously back and forth along the crown margins and overlapping each crimp (Fig. 5).

12. Stabilize the crown on the tooth with a finger and apply gentle finger pressure in a gingival direction until:

- The occlusal plane is reached.
- Resistance is met.

- If this is accomplished, your preparation is satisfactory and you may proceed.
- Resistance may indicate the presence of a ledge. If a ledge is encountered, modify the preparation or crown as indicated. A biting radiograph may be helpful to determine the presence and/or location of a ledge.
- Blanching indicates that:

- Blanching of the gingival tissue may be noted.

- The crown margin is overextended in the blanched area, or
- The crown is not closely adapted to the tooth in the blanched area. An indentation on the gingiva made during the trial fit may be used as a guide to the contouring.
- The crown size may be too large. If, after trying some initial contouring, the indentation still persists, try a smaller size crown form.

Trimming Crown

13. Scribe a line along the buccal and lingual walls of the crown at the crest of the gingival margin, using a suitable scribing instrument such as a sharp #1 anterior scaler (not an explorer).

A definite, visible line should be scribed along the buccal and lingual walls of the crown form.

14. Remove the crown and trim off the excess 1 mm. gingival from the scribed line, using a curved crown and bridge scissors.

The crown should be trimmed to 1 mm. below the crest of the gingiva. The margin of the crown must extend below the crest of the gingiva and gingival to the finish line of the preparation.

On the mesial and distal surfaces, cut along a line mentally extrapolated from the buccal and lingual scribed lines.

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15. Seat the crown on the preparation with finger pressure and have the patient close into occlusion.	Ideally, the crown should be in the plane of occlusion and the marginal ridges even. The occlusion may be checked by noting the intercus- pation of the teeth on the contralateral side of the arches.
16. Remove the crown and smooth off the rough edges of the crown margin with a green stone.	Smoothing the margins will provide better adaptation to the finish line of the preparation and protect the gingival tissues from injury.
Contouring the Crown	
17. Replace the crown on the preparation and have the patient close in centric occlusion.	The crown margin should be below the finish line of the preparation and seat 1 mm. gingival to the crest of the gingival margin.
18. Inspect for exposed tooth structure (shy crown margins) all along the marginal periphery of the crown, using an explorer.	If the crown is in proper occlusion and there is exposed marginal tooth structure, another crown of the same size must be selected, trimmed and adapted.
19. Remove the crown and contour the gingival third along the buccal and lingual, using the #114 contouring pliers as described in step 11.	
20. Seat the crown on the preparation with finger pressure, seating the crown from lingual toward the buccal as described previously, and have the patient gently close into occlusion.	The crown now should snap into place and should not be able to be removed with finger pressure. The margin of the crown should be maintained 1 mm. gingival when the teeth are in occlusion.
21. Using an explorer, inspect the crown for voids along the marginal periphery. Recontour the crown as required.	Be especially watchful to detect gaps at the "corners" of the crown.
22. Replace and position the crown with finger pressure and visually examine to see if the performance criteria listed are satisfied.	<p>Adapted Performance Criteria</p> <ol style="list-style-type: none"> 1. Crown must snap into place and should not be removable with finger pressure. 2. Crown must fit snugly against the preparation. 3. Crown margin should extend 1 mm. gingival to the gingival crest and should engage the undercuts of the buccal and lingual bulges. 4. Crown should seat without cutting or blanching the gingiva. 5. Crown should be in occlusion so as to permit closure without interference.
23. Reseat the crown and check the contacts with a mirror and dental floss. If inadequate, remove the crown and adjust as necessary with #112 pliers.	<ol style="list-style-type: none"> A. Contacts are deemed adequate if: Floss snaps through the contact (resistance is felt) and no light is visible in the area of contact when checking with a mirror or radiograph. B. Dental floss should be inserted in a straight gingival direction and removed in a straight lateral direction. If the floss is removed occlusally, the crown may pop off and may be accidentally swallowed or aspirated by the patient.
Finishing Margins of Crown	
24. Remove the crown and grind a bevel on the external surface of the crown margin around the entire periphery, using a green stone held at a 45-degree angle to the margin. A slow-speed handpiece should be used to give better control (Fig. 6).	<ol style="list-style-type: none"> A. This should result in a feather-edge margin. B. If the ION crown is used and no trimming was done, this step not necessary.
25. Polish the beveled margin of the crown with a rubber abrasive wheel, rotating from the occlusal toward the gingival.	<ol style="list-style-type: none"> A. Crown margins should be smooth and sharp. B. Identification markings should be removed. C. Crown margins should be beveled and polished.

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6. Polish the entire crown, using a #11 Robinson bristle brush. All grinding, scratch marks and fabrication marks should be removed.

cementation Radiograph

17. Reseat the crown and prepare a bite-wing radiograph with the crown seated, to determine:
- A. Is the crown seated properly?
 - B. Is the interproximal marginal adaptation correct?
 - C. Is the crown length adequate?
 - D. Are the contact areas adequate (Fig. 7)?

mentation

28. Debride the preparation and the gingival areas with a warm water spray, and evacuate the oral cavity. Dry the tooth with short blasts of air. Isolate the preparation with cotton rolls and insert a saliva ejector. Do not desiccate the tooth. The preparation should be clean, dried and isolated.

29. Apply a thin layer of cavity liner or cavity varnish, as indicated, to the prepared tooth surface. This step is not required if the tooth is non-vital.

30. Make a thin mix of carboxylate cement and fill the crown about $\frac{1}{2}$, being sure to coat all internal surfaces of the crown to the margin. Do not overfill. Zinc oxyphosphate cement will produce pulpal irritation in vital teeth and may ultimately cause pulpal damage and dental abscess. Overfilling the crown may jeopardize seating the crown in the proper position.

31. Seat the crown from lingual to buccal, allowing the excess cement to flow out buccally. The crown may seat more easily into position than it did previously, because the cement acts as a lubricant.

32. Remove the saliva ejector and cotton rolls and have the patient bite on a tongue blade to help to seat the crown into the proper position.

33. After the initial seating, remove the tongue blade and have the patient bite into centric occlusion and hold in that position until the initial set of the cement. The teeth should be in maximum intercuspation with the crown in occlusion. Check the occlusion of the teeth on the contralateral side.

When multiple crowns are to be seated, they should be adapted and cemented simultaneously to allow for adjustments in the interproximal spaces and to establish proper contact areas. To get these adjustments, adapt and seat the crowns with the most distal tooth first, proceeding mesially.

34. When the cement has set, carefully remove any excess cement with an explorer or a fine scaler. A. All excess cement should be removed.
B. No cement should be left in the gingival crevice.
C. There should be no blanching or distention of tissue.

35. Using a rubber cup and pumice, carefully polish the crown to remove any excess cement.

36. Re-examine the restored tooth according to the performance criteria.

Completed Restoration Performance Criteria

1. Crown should be smooth and polished.
2. Crown margins should be smooth and closely adapted to the tooth preparation.
3. The contacts should be properly established.
4. The crown should be in the proper occlusion.
5. The crown margins should extend 1 mm. gingival to the gingival crest and there should be no gingival blanching.
6. All excess cement should be removed (Fig. 7).

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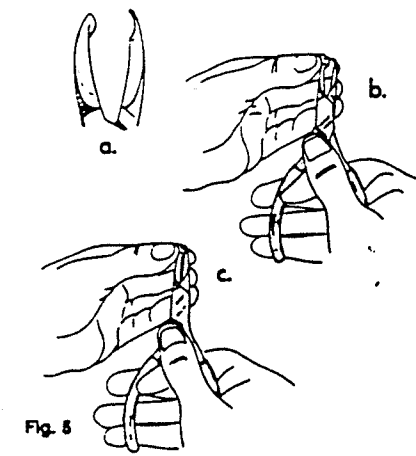


Fig. 6

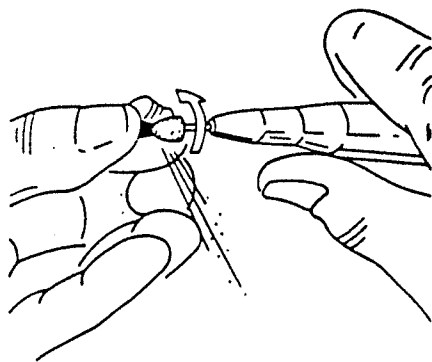
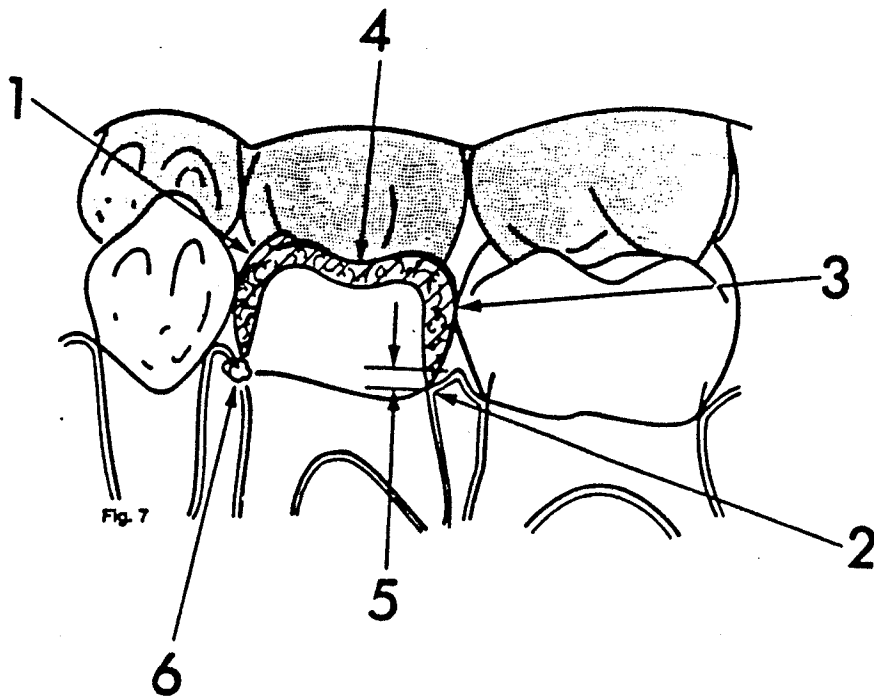



Fig. 7



Summary

The stainless or chrome steel crown has been used and abused for more than 25 years and continues to be a difficult restoration for many dentists. The general dental practitioner would reap numerous benefits, as would his patients, if the steel crown were utilized more frequently in the practice of dentistry for children. The secret to making it a simple and economical restoration is in realizing what the end result should be and then learning the simplest possible way to achieve that result.

A simple step-by-step technique is presented by which any practitioner or student may evaluate his own progress and end result. There is, of course, no substitute for practice in becoming proficient in any treatment technique in dentistry. The steel crown is no exception. 

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