When alginates were hand mixed, one product appeared to give better results than the other three alginates studied. In addition, two different mechanical devices were used to prepare one of the alginate impression materials, and one method was shown to be superior to either hand mixing or the other device method.

Comparative study of selected alginate materials and devices

Roy E. Koski, DMD, San Francisco

Four different brands of alginate impression materials were mixed by hand and ten impressions of each were made of a block for detail reproduction. In addition, two different mechanical devices were used to prepare one of these alginate impression materials. Thus a total of six groups was tested, with ten impressions per group. Stone casts of these 60 impressions were compared by the line study method and the number of surface defects.

A statistical analysis was performed on the collected data. The results indicated that the Whip-Mix vacuum mechanical spatulator produced significantly superior results to the Columbus system centrifugal mechanical spatulator, and that among the four alginates hand mixed, the Jeltrate impression material gave better results.

A source of discrepancy in crowns, bridges, and removable prostheses is the inaccuracy of the opposing casts. Recently, several new alginate products and a centrifugal mixing machine have appeared on the market. The casts produced from these are of indeterminate accuracy, and this vagueness in itself invites inaccuracy and unexpected problems for the dentist. Exactness requires a determination of the device, or of the impression material, or both, that will most consistently provide the most accurate casts.

A review of dental literature reveals that the number of comparative studies of alginate materials is meager. (A paper by Morrow and coworkers[1] is comprehensive in its review of alginate materials and dental stones using mechanical spatulation as the method of mixing. However, this does allow for further testing and evaluation of alginate materials and the various automatic mixing devices.)

The goal of this project was to test the Columbus system mechanical spatulator. To evaluate this device, four selected alginate impression materials and another automatic mixing device were studied in the laboratory. (Paffenbarger and Rupp[2] have said that dental materials must first be characterized in the laboratory and then clinically.) The primary objective was to demonstrate differences in stone casts when an algin-

ate material was mixed by the different methods. An acceptable dental stone was used to obtain stone casts from all impressions to achieve standardization. The final conclusions were reached only after all casts had been rated with regard to accuracy of detail reproduction and surface porosity.

Methods and materials

Four brands of alginate materials were selected for the study: Surgident,* Kerr Alginate,† Jeltrate,‡ and Columbus Alginate.§ These alginates were hand mixed. Dental stone§ was used to pour all alginate impressions for the stone casts. Whip-Mix¶ and Columbus system§ mechanical spatulators were used for mixing the Columbus alginate. A 2% solution of potassium sulfate was used to fix the alginate impressions. Distilled water at room temperature was incorporated into the measures of alginate and stone. A 20-power dissecting microscope served in the evaluation and scoring of the stone casts.

■ *Pretesting procedures:* Columbus dental stone was pretested according to ADA Specification No. 18.[3] The gypsum, when tested against the block for detail reproduction, reproduced the 0.050-mm wide line as required.

To determine the surface quality of the stone casts, test alginate impressions of the block for detail reproduction were poured in stone as prescribed in ADA Specification No. 18. Test alginate impressions also were taken of the block for detail reproduction and fixed in the 2% potassium sulfate solution before being poured in stone. The pilot study demonstrated that the fixed impressions result in stone casts of superior quality. (In a study by Harris,[4] and again in a study of Civjan and co-workers,[5] it was recommended that alginate impressions be immersed in a 2% aqueous solution of potassium sulfate for surface stabilization.)

■ *Controlling variables:* Alginate impression materials for the various samples were preweighed and packaged as suggested by Rudd and Morrow.[6] Distilled water that was used for mixing both the alginates and the dental stone was kept at a constant 21 C.[4] The dental stone selected for the study also was preweighed and prepackaged for each mix. Identical hand spatulation techniques were used for the four alginates. In addition, two machines for automatic mechanical spatulation were used on one of the alginates. All alginate impressions were allowed to set fifteen minutes before separation from the block for detail reproduction. Afterward, the alginate impressions were bathed in a 2% aqueous solution of potassium sulfate for six minutes.

■ *Methods used:* The impressions were made by placing a metal ring (3 cm at inside diameter and 16 mm in height) on the block for detail reproduction, so that the crossline and the 0.025-mm wide line of the block were centered within the ring (Fig 1). The block was lightly dusted with talcum. Once positioned, the mixed alginate was carried to the ring. The ring was slightly overfilled, and a flat plate was placed on top of the ring, compressing the material and expelling the excess. After 15 minutes, the ring (with the alginate) was separated from the block, bathed in the 2% potassium sulfate solution for six minutes, and then gently hand shaken to remove the excess solution. The dental stone was mixed, gently vibrated, and poured against the impression. The poured impression was then placed into an air bath of 23±2 C, with 100% relative humidity, for 30 minutes. At this time the specimens were coded. With the use of the Whip-Mix device, the Columbus alginate was mechanically spatulated at 20 to 28 lb of vacuum for five sec-

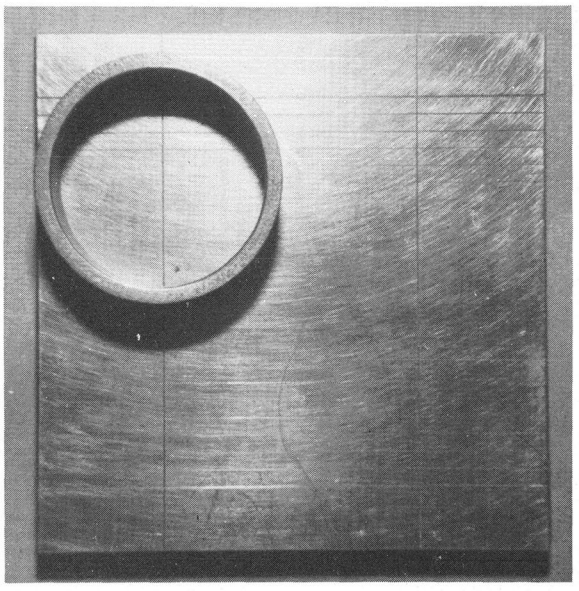

Fig 1 ■ Stainless steel test block referred to as block for detail reproduction, and metal ring that meets the ADA Specification No. 18. Metal ring was positioned on block for detail reproduction so that intersection of crossline and 0.025-mm wide line was in center of ring.

Table ■ A summary of the experimental design.

Group	Impression material	Mixing technique: Alginate	Mixing technique: Stone
1	Surgident (Lactona)	Hand	Hand
2	Alginate (Kerr)	Hand	Hand
3	Jeltrate (Caulk)	Hand	Hand
4	Alginate (Columbus)	Hand	Hand
5	Alginate (Columbus)	Whip-Mix machine	Whip-Mix machine
6	Alginate (Columbus)	Columbus system	Columbus system

onds and the stone was mixed under the same vacuum with the same device for ten seconds. With the use of the Columbus device, another batch of the Columbus alginate was mechanically spatulated for 20 seconds and the stone mixed with the same device for ten seconds. A summary of the experimental design is shown (Table).

Data collection

■ *Line study measurements:* The gypsum casts were inspected under low-angle illumination with a 20-power dissecting microscope, for a critical evaluation of the reproducibility of the various scaled lines.

The reproduction of the 0.075-mm wide line was judged by the same criterion as that used for the 0.025-mm wide line, as advanced by Morrow and co-workers.[1]

The casts were scored on the basis of 1 to 4. A score of 1 was given if a well-defined, sharp 0.025-mm wide line was reproduced across the width of the cast. A score of 2 was given if the 0.025-mm wide line was reproduced across the width of the cast, but with some loss of sharpness. A score of 3 was given if a loss of continuity occurred in the 0.025-mm wide line. A score of 4 was given if the cast failed to reproduce the 0.025-mm wide line.

All ten specimens in each group were rated by two-way mixed model analysis of variance (raters times groups). Pairwide comparisons between groups were made using the Scheffé test.

■ *Stone surface detail observation:* The stone casts were studied through the dissecting microscope at 20-power for a total count of the number of surface defects within a 5-mm square area (Fig 3). For the line and surface detail studies, the casts were observed in chance order and without knowledge of the method of preparation.

The 0.025 line ratings, 0.075 line ratings, and counts of surface defects were analyzed by a two-way mixed model analysis of variance (raters times groups).

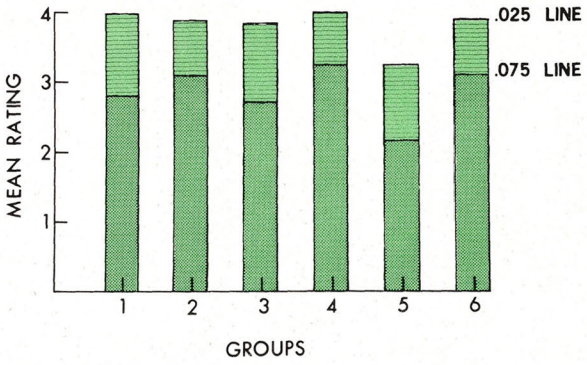

Fig 2 ■ Mean line score ratings of 0.025- and 0.075-mm lines, by group.

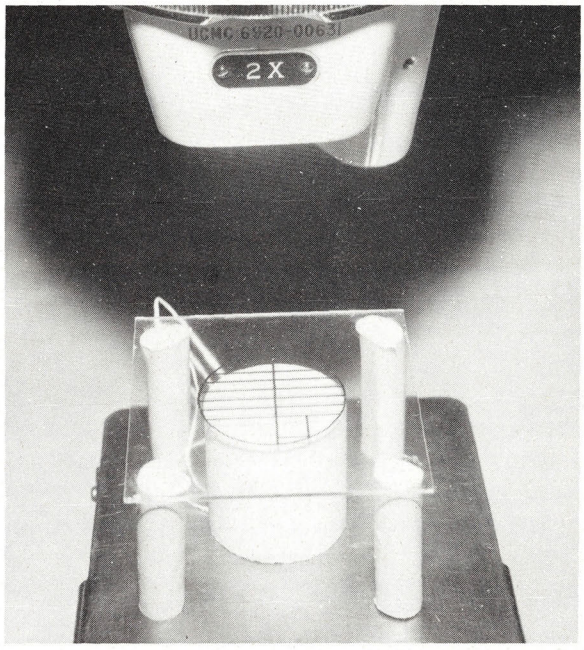

Fig 3 ■ View of method used for surface detail observation. Note glass scoring grid with 5-mm square area used for counting number of surface defects.

Results

■ *Line study:* At the 0.025-mm wide level, comparison of the hand-mixed groups showed no significant differences ($P>.05$). Comparisons of the alginates mechanically mixed showed that Columbus alginate mixed with the Whip-Mix device (group 5) was significantly better than either Columbus alginate mixed by hand (group 4) or Columbus alginate mixed by the Columbus

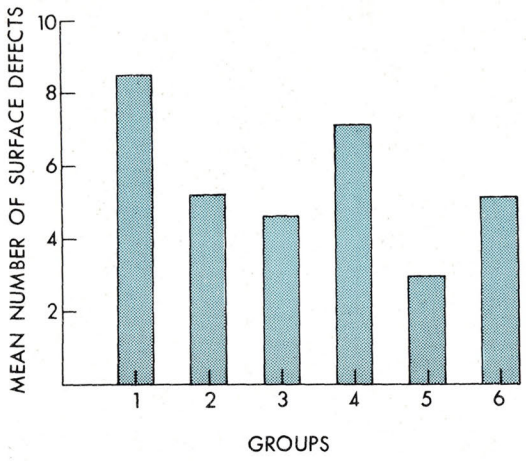

Fig 4 ■ Mean number of surface defects counted, by group.

device (group 6). ($P<.001$ in each instance.)

At the 0.075-mm wide level, comparison of the hand-mixed groups did show variation, but still no significant differences. For the mechanically mixed groups, Columbus alginate mixed by the Whip-Mix device (group 5) was significantly better than Columbus alginate mixed by the Columbus device (group 6). ($P<.01$ in each instance).

■ *Stone surface detail study:* The average number of the defects for the specimens within each group were compiled and plotted. Columbus alginate mixed with the Whip-Mix device (group 5) had the lowest mean number of surface defects (Fig 4).

Discussion

Each cast underwent three inspections within the scope of this study: a 0.025-mm line rating, a 0.075-mm line rating, and surface defects.

At the 0.025-mm wide line ratings, comparison of the hand-mixed groups of Surgident, Kerr Alginate, Jeltrate, and Columbus Alginate (groups 1 to 4) showed no significant difference. Comparisons of the Columbus alginate groups mixed by hand, by the Whip-Mix device, and by the Columbus device (groups 4 to 6) showed that the Columbus alginate mixed with the Whip-Mix device (group 5) had significantly better ratings.

At the 0.075-mm wide line ratings, the significant differences found between groups were the same as those reached in the more difficult 0.025-mm ratings. Thus, the data remained consistent throughout the study.

The surface defect comparisons of the hand-mixed groups of Surgident, Kerr Alginate, Jeltrate, and Columbus Alginate (groups 1 to 4) showed Kerr Alginate (group 2) and Jeltrate (group 3) significantly better for the category, and within the experimental range of the Columbus Alginate mixed by the Columbus device (group 6). Comparison of the groups using Columbus alginates showed the Whip-Mix device superior (group 5)—statistically better than hand mixing (group 4) or the Columbus device (group 6), and the best of the total study.

Conclusions

The Columbus system mechanical spatulator was not shown to be more accurate. Using the Columbus alginate, the Whip-Mix method was shown to be superior to either the hand-mix method or the Columbus device method.

Among the four selected alginates, using hand mixing for all, Jeltrate (group 3) produced the best results.

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Dr. Koski is assistant clinical professor of operative dentistry at the University of California School of Dentistry in San Francisco, and is in private practice at 2281 Chestnut St, San Francisco, 94123.

*Lactona-Surgident Corp., Morris Plains, NJ 07950.
†Kerr Mfg. Co., Romulus, Mich 48174.
‡L. D. Caulk Co., Milford, Del 19963.
§Columbus Dental Co., Columbus, Ohio 43206.
¶Whip-Mix Corp., Louisville, 40217.

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