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A three-year clinical study of high copper amalgams in primary teeth

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Abstract

Over 300 restorations of four high copper amalgams — Dispersalloy, Tytin, Optaloy II, and Aristaloy CR — were placed in posterior primary teeth by one operator in his private practice. After three years the restorations were photographed and evaluated for marginal breakdown. Two evaluators categorized and ranked the restorations to determine rate of failure and difference in materials. The results indicate that Dispersalloy and Tytin had the least amount of failure at the margins and were superior to Optaloy II and Aristaloy CR. These results correlate with other clinical studies on permanent teeth.

Introduction

The most common failure of the amalgam restoration is fracture at the cavosurface margin.[1] During the past decade extensive research has related marginal failure to several factors and quantified the rate at which it occurs. Failure at the margins has been directly related to the longevity of the amalgam restoration and its replacement time in the office.[2,3] A number of clinical projects have demonstrated a relationship between rate of fracture at the margins and the alloy selected,[1,3-8] trituration time,[9] oral hygiene,[7] and cavity design.[8]

In addition, one of the most dramatic changes in restorative materials has been in the development of the high copper alloys. Development of these higher copper content alloys was accelerated by the classic work of Mahler and cohorts.[1] They demonstrated a relationship between less marginal fracture and a lowering of the mechanical property creep. The use of the creep test aided manufacturers in developing new alloy systems which in general gave better clinical results.[5-7]

In primary teeth, MacRea[10] showed that the first primary molar had the most fracture, and that the buccal margins on the occlusal were the most susceptible to this failure. Mathewson[11] showed that selection of the alloy can also affect the marginal failure rate in primary teeth, but that placement of retentive grooves did not.

Most clinical research on amalgam has been conducted in permanent teeth at dental institutions. In primary teeth most work was done when the old traditional alloys were used. Therefore it would seem to be appropriate to conduct a clinical study from a different point of view.

The purpose of this study was to determine the fracture rate at the margins of amalgams in primary teeth in a private practice setting.

Methods and Materials

Four alloys — Dispersalloy, Tytin, Optaloy II, and Aristaloy CR — were placed by one operator in his private practice of pediatric dentistry in Sioux Falls, South Dakota. Manufacturer, batch number, trituration time, mercury content, and copper content for each amalgam alloy are listed in Table 1.

Patients were selected that had one and two surface lesions in multiple primary teeth. The rubber dam was utilized throughout the operative procedures. Alloys were selected for placement on a random basis. Dycal was placed in deep restorations and a copal varnish applied to all walls. The restorations were condensed by hand and carved by conventional methods. After the alloys had attained their initial set of three to five minutes, they were burnished to smooth the restoration.

At the three-year periodic recall of patients, color photographs were taken of 300 restorations 1½ X magnification with a Medical Nikor lens. After the photographs of the restorations were accumulated, they were evaluated for marginal breakdown by two evaluators. These evaluators were at different loca-

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Table 1. Manufacturer, batch number, Hg content, trituration time, and Cu content of the alloys placed in the clinic.

Alloy	Manufacturer	Batch #	Trituration*	Hg %	Cu %
Dispersalloy	Johnson & Johnson Dental Products East Windsor, NY 08520	7L058	14 seconds	50.0	12.0
Tytin	The S. S. White Dental Mfg. Co. Philadelphia, PA 19102	7027706	2 seconds	43.5	13.0
OptaloyII	The L. D. Caulk Co. Milford, DE 19963	050777	16 seconds	54.5	9.0
Aristaloy CR	Baker Dental Carteret, NJ 07008	051876-3	12 seconds	50.0	13.0

* Caulk Vari-Mix, M-2 setting.

tions during the evaluation process. Both evaluators categorized the restorations into five groups of increasing failure at the margins as described by Mahler.[1] The second evaluator also ranked the restorations from best to worst. After the independent evaluations, appropriate statistical tests were applied to determine the amount of fracture at the margins and difference between materials. A ridit analysis and Chi square test were performed on the categorized data. A Kruskal-Wallis analysis of variance was applied to the rank order data.

Results

The data for the ridit analysis, Chi square test, and rank ordering of the alloys is summarized in Table 2. The results can be interpreted as follows:

1. Dispersalloy and Tytin had the lowest ridit means, indicating the least fracture at the margins of the restorations, but they were not statistically different from each other;
2. Optaloy II and Aristaloy CR had the highest ridit means, indicating the greatest marginal breakdown rate, but they also were not different from each other;
3. Dispersalloy and Tytin were superior to Optaloy II and Aristaloy CR ($p<.01$) with regard to marginal fracture.

The percentage of breakdown of the various categories for each alloy is given in Table 3. Category #1 has little or no fracture at the margins and #5 has a great deal of breakdown. Dispersalloy and Tytin had 31% and 25% respectively in the first category, whereas Optaloy II and Aristaloy CR had 3.5% and 9% respectively in the excellent group. Only Aristaloy CR has restorations in the poorest (#5) category. This demonstrates the similarity of Dispersalloy and Tytin and the similarity of Optaloy II and Aristaloy CR, but it also shows the discrepancy between the two groups.

Discussion

There are four points that should be made in regard to this research project. First, the clinical results indicate a wide difference in the fracture rate at the margins of primary teeth with different high copper alloys. Not surprisingly the same relative performance of these alloys has been shown in studies on permanent teeth.[5,6] It is probable that the same factors either

Table 2. Ridit Means, Chi square, and rank ordering tests.

Rank ordering ($p\leq.01$)		Ridit Means	Chi Square ($p\leq.01$)
[	Dispersalloy	.3678	]
[	Tytin	.4129	]
[	Optaloy II	.6173	]
[	Aristaloy CR	.6197	]

lower ridit = less fracture at margins
[= no significant difference

Table 3. Percentage distribution of restorations in ridit categories.

Ridit Categories	Dispersalloy	Tytin	Optaloy II	Aristaloy CR
1	31.0%	25.0%	3.5%	9.0%
2	59.0%	58.0%	61.0%	52.0%
3	9.0%	15.0%	32.0%	32.0%
4	1.0%	2.0%	3.5%	6.0%
5	0.0%	0.0%	0.0%	1.0%

reducing or accelerating the rate of fracture at the margin is similar in both children and adults.

Two of the alloys in this project are made off the identical patents and therefore have the same composition. But, interestingly, they do not have the same rate of fracture at the margins. The poorer performance of Aristaloy CR is probably due to the higher mercury content (50% vs. 43.5%) of the material. This points out the sensitivity of certain manipulative variables in some alloy systems.

In primary teeth we do not need a restoration that will last the lifetime of the patient, as the ideal restoration would in a permanent tooth. What is needed is a restoration that lasts the lifetime of the *tooth.* Therefore, from a cost-effectiveness standpoint, one should select a material that will last six to eight years maximum. It is obvious that a great deal of work needs to be done in this area. The newer low-cost "low silver" amalgams may be a choice or, as reported,[12] the composite resin may be effective. In any case, these options and others should be evaluated in the pedodontic situation.

Fourth, but not least, it is important to note that the clinical procedures and portions of the evaluation of this project were performed in the environment of a private practice. The purpose in reemphasizing this is to encourage other private practitioners to conduct clinical studies. This can be done without severely interrupting the daily routine of the office. Once the restorations have been placed, photographs or impressions (or whatever evaluation is used) can be taken at any recall period. One method of evaluation could be to project pictures before a study club and obtain an evaluation by the group. Assistance for statistics and interpretation of the data can be obtained from a variety of sources. Most local colleges have a statistician on the faculty.

Conclusion

After three years of clinical service, 300 restorations of four high copper amalgam alloys were evaluated for fracture at the margins in a private practice setting. Results indicate that Dispersalloy and Tytin were not different from one another but that they were superior to Optaloy II and Aristaloy CR.

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References

1. Mahler, D. B., Terkla, L. G. and Van Eysden, J.: Marginal fracture of amalgam restorations, *J Dent Res,* 52:823, 1973.
2. Goldberg, J., Tanzer, J., Manster, E., Amara, J. and Birkhead, D.: Clinical association of recurrent caries with marginal integrity and oral hygiene, *J Dent Res,* 59: Special Issue A, Abstract #283, 1979.
3. Osborne, J. W., Binon, P. P. and Gale, E. N.: Dental amalgam: clinical behavior up to eight years, *J Oper Dent,* 5:24, Winter 1980, p 4.
4. Mahler, D. B., Van Eysden, J. and Terkla, L. G.: Relationship of creep to marginal fracture of amalgam, *J Dent Res,* 54: Special Issue, Abstract #553, 1975.
5. Leinfelder, K. F., Strickland, W. D., Sockwell, L. and Eames, W. B.: Two-year clinical evaluation of high copper content amalgams, *J Dent Res,* 58: Special Issue A, Abstract #425, 1979.
6. Osborne, J. W., Gale, E. N., Chen, C. H., Rhodes, B. B. and Phillips, R. W.: Clinical performance and physical properties of twelve amalgam alloys, *J Dent Res,* 57:983, 1978.
7. Letzel, A., Aardening, C. J. M. W., Fick, J. M., Van Heusen, J. and Vrijhoff, M. M. A.: Tarnish, corrosion, marginal fracture and creep of amalgam restorations: a two-year clinical study, *J Oper Dent,* 3:82, 1978.
8. Berry, T. G., Laswell, H. R. and Osborne, J. W.: A comparison of restoration margin integrity with restoration dimension, *J Dent Res,* 59: Special Issue A, Abstract #451, 1979.
9. Cochran, M. A., Osborne, J. W., Winchell, P. G., Gale, E. N. and Phillips R. W.: Clinical performance, creep and microstructure in a gamma-2 containing amalgam, *J Dent Res,* Special Issue A, Abstract #198, 1978.
10. MacRae, P. D., Zacherl, W. and Castaldi, C. R.: A study of defective class II dental amalgam restorations in deciduous molars, *Can Dent Assoc J,* 28:491, 1962.
11. Mathewson, R. J., Retzlaff, A. E. and Porter, D. R.: Marginal failure of amalgam in deciduous teeth: a two-year report, *J Am Dent Assoc,* Jan., 1974.
12. Nelson, G. V., Osborne, J. W., Gale, E. N., Norman, R. D. and Phillips, R. W.: A clinical comparison of amalgam and composites in posterior primary teeth over three years, *JDC* (In Press), Nov-Dec, 1980.