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A study of the compaction of Pure Gold into retention holes, convenience points and point angles in class III cavity preparations

Various designs are advocated in cavity preparations for Class III restorations of pure gold. One design that is widely recognized was refined by Ferrier[1]. It is characterized by sharp internal line angles for resistance form during insertion of the gold and by sharp internal point angles for convenience in starting the gold at the labio-axiogingival and linguo-axiogingival point angles. This basic form is highly satisfactory, but some operators[2] [3] prefer added convenience in the form of a pit in the labio-axiogingival and/or linguo-axiogingival point angles. Such convenience pits facilitate starting the compaction of the gold. Although larger holes are advocated by some [4] [7] for retention of the finished restoration, a long history of success with the Ferrier design has shown that large holes are not necessary for retention, and, furthermore, such holes may undermine the enamel or encroach needlessly upon the pulp.

A study was made to determine the size of the smallest pit in clinical use into which gold could be densely compacted, since Jeffery[2] and Stibbs[3] have recommended that small pits, approximately 0.42 mm in diameter, are adequate to serve as convenience points for receiving the initial pellets of pure gold to which the remainder of the restoration is added.

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Materials and Methods

Convenience pits were prepared in 24 extracted, dried, human teeth which were cleaned and trimmed to remove most of the enamel. The roots were squared to create flat surfaces for mounting in the bench vice. Triangular preparations were cut* in the dentin on one side of the tooth with a 33½ inverted-cone, carbide bur. The internal line angles were finished with a 6½-2½-9 hoe and with 7-(84)-2½-9 right and left angle formers. The finished cavity preparation had three walls which met to form an acute point angle. It was at this location that the point angle was accentuated with a retentive hole or convenience pit. Retentive holes were cut with the 3/0 round bur (0.75 mm diameter) and the 27 gauge twist drill (0.7 mm diameter) to a depth of 0.9 to 1.8 mm. The convenience pits were cut with the 4/0 (0.4 mm) end-cutting inverted-cone bur to a depth of 0.4 to 1.4 mm. The Ferrier cavity was used without pits or holes to demonstrate compaction density at a point angle.

Two forms of pure gold were used. Size 1/128th and 1/64th pellets were rolled from a sheet of Number 4 gold foil** and compacted with hand malleting in 21 specimens[8 9]. Mat gold*** was cut into triangular pieces measuring 2 mm on each side, placed over the retentive holes with hand pressure, and then covered with foil pellets compacted with hand malleting in three specimens.

A 0.5 mm condenser was used to compact the 0.7 and 0.75 mm diameter retention hole specimens and one group of the 0.42 mm pit specimens. The remaining specimens were compacted with the 0.4 mm condenser. All specimens were compacted with hand malleting.

After compaction, the specimens were trimmed to remove excess tooth structure and embedded with epoxy resin in acrylic blocks. They were sectioned vertically and then ground on abrasive papers through No. 4/0 and polished on nylon cloth with wet alumina for microscopic study with the metallograph.**** Representative specimens were photographed as polished. Metallurgical etching was not performed in this study because the walls of the preparations would have been lost due to the solubility of dentin in gold etchants.

Results

The porosity observed in the gold was used as a basis for comparison of the efficiency of compaction. Void spaces occurred in the folds of single pellets and between unwelded pellets.

The specimens were divided into six groups according to the diameters of the bur and condenser (Table I). The first group had no pit or hole

* *Air Turbine, Midwest American, Melrose Park, Illinois.*
** *Morgan, Hastings & Co., Philadelphia, Pa.*
*** *Williams Gold Refining Co., Buffalo, N.Y.*
**** *Me F. C. Reichert, Vienna, Austria.*

placed. The cavities were filled with 1/64th pellets and compacted with the 0.4 mm condenser. These specimens (1 through 3, Table 1) demonstrated dense and well compacted gold foil. Voids were present in all specimens, but they were smaller, shallower, and fewer in number per unit area in these point angles than the voids in the specimens with pits or holes (Fig. 1).

TABLE 1: *Compaction Results.*

				Void Distribution					
				Pit				Pellet	
Specimen No.	Bur Dia. (mm)	Condenser Dia. (mm)	Hole Depth (mm)	Bottom 1/3	Middle 1/3	Top 1/3	Angle	Size	No. ⋆ ⋆
1	none	0.4	N.A.*	N.A.	N.A.	N.A.	+	1/64	0
2	"	"	"	"	"	"	+	"	0
3	"	"	"	"	"	"	+	"	0
4	0.4*	0.5	1.4	0	0	—	N.A.	"	2
5	"	"	0.5	0	+	+	"	"	1
6	"	"	0.9	0	0	—	"	"	1
7	"	"	1.4	0	—	—	"	"	2
8	"	0.4	0.7	—	+	+	N.A.	"	1
9	"	"	0.5	—	+	+	"	"	1
10	"	"	0.8	0	0	0	"	"	1
11	"	"	0.4	—	+	+	"	"	1
12	"	"	0.5	—	+	+	"	"	1
13	"	"	1.3	—	+	+	N.A.	1/128	2
14	"	"	0.8	0	+	+	"	"	2
15	"	"	0.5	0	+	+	"	"	2
16	"	"	0.5	—	+	+	"	"	2
17	0.75**	0.5	1.4	—	—	—	N.A.	1/64	3
18	"	"	1.2	+	—	—	"	"	2
19	"	"	1.8	—	—	+	"	"	3
20	"	"	1.0	0	—	+	"	"	2
21	"	"	0.8	—	—	+	"	"	2
22	0.7**	"	1.5	—	—	—	N.A.	mat & 1/64	
23	"	"	0.9	—	—	—	"	"	"
24	"	"	1.8	0	—	—	"	"	"

\+ Small voids, good compaction density
— Large and small voids, poor compaction density
0 Complete absence of gold, lack of penetration
* End-cutting inverted cone
** 3/0
*** 27 gauge twist drill
⋆ Non-applicable
⋆ ⋆ Number of pellets in hole

Fig. 1 – *Photomicrograph of gold foil compacted into a line angle in dentin of an extracted tooth; condenser serrations at the top surface, voids near the point angle at the bottom. Cross striations are artifacts resulting from specimen preparation. Porosity was minimal (Specimen No. 1).*

Fig. 2 – *Gold foil compacted into a convenience point prepared with the 440 (0.4 mm) end-cutting inverted-cone bur. Pit depth is 0.5 mm. Small voids, linear foil laminations, condenser imprints and polishing striations (Specimen No. 9).*

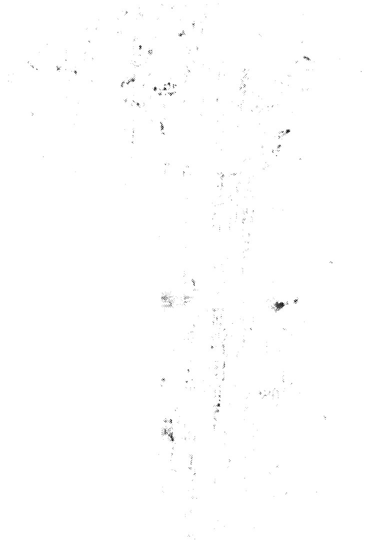

Fig. 3 – Gold foil compacted into retention hole prepared with 330 (0.75 mm) round bur. [illegible] plane of section = 1.2 mm. Dense gold at depth of hole, large voids along the walls of hole towards opening with occasional voids in the center of the mass. Condenser imprints [illegible] (Specimen No. 18.)

Fig. 4 – Mat gold and gold foil compacted into retention hole prepared with 27 gauge twist drill (0.7 mm). [illegible] mm. Uncompacted mat gold in depth of hole, porous gold foil above. Large voids present throughout the [illegible] present in the gold foil in the cavity above [illegible]

The specimens of the second group were prepared with the 0.4 mm diameter end-cutting inverted-cone bur. They were compacted with 1/64th gold foil pellets and the 0.5 mm diameter condenser point. These specimens (Nos. 4 through 7) demonstrated incomplete compaction of the gold foil into the pit. The gold had the appearance of having been placed in the pit with little or no compaction force. In none of these specimens was the foil found to be present at the bottom of the pit. This result was expected because the condenser nib was of larger diameter than the pit. The foil thus placed showed large voids throughout the mass in all except the shallowest specimen (No. 5). Two of the specimens (Nos. 4 and 6) showed that the foil penetrated into less than one-third the depth of the pit. Even the shallowest pit of 0.5 mm (Specimen No. 5) was not filled to its depth with the oversize condenser.

The specimens of the third group (Nos. 8 through 12) were prepared with the same 0.4 mm diameter inverted cone bur, filled with 1/64th size pellets, and compacted with the smaller 0.4 mm diameter condenser. In one specimen of this group (No. 10) the foil did not penetrate the pit. Those specimens in which the gold foil filled the pit were densely compacted, but voids were observed in the deeper portions of the pits and were present on the walls of the pits (Fig. 2). These specimens showed evidence of movement of the foil pellets at the opening of the pit into the cavity.

The specimens of the fourth group were prepared with the 0.4 mm diameter bur, and the 0.4 mm condenser, but were filled with the smaller 1/128th size pellets. The specimens (Nos. 13 through 16) showed compacted gold foil within the pits that was similar to the gold in the previous group. Although the foil did not fill all pits to their depth, there was evidence of dense packing in each specimen. Specimens differed in appearance from the previous group in that porosity was evident where the second 1/128th pellet failed to weld against the first pellet in the pit. Voids along the walls of the pits were similar to those in the specimens compacted with 1/64th pellets, but the gold was less porous around the opening of pits.

The specimens for the fifth group (Nos. 17 through 21) were prepared with the 0.75 mm diameter 3/0 round bur, the 0.5 mm diameter condenser, and 1/64th pellets of gold foil. Voids and uncompacted gold characterized these specimens. It appeared that the first and second pellets were not welded together as the foil was placed, and voids were observed also in the gold at the entrance to the hole. The foil penetrated to the depth of the hole with varying degrees of density. The gold was well compacted in the depth of the hole in one specimen (No. 18, Fig. 3) but was porous in three specimens at this level (Nos. 17, 19 and 21), and failed to reach the depth in another (No. 20).

The last group was prepared with the 0.7 mm diameter, 27 gauge, twist drill. Triangles of mat gold were loosely tucked into the retentive holes with hand instruments, then overlayed with 1/64th gold foil pellets compacted with the 0.5 mm condenser. In these specimens (Nos. 22 through 24) there were large voids in the depth of the hole, and voids could be seen throughout the mass (Fig. 4).

Conclusion

Conservation of tooth structure is desirable in dentistry[10], and adequate convenience and resistance form may be obtained in Class III cavity preparations from the placement of sharp internal line angles and acute point angles[11]. Small pits may be placed where necessary for additional convenience form. Large holes involve needless destruction of tooth structure and are incompletely filled. It may be concluded from this study that the 0.42 mm diameter pit was adequately filled with dense gold. It is difficult to produce a well-compacted, stable, mass of gold with 1/128th size pellets, and, therefore, the larger 1/64th size pellet is recommended for clinical use with the small convenience pit. A pit depth to 0.5 mm is sufficient to provide stabilization of the gold as compaction is begun. Additional convenience form is not gained with deeper pits, and tooth structure may be unnecessarily weakened.

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