Care of Metal Crown Restorations

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Appropriate care of metal restorations is important to prevent the degradation of the restorative margin, reduce the adherence of plaque, reduce corrosion, and maintain periodontal health.[1,2] Full coverage metal crowns, also called full metal jackets or "caps" are indicated for teeth with loss of coronal structure including endodontically treated teeth.[3] Crowns protect the remaining tooth structure from further fracture, prevent marginal leakage at underlying root canal access restorations, and restore occlusal function with the aim of maintaining a healthy periodontium.[3,4,5,6] Full metal crowns are often placed supragingivally in veterinary patients, specifically 1-2 mm coronal to the gingival margin, as supragingival placement of crown margins produce less gingival inflammation than subgingival margins.[4,6] The proximity of the restorative margin to the gingiva demands good plaque control to prevent or minimize gingivitis.[7]

During a professional dental prophylaxis, plaque and calculus are removed subgingivally and supragingivally usually with an ultrasonic mechanical scaling instrument[a].[8] The metal crown margins are intimately associated with the gingival sulcus and exposed to explorers, scalers, ultrasonic instruments, and curettes.[1] Improper use of these instruments can lead to surface deterioration, scratching and pitting which could cause plaque retention, breakdown of the marginal integrity, and increased roughness. Increased roughness can lead to painful irritation, gingivitis, recession of the soft tissue, and "suboptimal esthetics of restored teeth."[1,9]

In addition to improper instrumentation, some dentifrices can abrade restorative materials and create grooves. These surface irregularities and grooves can also increase plaque and debris retention.[1]

Full metal crown restorations are increasing in veterinary medicine and adequate care during routine dental prophylaxis for full metal crown restorations is important to insure clinically successful restorations.[1] This review article will emphasize the care and polishing techniques for full metal crown restorations. There are numerous proprietary polishing systems available to the dental clinician to match each individual's preference.[10] The methods and materials presented here are commonly used for polishing metal restorations, but are not intended to be all-inclusive.

Care of full metal crown restoration begins with good margins

Prevention of accumulation of plaque, food, and debris begins with good crown design. Appropriate contour, marginal fit, and a smooth surface are critically important in crown placement.[6,11] A well-designed, well-adapted cavosurface margin will serve as the foundation for the care of full metal crown restorations[9] (Fig. 1). Crown calipers[b] can be used, along with a periodontal probe[c] or

Figure 1

Photographs showing appropriate marginal contour (A) and fit (B) for full metal crown restoration of the left mandibular canine tooth. A well-designed, well-adapted cavosurface margin will serve as the foundation for the care of full metal crown restorations (C).

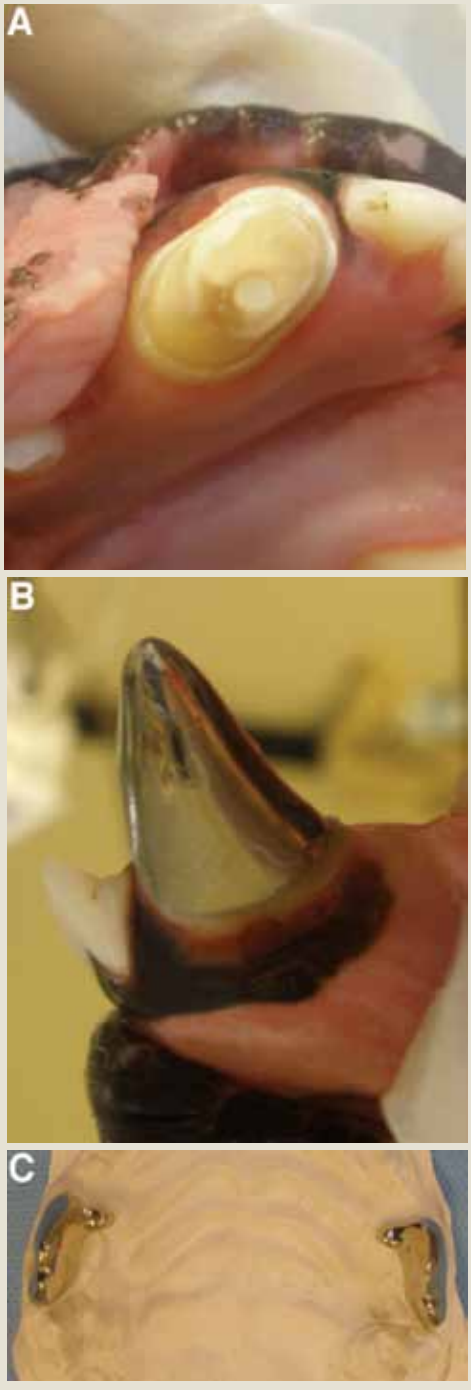


Figure 2

Photographs showing crown calipers used to confirm a 6° vertical taper (A) and a periodontal probe to verify supragingival placement of 1 to 2-mm.

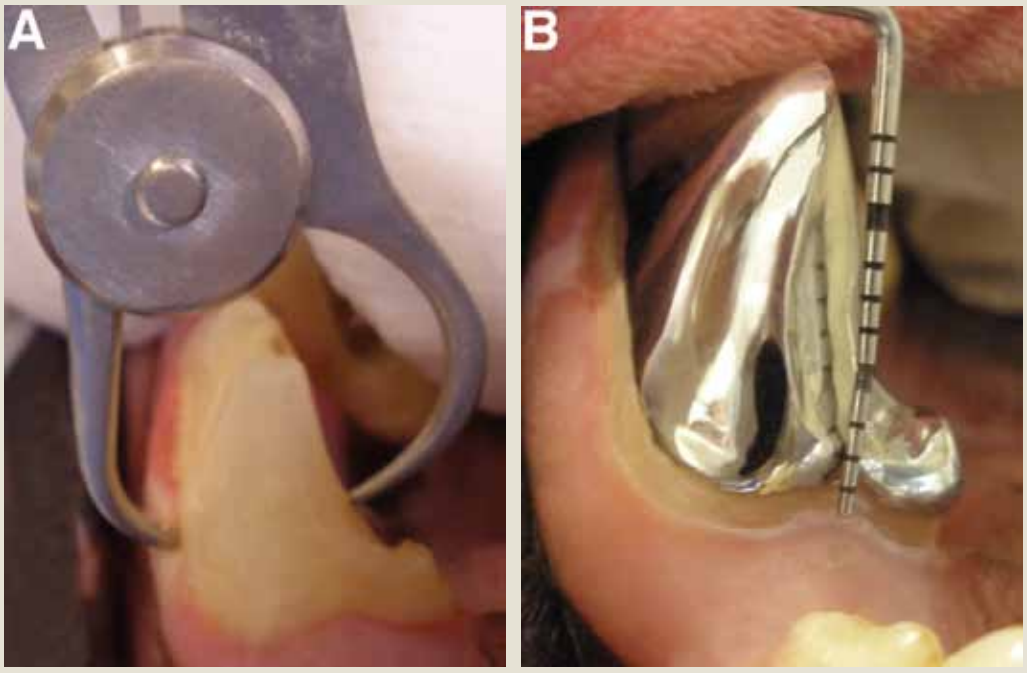
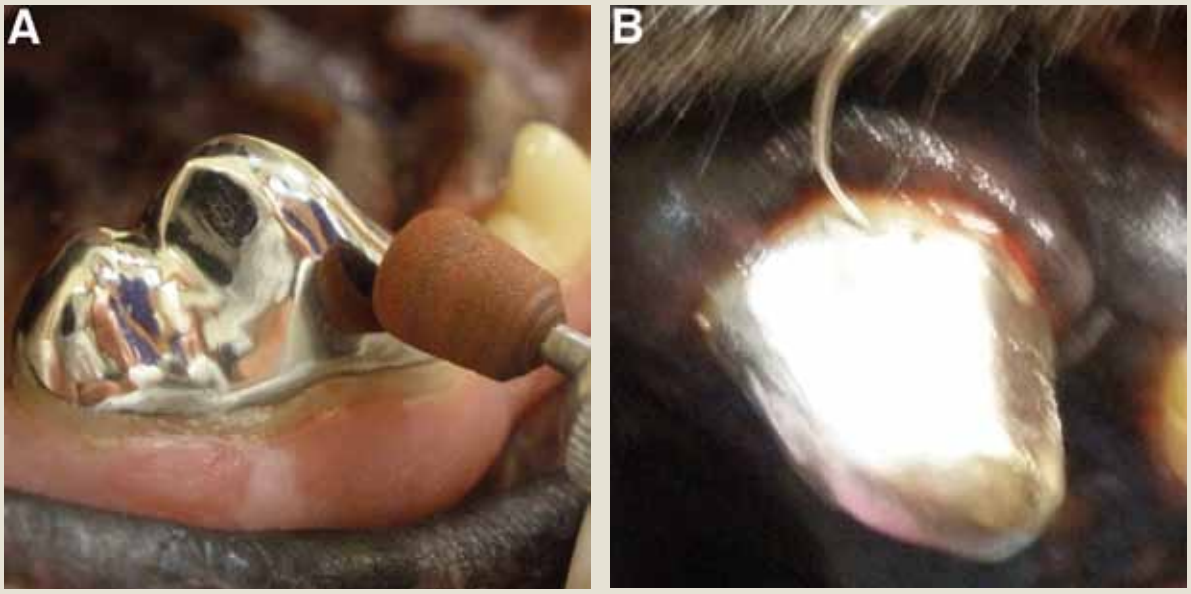


Figure 3

Photograph showing margination being accomplished with a stone lubricated with silicon grease using the contra angle on a slow speed handpiece moving from the metal crown to the tooth at a 45° angle (A). An explorer is used to evaluate the margin and confirm a smooth, imperceptible transition between the metal crown and tooth (B).



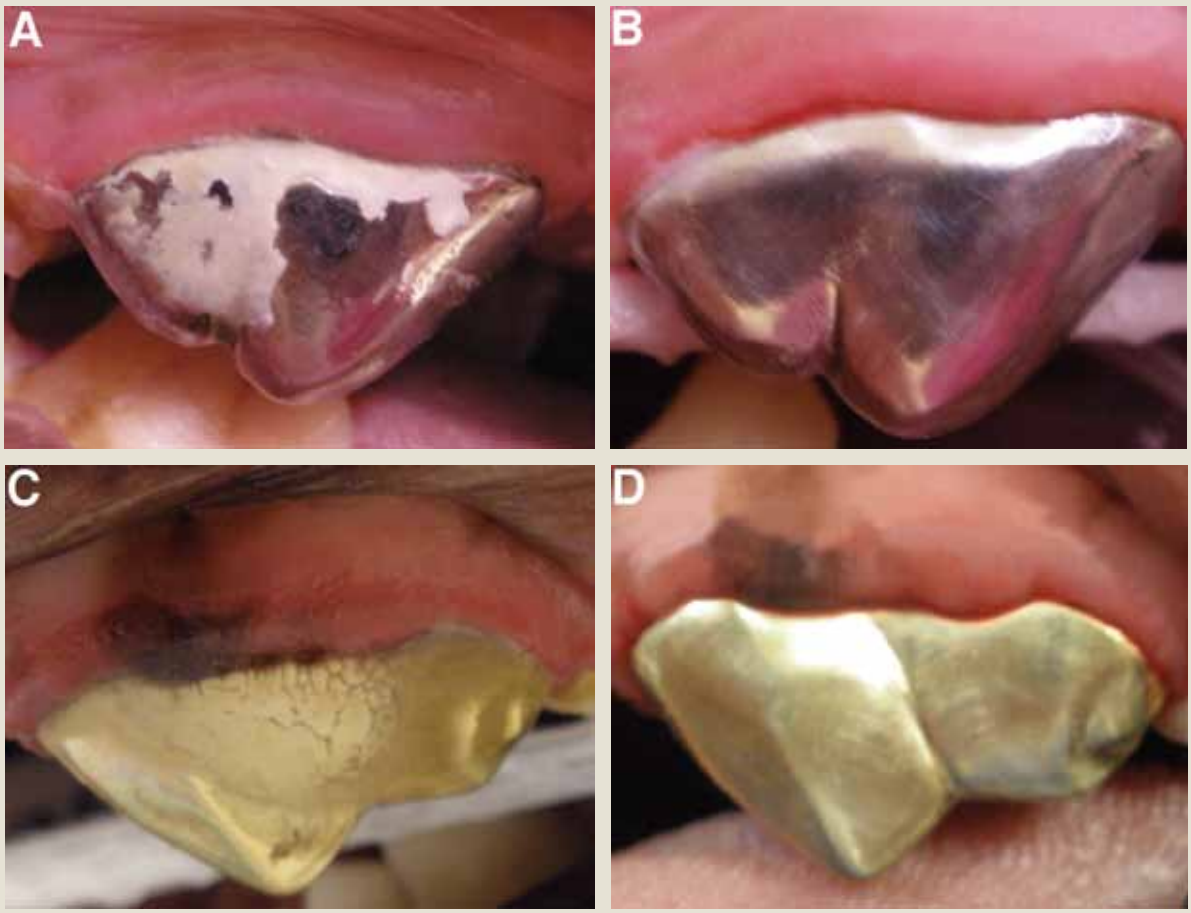
ruler[d], in crown design for supragingival placement of 1 to 2-mm and a 6º vertical taper[1,2] (Fig. 2).

The first step to create good margins is finishing. Finishing is the removal of marginal irregularities and defining anatomic contours.[1] Margination continues the finishing process by adapting the margin of the crown to the tooth so that the margin is "essentially imperceptible." Margination can be accomplished with a stone lubricated with silicon grease using the contra angle[e] on a slow speed handpiece[f] moving from the metal crown to the tooth at a 45º angle.[6] Polishing is the final step to remove scratches to obtain a smooth surface.[1,6]

An open margin is detected with a sharp explorer[g] at the crown's buccal, lingual, and palatal walls.[6,7] The explorer should move without any resistance across the metal crown-tooth

Figure 4

Photographs in two patients 6-months following full metal crown restoration of the maxillary fourth premolar tooth before (A and C) and after (B and D) dental prophylaxis. Note the gingivitis associated with calculus accumulation in both cases.



interface.[6] Crowns with defective margins and excess cement have been shown to have an increased degree of plaque acclumulation[7] (Fig. 3).

Checking and assuring proper occlusion during the cementation visit avoids unnecessary crown damage, provides good contact, and verifies absence of supraocclusion. Supraocclusion or "hitting high" is premature contact of the restoration with the occluding teeth.[6,13] Occlusion can be checked with articulation paper[h] or color indictor spray[i]. Problems with occlusion can lead to sensitivity, tenderness, and myofacial disturbances.[13]

After placement of a full metal crown restoration, the owner is instructed to brush with a soft bristle brush[j] on a daily basis. Calculus continues to build-up on the restoration even with home care making it all the more important to make sure the owner is committed to home care and routine dental prophylaxis.[8]

Home care of full metal crown restorations

The triad of owner-animal-environment must be involved in maintaining good periodontal health around restorations and natural dentition.[14] Owners should be instructed to use a soft bristle toothbrush with the bristles at a 45º angle to the long axis of the tooth moving from the gingival sulcus to the crown. Caudal teeth are brushed at the same angle with a vibratory or back and forth direction. Careful attention should be given to the gingival margin.[15] Bacteria can grow in an open margin of a restoration, even in a 0.1-mm space.[15] Daily tooth-brushing remains the most effective means of plaque control.[16,17] Plaque will readily recur on full metal crown restorations if home care is not performed (Fig. 4). Calculus forms as the plaque is mineralized and cannot be removed with home care. A professional dental prophylaxis with the pet under general anesthesia is necessary in controlling periodontal disease.[16,18]

Care of full metal crown restorations during professional scaling

Ultrasonic scalers should be avoided on metal restorations as this contributes to etching, scratches, pitting, and deformation (Fig. 5). The side of the ultrasonic instrument is the working edge and it is used to remove plaque and calculus on exposed enamel apical to the restoration.[8] The scaler should be water cooled and not contact the tooth more than 12 to 15-seconds to avoid thermal injury if the crowned tooth is vital.[8, 16]

Subgingival scaling and subgingival curettage is performed as would be on any normal, unrestored tooth. Hand curettes[k] and ultrasonic tips specifically designed for subgingival scaling[l] can be used to reduce damage to the epithelial attachment.[16]

Figure 5

The side of the ultrasonic instrument is the working edge and it is used to remove plaque and calculus on exposed enamel apical to the restoration (A). It should not be used on the full metal crown restoration since it contributes to etching, scratches, pitting, and deformation (B).

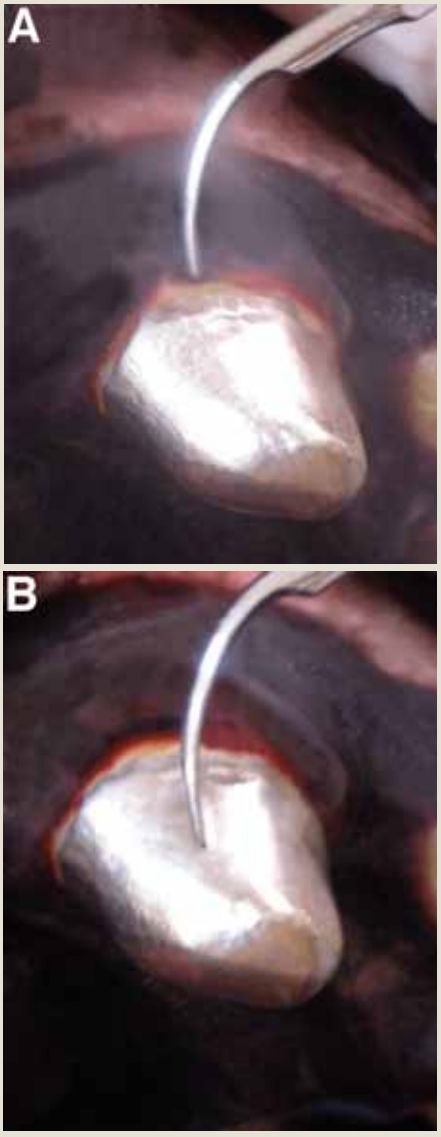


Figure 6

Photographs showing polishing full metal crown restorations. A mixture of tin oxide and either glycerin or water (A) may be used for polishing with a soft grey latch grip rubber cup on a 10:1 reduction contra angle in a slow speed handpiece (B). A soft Robinson brush mounted in a slow speed handpiece with fine siliceous powder that comes bound to wax in cake form may also be used for polishing (C). Finally, a fine grit rubber point impregnated with silicon carbide on a 10:1 contra angle in a slow speed handpiece is used to achieve a high luster and polished appearance (D).

Personal protective equipment should be used to protect clothes, skin, eyes, and mouth from aerosolized bacteria and polishing agents as recommended during any professional dental prophylaxis. Avoid careless use of any instrument that could scratch metal restorations and cause surface deterioration. A study comparing an explorer, hand scaler, curette, and an ultrasonic scaler on the effects on four metal alloys revealed that the ultrasonic scaler[m] caused the most surface deterioration.[2]

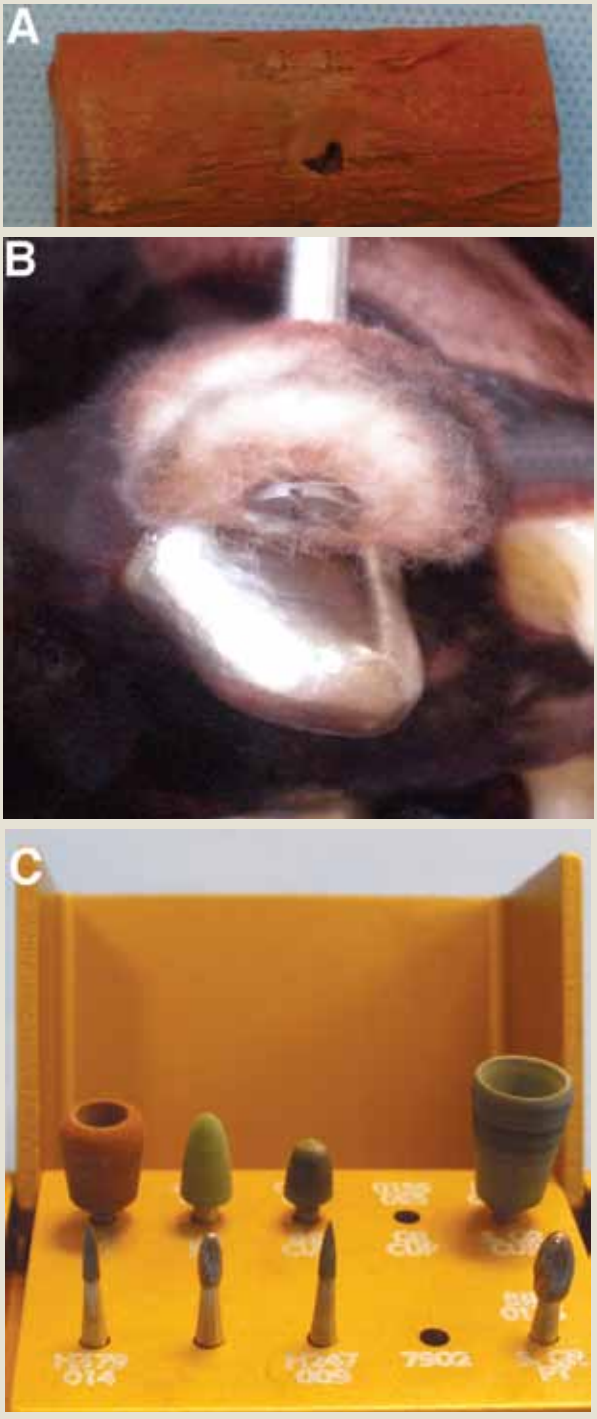
Polishing full metal crown restorations

After subgingival and supragingival plaque and calculus have been removed, the enamel and full metal crown restoration are polished to achieve a smooth surface. A prophy cup is placed on a slow speed handpiece at a speed with a 90º prophylaxis[n] angle.[16] A softer prophylaxis cup will flare more readily and reach the target subgingival areas.[8,16] Tin oxide prophylaxis powder[o] is mixed with water or glycerin[p] to remove most surface debris and calculus. Glycerin will provide a more consistent slurry, as water evaporates and the desiccated paste becomes more abrasive.[9] If the crowned tooth is vital, polishing with any method should be limited to less than 5-seconds per tooth to reduce the incidence of hyperthermia of the pulp.[16]

After all gross debris and calculus are removed, the soft grey latch grip rubber cup[q] is used on a 10:1 reduction contra angle[r] in a slow speed handpiece with tin oxide to begin the polishing sequence. A soft Robinson brush[s] mounted in a slow speed handpiece with fine siliceous powder[s] that comes bound to wax in cake form may also be used for polishing. Care must be taken to avoid contact and prevent damage to soft tissues during polishing. Finally, a fine grit rubber point impregnated with silicon carbide[u] in a 10:1 contra angle on a slow speed handpiece is used (Fig. 6). A rubber point with an even finer particulate of silicon carbide[v] can be used to achieve a high luster and polished appearance.[13] White stones or rubber points ("whities") impregnated with sintered aluminum oxide can also be used. These abrasives

Figure 7

Photographs showing final polishing using iron oxide rouge (A) and a cloth wheel (B). Metal and intra-oral gold finishing and polishing tools may also be used (C).



come in many shapes like cone, flame point, cylinder, wheel, and round with coarse, medium, fine, and ultrafine grades.[9,13] The clinician can select a combination of shapes to adapt to the contours of the metal restoration. The clinician must be mindful to carefully polish around the margins since they may be fragile and can be easily bent.[9]

The final step of polishing, after the surface is smooth, is to achieve a high gloss value, a measure of reflective light. The final step involves the use of rouge[w] (iron oxide) on a cloth wheel[x], that may be made of linen, muslin, cotton, or felt.[1] The cloth wheel is attached to a mandrel that inserts into the slow speed handpiece. Mandrels can be latch, straight, or FG burs.[12] Metal and intra-oral gold finishing kits are also available that include finishing and polishing tools in an organized autoclavable block[y] (Fig. 7).

After the abrasives achieve the desired smoothness, gloss value, and luster, the sulcus and oral cavity must be properly rinsed and irrigated with saline or 0.12% chlorihexidine gluconate[z] to remove loose debris that could cause local inflammation or periodontal abscesses.[8,12,16]

Discussion

The structural and mechanical properties of the abrasives and the metal being polished will determine the effectiveness of any polishing system. The properties of abrasives are determined by the particle size and shape of the abrasive, speed and pressure in which they are applied, and the method of application whether in a lubrication or fixed in rigid backing material like plastic, paper, polymer, metal, or disks.[9] Knowing the properties of a metal crown aids in understanding its corrosive tendencies. There are noble metals and base metals. Noble metals contain: Gold (Au), palladium (Pd), platinum (Pt), iridium (Ir), rhodium (Rh), ruthenium (Ru), and osmium (Os) with Au, Pd, and Pt being commonly used in dentistry. Noble metals are considered the least corrosive.[19] Some texts have described noble metal crowns as precious metal or non-precious or even semi-precious metal referring to the related costs of noble metals.[1] Base metals in dentistry include: titanium (Ti), nickel (Ni), Copper (Cu), Silver (Ag), and Zinc (Zn). Base metals are less resistant to corrosion, but offer strength, flexibility, and wear resistance.[1]

Any metal in the oral cavity can be affected by corrosion. Corrosion is defined by the dissolution, deterioration, or weakening of a solid.[1] More specifically, pitting corrosion occurs in a localized area where the oxide layer of the base metal like iron, nickel, and chromium is degraded in an acidic environment with rapid dissolution of the underlying metal.[19] Stress corrosion occurs when mechanical stress and a corrosive environment exert a negative effect on the metal resulting in a crack or hertzian fractures.[9,19] Stress corrosion can occur at margins due to over bending, over burnishing, or malleting the metal.[19]

Metals can lose their luster due to tarnish, sulfide reactions, or an oxide film. Tarnish is usually due to surface discoloration from calculus, plaque, films of microorganisms, mucin, oxides, sulfides, and chlorides. Tarnish can proceed from a surface deposit to a corrosive agent that causes actual deterioration of the metal.[19] Silver reacts with oxygen, water, and sulfur to form silver sulfide, a dark unaesthetic discolored product and is therefore, not considered a noble metal in dentistry.[19] The oral cavity has sulfur compounds from food, chloride ions from saliva, and phosphoric, acetic, and lactic acid that alters the oral pH leading to corrosion.[19]

The finishing of a dental material is defined as removing blemishes and imperfections, shaping to an ideal form, and developing the outermost surface of the material to the desired state.[19] The polishability of metal refers to the alloy's hardness.

An alloy with a high hardness scale, referring to Knoop's hardness number, is more difficult to polish and to indent.[1,20]

The first time a metal crown is polished is prior to being exposed to the oral cavity in the dental laboratory after casting, devesting, and pickling, if applicable.[1] The goal of polishing restoratives is to make the external surface of the restorative as smooth as possible. Polishing involves using progressively finer abrasives in each sequential step.[1] There should be a high luster with a perfectly smooth finish.[1]

Polishing can be accomplished using a two body or three body abrasive. Two body abrasives involve abrading burs, bonded abrasives like the rubber points with silicon carbide, and coated abrasives. Three body abrasives have small pieces of loose material circulating within the contact zones of the abrasive and the substrate like polishing paste, tin oxide in glycerin, an aluminum oxide slurry, or diamond polishing paste.[9] Tin oxide (SnO_2) is used as a fine white powder on a brush or rubber cup for final polishing of metal restorations.[13] Tripoli is another common polish used in metal restorations that originates from porous rocks from North Africa. The final step to polishing the metal restoration is rouge, a fine red powder of iron oxide (Fe_2O_3) usually applied with a soft cloth wheel, or rag wheel.[1] Regardless of methods used for polishing, rinsing and irrigation should be judicious in order to remove any remaining debris.[16] The right match between alloy and abrasives can be aided by good communication with the dental laboratories and the practitioner to ensure clinically successful restorations.

In summary, adequate care of full metal crown restorations can reduce plaque accumulation, decrease gingival irritation, gingivitis, and periodontal disease. Polishing not only provides an esthetic result but more importantly, for the periodontium, it smoothes the metal surface and, in theory, delays adherence of plaque.[2,8] Careful finishing and polishing can reduce the risk of fracture by removing rough surfaces that are more likely to fracture, reduce the risk of corrosion, improve oral function, facilitate good oral hygiene, and allow access to all surfaces for cleaning.[9] Proper care of full metal crown restorations begins with the proper preparation, design, and retentive form, followed by consistent home care and regular professional dental prophylaxis for years of continued use and protection.[21]

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[a] Piezo ultrasonic scaler, Gulin Woodpecker, Pearson Dental, Sylmar, CA

[b] Iwanson calipers, Hu Friedy, Chicago, IL

[c] UNC 12 Periodontal probe, Hu Friedy, Chicago, IL

[d] Stainless Steel Dental Ruler, Patterson Dental, St. Paul, MN

[e] Contra angle 200, Henry Schein, Melville, NY

[f] Slow Speed handpiece, Henry Schein, Melville,NY on iM3 Pro 2000, iM3 Inc, Vancouver, WA

[g] Dental Explorer, Hu Friedy, Chicago, IL

[h] Bausch Articulating Paper, Nashua, NH

[i] QuickCheck, Henry Schein Shalfoon, North Shore, NZ

[j] C.E.T. toothbrush with toothpaste kit, Virbac, Fort Worth, TX

[k] Curette, Columbia #13/14 Hu Friedy, Chicago, IL

[l] Piezo Periotip E- Series #100 Universal, Hu Friedy, Chicago, IL

[m] Cavitron, Dentsply International, York, PA

[n] Pivot DPA Soft Green prophy angle, Preventech, Indian Trail, NC

[o] Tin oxide powder, Patterson Dental, St. Paul, MN

[p] Glycerin, Henry Schein, Melville, NY

[q] Soft rubber polishing cup FG, Brassler USA, Savannah, GA

[r] Contra angle, 200 Henry Schein, Melville, NY

[s] Soft Robinson-Abbott brush #12, Buffalo Dental Manufacturing Co, Syosset, NY

[t] Tripoli polish, Buffalo Dental Manufacturing Co, Syosset, NY

[u] Greenie®, Shofu polishing system, Shofu Dental Corp, San Marcos, CA

[v] Supergreenies, Shofu polishing system, Shofu Dental Corp, San Marcos, CA

[w] Red Rouge XXG Stick, Iron oxide cake, Buffalo Dental Manufacturing Co, Syosset, NY

[x] Chamois buff wheel, Buffalo Dental Manufacturing Co, Syosset, NY

[y] Brasseler's Gold Crown Polishing Kit, Brasseler USA, Savannah, GA

[z] C.E.T. 0.12% Chlorhexidine Gluconate Rinse, Virbac, Fort Worth, TX

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References

1. Powers JM, Wataha JC. Finishing, polishing, and cleansing materials. In: *Dental materials properties and manipulation.* St. Louis: Mosby Elsevier, 2008;121-137,278.

2. Cutler BJ, Goldstein GR, Simonelli G. The effect of dental prophylaxis instruments on the surface roughness of metals used for metal ceramic crowns. *J Prosthet Dent*1995; 219.

3. Coffman CR, Visser L. Crown restoration of the endodontically treated tooth: Literature review. *J Vet Dent* 2007; 24:11.

4. Brine EJ, Marretta SM. Endodontic treatment and metal crown restoration of a fractured maxillary right fourth premolar tooth: A case report. *J Vet Dent* 1999;159.

5. Coffman CR, Visser L, Visser C. Tooth preparation and impression for full metal crown restoration. *J Vet Dent* 2007; 24:59.

6. Visser CJ. Restorative dentistry. In: Holmstrom SE, ed. *Veterinary clinics of north america small animal practice: dentistry.* Philadelphia: WB Saunders, 1998; 1273-1284.

7. Sharaf AA, Najat M, et al. A clinical and radiographic evaluation of stainless steel crowns for primary molars. *J Dent* 2004; 28.

8. Niemiec BA. Foundations: Professional teeth cleaning. *J Vet Dent* 2003; 20:176.

9. Jefferies SR. Abrasive finishing and polishing in restorative dentistry: A state of the art review. In: Calamia JR, Wolff MS, Simonsen, RJ, eds. *Dental clinics of north america.* Philadelphia; Saunders, 2007; 379-397.

10. American Veterinary Dental College Website 2010. *Locate a Specialist.* www.avdc.org

11. Sorensen JA. A rational comparison for plaque-retaining properties of crown systems. *J Prosthet Dent* 1989; 9:264.

12. Holmstrom SE, Frost P, Gammon RL. Endodontics. In: *Veterinary dental techniques for the small animal practitioner.* Philadelphia: WB Saunders;1992: 360.

13. Shillingburg HT, Hobo S et al. Finishing and cementation. In: *Fundamentals of fixed prosthodontics.* Chicago: Quintessence Publishing Co, 1997; 399.

14. Hale FA. The owner-animal-environment triad in the treatment of canine periodontal disease. *J Vet Dent* 2003; 20: 118.

15. Perry D. Plaque control for the periodontal patient. In: Carranza FA, ed. *Clinical periodontology.* Philadelphia: WB Saunders, 2002; 659-674.

16. Wiggs R, Lobprise H. Periodontology. In: *Veterinary dentistry principles and practice.* Philadelphia: Lippincott-Raven, 1997; 186-219.

17. Gorrel C, Rawlings JM. The role of tooth-brushing and diet in the maintenance of periodontal health in dogs. *J Vet Dent* 1996; 13: 139.

18. Hale FA. Home care for the veterinary dental patient. *J Vet Dent* 2003; 20:52.

19. Anusavice. KJ. Finishing and polishing materials. In: *Phillips' science of dental materials.* Philadephia: WB Saunders, 2003; 663-680.

20. Gladwin M, Bagby M. Polishing materials and abrasion. In: *Clinical aspects of dental materials.* Philadelphia: Lippincott-Williams & Wilkins, 2000; 149.

21. Van Foreest A, Roeters J. Evaluation of the clinical performance and effectiveness of adhesively-bonded metal crowns on damaged canine teeth of working dogs over a two-52 month period. *J Vet Dent* 1998; 15:13.