Australian Dental Journal, October, 1983

Volume 28,
No. 5

Electrochemical etching of full crowns

M. Darveniza, M.D.Sc., F.R.A.C.D.S.

Lecturer in Operative Dentistry, University of Queensland

ABSTRACT—The orientation of full crowns in an electrolytic bath during electrochemical etching influences the amount of gold alloy removal. The etching was non-uniform and the amount removed not proportional with time.

(Received for publication May 1982. Revised July 1983.)

Introduction

Electrochemical etching of gold castings has been used to improve marginal fit of poorly seating castings,[1] and to provide internal space for the cement film.[1]

Previous studies measuring the rate of gold alloy removal from a casting have used inlays,[1-5] a partial veneer crown,[6] cast flat surfaces,[7] and cast bevelled plates.[8] However, no previous study has attempted to monitor the removal of gold alloy within a full veneer crown.

The purpose of this study was to evaluate the removal of gold alloy within a full crown by measuring shortening of internally placed pins.

Method

Three gold alloy* crowns were constructed from a master die. The first was sprued at right angles to the occlusal surface.

The occlusally sprued crown was used to monitor the gross effects of electrochemical etching. A standardized procedure was performed with an electrochemical etching unit† and the ammeter was adjusted to 4 amps. A fresh 60 ml electropolishing solution,† heated to 60°C, containing potassium cyanide, was used for each etching. The cathode alligator clip was attached to a stainless steel bowl and the anode clip to the sprue.

The attached crown was lowered vertically into the bath so that the margins faced downwards. This crown was etched for 5 minutes and examined under a binocular microscope (×40) for evidence of etching. Since no etching was evident internally, but occurred externally, a further 10 minutes of etching was performed before re-examination under the microscope. Since no etching was found internally the other crowns were constructed mesially sprued for anodes.

A mesial sprued crown was attached to the anode clip and lowered vertically into the bath so that the margins faced the side of the bowl and the distal surface downward. This crown was etched for two hours and

[1] Ingaham R, Bassett RW, Koser J. An atlas of cast gold procedures. 2nd ed. Los Angeles, Department of Operative Dentistry, University of Southern California School of Dentistry, 1969:92-5.

[2] Patel MG. The effect of electrochemical milling on margins of MOD inlays. J Prosthet Dent 1973;30:66-73.

[3] Weiss MB. Stripping gold castings. J Dent Res 1964;43:919-20.

[4] Bassett RW, Status BM. Evaluation of electro-chemical milling (stripping) versus etching with aqua-regia. J South Calif State Dent Assoc 1966;34:478-83.

[5] Farne JF, Nealey ET. The effects of etching on the margins of cast gold restorations. J Prosthet Dent 1976;35:273-8.

[6] Lorencki SF. A rationale for electro-deplating a cast restoration. Dent Digest 1968;74:249-51.

[7] Cherberg JW, Nicholls JI. The analysis of gold removal by acid etching and electrochemical stripping. J Prosthet Dent 1979;42:638-44.

[8] Merrill OM, Welk DA. Electrochemical etching of gold castings. IADR Program and Abstracts of Papers 1966:86.

* Type III gold alloy. Matthey Garrett Pty. Ltd. Brisbane, Australia.
† Matthey Garrett Pty. Ltd. Brisbane, Australia.

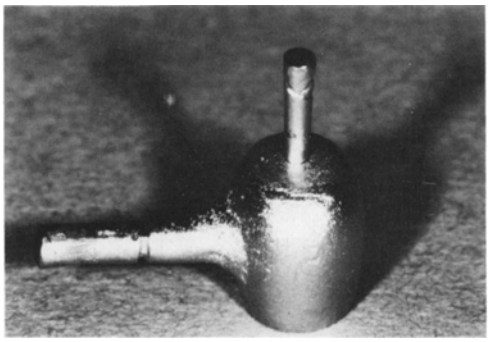

Fig. 1.—A mesially sprued crown with pin through the occlusal surface access hole.

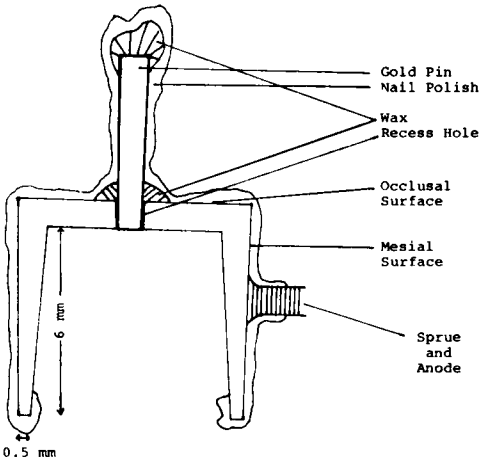

Fig. 2.—Diagram of the regions protected with wax and nail polish prior to electrochemical etching.

examined under the microscope every fifteen minutes. Etching was evident on both the internal and external surfaces.

The remaining mesial sprued crown was used as a vehicle for measuring the amount of internal etching against time. To monitor the rate of etching a cast pin was placed within the crown and measured for shortening (Fig. 1). This procedure was performed separately for ten pins in the following manner. Ten large plastic points‡ were used as patterns to cast new Type III gold alloy for the pins. The cast pins were embedded in clear acrylic resin and using different grade lapping plates the ends of each pin were ground plano-parallel by a toolmaker. Each pin was then removed, cleaned and measured with a horizontal metroscope§ to an accuracy of 0.25 μm. A recess hole was prepared through the occlusal surface of the crown with a 0.6 mm twist drill followed by a tapered fissure No. 701 steel bur until a pin when placed from the occlusal surface rested flush with the internal surface of the crown. Each pin was then luted to this crown with wax (Fig. 2).

The crown was positioned in the electrolyte bath so that the distal margin of the crown was 10 mm below the level of the electrolyte. A fresh electropolishing solution was used to etch each pin. Nail polish was used to cover and protect the external surfaces and margins of the crown and pin (Fig. 2).

The time of etching was seven minutes for No. 1 pin and this increased by one minute for each succeeding pin with a duplicate pin at 10 minutes. Each pin was removed from the crown, cleaned, measured, and the ground end microscopically examined.

Results

Microscopic examination of the occlusally sprued crown revealed etching had occurred externally but not internally.

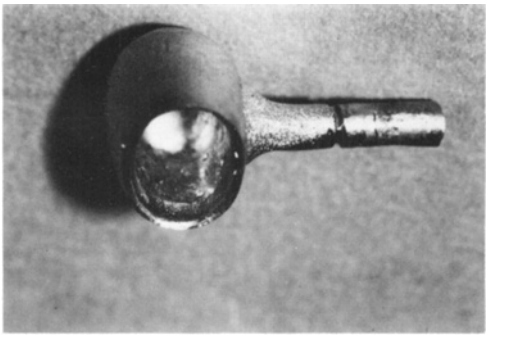

Fig. 3.—The internal surface of the crown shows the marked etching that has occurred in comparison with the protected margins. Etching of the mesial internal surface is evident. The groove in the sprue was used for standardization of the crowns' depth in the electrolytic bath.

Visual examination of the two mesial sprued crowns revealed gross etching of the mesial internal surface in the form of a deep concavity towards the sprue (Fig. 3).

The shortening of the ten pins was 5, 1, 13, 17, 8, 3, 8, 4, 4, and 15 μm with times of etching 7, 8, 9, 10, 10, 11, 12, 13, 14 and 15 min, respectively. This rate of removal of metal was not directly proportional with time.

Microscopic examination of the pin ends revealed a non-uniform loss across the pin face indicated by a rounding of the ends.

Discussion

Microscopic examination of the internal surface of the occlusally sprued crown showed no etching but the external surface did. It appears that the position of the sprue

‡ **KAE Precision Points.** SS White Dental Products International, Philadelphia, U.S.A.
§ Carl Zeiss Pty. Ltd. Brisbane, Australia.

and hence the position of the crown in the electrolyte bath allowed gas bubbles, such as oxygen,[1] to collect and trap inside the crown thus starving the internal surface of electrolyte.

Visual examination of the inside of the mesially sprued crowns showed a highly polished, non-uniform loss from the internal surfaces (Fig. 3). The mesial internal surface suffered pronounced etching compared to the remaining internal surfaces of the crowns. This preferential etching of the mesial surface may be associated with current entering the crown via the mesial surface.

Microscopic examination of the pin ends revealed a preferential loss from the edge rather than from the face of the pin. This partly accounts for the relatively small change of length of pins with time.

The inherent disadvantages of electropolishing are three-fold. Firstly, the electrolyte contains potassium cyanide, a potentially lethal central nervous system poison; secondly, etching of the internal surfaces removes surface roughness resulting in a polished surface[7] which is less amenable for micromechanical retention of the luting cement; thirdly, etching is a non-uniform process[9] and the amount removed from an internal surface varies erratically with time. Despite these disadvantages electrochemical etching has been used successfully to afford an increased precementation space, create passivity and significantly improve marginal fit of crowns after luting.[10,11]

The practice of electrochemical etching must be considered in light of other techniques that are simple and require no sophisticated equipment to improve marginal fit. The paint-on-die-spacing varnishes‖ used on a die prior to waxing is an example of a simple and successful technique[9] that provides internal space for a crown prior to cementation. As an aid for poorly seating casting on either die or tooth various materials such as coloured sprays¶ or silicone matterials** are used with ease to detect internal interferences of a casting prior to internal adjustment.

Conclusion

This experiment indicated that the process of electrochemical etching was non-uniform and the amount removed not proportional with time.

Acknowledgements

The author's thanks are expressed to Dr B. A. Junner and Mr L. Stevens for their help and advice in this research project.

Address for reprints:
Dental School,
University of Queensland,
Turbot Street,
Brisbane, Qld, 4000.

‖ George Taub Productions and Fusion Co., Inc., New Jersey, U.S.A.
¶ Pascal Co., Inc., Bellevue, USA.
** G.C. Dental Industrial Corporation, Tokyo, Japan.

[9] Eames WB, O'Neal SJ, Monteiro J, Miller C, Roan JD, Cohen KS. Techniques to improve the seating of castings. J Am Dent Assoc 1978;96:432-7.
[10] Bassett RW. Solving the problems of cementing the full veneer cast gold crown. J Prosthet Dent 1966;16:740-7.
[11] Darveniza M, Stevens L, Adkins B. Luting of vented and etched crowns. Aust Dent J 1983;28:233-8.