Bull. Tokyo Med. Dent. Univ., 25: 165–168, 1978.

MARGINAL CLOSURE OF NON-γ_2 AMALGAM

BY

Joji OHBA,*1 Koichi OKUSE,*1 Shinichi KATO*2 and Masaaki IWAKU*1

ABSTRACT

In order to investigate the effect of burnishing on the marginal closure of non-γ_2 amalgam restorations, a single-composition high-copper alloy (Indiloy), a conventional lathe-cut alloy (Lunargent Alloy), and a conventional spherical alloy (Shofu Spherical) were each mixed with mercury and filled in transparent plastic cavities. Half of the specimens were burnished along the cavity margins immediately after packing and again after carving. The remainder was unburnished. A dye was sprayed on their occlusal surfaces after 24 hr and leakage indicated by the dye penetration was observed through the plastic walls, and following facts were found:

1. Burnishing markedly decreased the leakage of all type alloy amalgams.
2. When burnished, the marginal leakage with the high-copper alloy was remarkably less than that with the conventional spherical alloy but slightly more than that with the lathe-cut alloy.
3. The difference in the marginal leakage and in the effect of burnishing among the three amalgams was apparently related to their setting dimensional change curves.

INTRODUCTION

New type high-copper amalgam alloys for producing non-γ_2 amalgam were recently developed. It has been reported that this type amalgam has markedly improved physical and chemical properties[1,2], and showed less marginal fracture and surface discoloration in the clinical tests[1,3]. In the present study, the marginal closure of a high-copper amalgam and the effect of burnishing were examined by the dye-penetration technique[4], in comparison with a lathe-cut and spherical amalgams.

MATERIALS AND METHODS

The alloys studied were Indiloy (B.N. 11), which is a single composition spherical high-copper amalgam alloy, Lunargent Alloy (B.N. K016) which is a conventional lathe-cut alloy, and Shofu spherical (B.N. 331) which is a conventional spherical alloy. They were respectively mixed with mercury at a ratio of 1:0.84, 1:1.2, and 1:0.84, respectively, for 15, 8, and 10 sec with a mechanical amalgamator*3 according to the manufacturer's direction. The mix was divided into 5 increments and filled in a clear acrylic resin cylindrical cavity of 5 mm diameter, 4 mm depth, and 130° cavo-surface angle (Fig. 1), pressing 5 times for each increment with a flat end condensor point of 3 mm diameter and removing plashy excess. The condensor point was used by mounting on an electromagnetically driven horizontal vibrator*4 for the

*1 大庭譲治・奥瀬孝一・岩久正明: Department of Operative Dentistry (Chief: Prof. T. FUSAYAMA), School of Dentistry, Tokyo Medical and Dental University (Tokyo Ika Shika Daigaku).
*2 加藤慎一: Chiyoda ku, Tokyo.
*3 Shofu Amalgam Mixer Delux, Shofu Co., Kyoto, Japan.
*4 Universal Plugger, Shofu Co., Kyoto, Japan.
Received for publication, March 22, 1978.

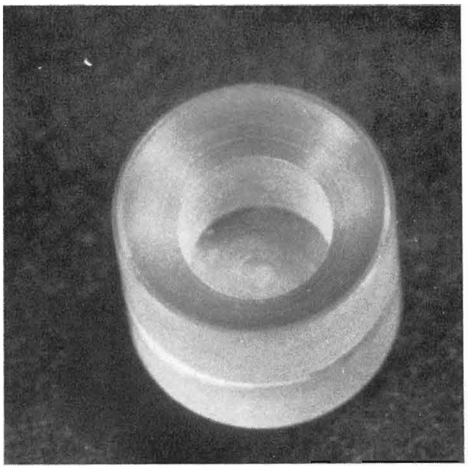

Fig. 1. Acrylic resin cylindrical cavity of 5.0 mm diameter, 4.0 mm depth, and 130° cavo-surface angle.

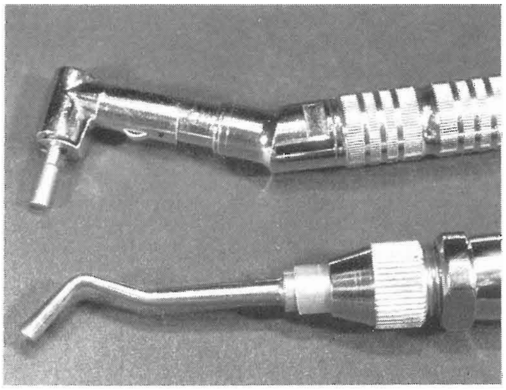

Fig. 2. Amalpak (top) and Universal plugger (bottom) used for condensing amalgam.

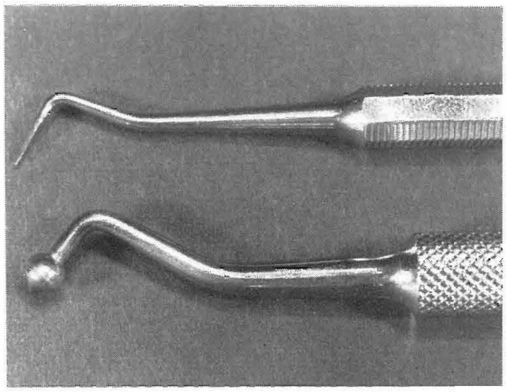

Fig. 3. A cleoid amalgam carver (top) and a bud-shaped amalgam burnisher (bottom).

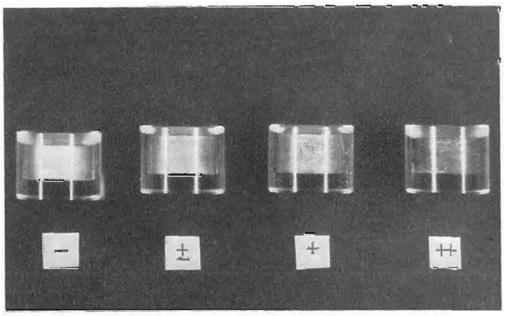

Fig. 4. Standard samples of the four grades of leakage indicated withe Dye Mark penetrant.

spherical alloys, Indiloy and Shofu Spherical, and on an engine-driven vertical vibrator*5 for the lath-cut alloy, Lunargent Alloy (Fig. 2). They were loaded with 2 kg weight by a hanging type pressure regulator designed previously[5]. The cavity was slightly over-filled. At 7 min. after the start of the mixing, the packed amalgam was burnished along the cavity margins by a bud-shaped amalgam burnisher of 4 mm in diameter and 100° tip angle (Fig. 3, bottom). The occlusal surface was carved with a cleoid carver (Fig. 3, top), removing the marginal excess. The second burnishing was applied at 10 min after the start of the mixing.

One-half of the specimens of each alloy was burnished twice and the other was not burnished. Twenty specimens were prepared for each group, and stored in air for 24 hr.

For testing marginal leakage, a red dye for detecting cracks, Dye Mark*6, was sprayed on their occlusal surfaces. After 24 hr, the dye on the occlusal surface was removed and the dye penetration between

*5 Amalpak, Morita Co., Tokyo, Japan.

*6 Dye Mark, Shimadzu Seisakusho Ltd., Kyoto, Japan.

the amalgam and the cavity wall was observed through the transparent resin. This test was performed in a room at 23±2°C. The penetration was recorded dividing into the following four degrees: non (−), trace (±), slight (+), and considerable (#) (Fig. 4). The group results were compared by the sum of the scores made by four examiners independently for minimizing subjective error.

For reference, the setting expansion of the amalgams was determined by loading cylindrical specimens of 4 mm diameter and 10 mm height on an electromicrometer at 5 min after the start of the mixing at the room temperature.

Table 1. Number of Cases Showing Various Grades of Leakage of Unburnished Amalgam Fillings

Materials		Lunargent Alloy	Shofu Spherical	Indiloy
Grades of leakage	−	0	0	0
	±	0	0	0
	+	10 (12.5)	9 (11.25)	59 (73.75)
	#	70 (87.5)	71 (88.75)	21 (26.25)

Percentage in parentheses

Table 2. Number of Cases Showing Various Grades of Leakage of Burnished Amalgam Fillings

Materials		Lunargent Alloy	Shofu Spherical	Indiloy
Grades of leakage	−	28 (35.0)	0	5 (6.25)
	±	45 (56.25)	7 (8.75)	49 (61.25)
	+	7 (8.75)	57 (71.25)	26 (32.5)
	#	0	16 (20.0)	0

Percentage in parentheses

Results

1. Leakage

All of the unburnished specimens showed slight to considerable leakage (Table 1). Considerable leakage was found in nearly 90% of Lunargent Alloy and Shofu Spherical while in 26% of Indiloy.

The burnished specimens showed obviously less leakage than the unburnished (Table 2). When burnished, the leakage was least with Lunargent Alloy, next with Indiloy, and most with Shofu Spherical.

2. Setting dimensional change

All types of amalgam tested showed some initial shrinkage (Fig. 5). Lunargent Alloy amalgam shrank most but turned to ex-

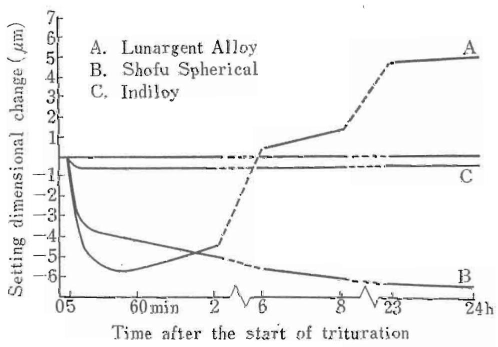

Fig. 5. The setting dimensional change curves of the amalgams used.

pand at 40 min, recovering the original dimension at 6 hr and expanding further. Shofu Spherical amalgam showed the next greatest initial shrinkage and did not turn to expand. Indiloy amalgam initially shrank very slightly and did not change thereafter.

Discussion

Dye Mark penetrant used in this study is a red dye for detecting cracks and reported to penetrate crevices as small as 2 μm. A crevice allowing penetration of the dye was, therefore, considered to be more than 2 μm.

Burnishing margins decreased the leakage with all types of amalgam. Lunargent Alloy amalgam having the greatest initial shrinkage showed the greatest leakage when unburnished. Its leakage was, however, smallest when burnished, since it further expanded after being brought in contact with the cavity wall by burnishing.

Shofu Spherical amalgam having the next greatest initial shrinkage and further shrinking slightly thereafter showed the greatest leakage even when burnished.

Indiloy amalgam having very slight initial shrinkage and no subsequent shrinkage showed remarkably decreased leakage when burnished. Burnishing was effective in eliminating the leakage due to the initial shrinkage but not completely. Such a slight space between the cavity wall and the amalgam is considered to be filled, even if left, with corrosion products of amalgam[5-7] and mineral precipitation from saliva[8], diminishing leakage soon in the mouth.

Acknowledgement

The authors thank Dr. Fusayama, Professor of Operative Dentistry, Tokyo Medical and Dental University, for his valuable advices and assistance.

References

1) Mahler, D. B., Terkla, L. G., Eysden, J. V., and Reisbick, M. H.: Marginal fracture vs. mechanical properties of amalgam. J. Dent. Res. 49: 1452–1457, 1970.
2) Takatsu, T., Iwaku, M., and Fusayama, T.: Structure and effect of non-gamma-2 amalgam. J. Dent. Res. 56: 40–45, 1977.
3) Mahler, D. B., Terkla, L. G., and Eysden, J. V.: Marginal fracture of amalgam restoration. J. Dent. Res. 52: 823–827, 1973.
4) Kato, S., Okuse, K., and Fusayama, T.: The effect of burnishing on the marginal seal of agalgam restorations. J. Prosth. Dent. 19: 393–398, 1968.
5) Phillips, R. W.: Research on dental amalgam and its application in practice. J. Am. Dent. Assoc. 54: 309–318, 1957.
6) Von Kreudenstein, T. S.: Teeth filled with agalgam and cement: Conditions of junction tested with ^{32}P. Int. Dent. J. 8: 326–348, 1958.
7) Phillips, R. W., Gilmore, H. W., Swartz, M. L., and Schenker, S. I.: Adaptation of restorations in vivo as assessed by ^{45}Ca. J. Am. Dent. Assoc. 62: 9–20, 1961.
8) Takatsu, T., Ikeda, T., Higashi, C., and Yamada, T.: Accumulation between amalgam and tooth substance. Nippon Shika Zairyo Kikai Gakkai Zasshi Appl. 33: 284–289, 1976.