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THE INFLUENCE OF TRITURATION TIME ON THE CRUSHING STRENGTH OF SILVER AMALGAM

by

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According to investigations, the results of which are available in literature, prolonged trituration of silver amalgam may under certain conditions produce a higher crushing strength in the finished amalgam (*Ward & Scott,* 1932, *Taylor et al.,* 1949, *Ware & Docking,* 1955). For a further study of the effect of trituration time on the crushing strength of the amalgam, a series of tests were performed, covered by the following report.

PROCEDURE

The tests comprised alloy of 7 different brands and one brand of copper amalgam (Table I). The alloy and mercury were weighed in the ratios prescribed by the manufacturers. For the trituration was employed a "Wig-L-Bug"® amalgamator (The Crescent Dental Mfg. Co., U.S.A.), and the capsule and pestle used were of bakelite. The trituration was timed, varying from the minimum just sufficient to secure cohesion to extensive over-trituration. Ten tests were performed on each brand at each time limit. Following the trituration the amalgam was placed in a steel cylinder, 5 mm internal diameter, provided with a piston of adequate dimensions. In this mould the amalgam was condensed for three minutes by means of an Alpha Durometer at

Table I

List of Alloys Tested

No.	Brand	Manufacturer
1	True Dentalloy®	S. S. White Dental Mfg. Co. (G. B.)
2	New True Dentalloy®	S. S. White Dental Mfg. Co. (G. B.)
3	Zinc-free True Dentalloy®	S. S. White Dental Mfg. Co. (G. B.)
4	Standard®	A. B. Svenska Dental Instrument
5	Argos®	A. B. Svenska Dental Instrument
6	Globe Copper Amalgam®	The Amalgamated Dental Co. Ltd.
7	STA 68®	Guldsmeds Aktiebolaget i Stockholm G. A. B.
8	Solila Alloy®	The Amalgamated Dental Co. Ltd. (licence from de Trey frères S. A., Zürich)

pressures of 0.8 and 1.5 kg/mm², respectively*). One minute after condensation the specimens were removed from the cylinder. The quantity of alloy and mercury used was gauged with a view to producing specimens about 10 mm in length.

The specimens were kept at room temperature for 3 days and 30 days, respectively, and were then crushed in a Losenhausen compressive strength testing machine at a rate of loading of 5 kg/sec.

RESULTS

The results are presented in Tables II, III, and IV and in Figures 1 and 2. From Tables II and III it will be observed that the

*) For a further description of mould and durometer reference is made to *Knud Dreyer Jørgensen, Karen Holst & Ole P. Palbøl:* "Mercury content of silver amalgam, influence of time between completion of the mix and start of condensation." Published in Acta Odontologica Scandinavica 1964: 22, 207—214.

Table II

Crushing Strength (kg/cm²) of Brands 1, 3, and 4 as related to Time of Trituration

Condensation pressure: 0.8 kg/mm². Specimens crushed after 3 days.

	Brand Nos.		
Trituration Time in Seconds	1	3	4
2		2273 ± 366	
4	1251 ± 220		
5		2707 ± 148	
6			1118 ± 157
7	1840 ± 190		
10	2167 ± 368		
12			1893 ± 294
15	2985 ± 203	3205 ± 113	2487 ± 182
20	3212 ± 144	3426 ± 90	2763 ± 111
30	3269 ± 151		
50	3525 ± 237	3593 ± 92	3421 ± 232

crushing strength of all brands of silver amalgam after 3 days shows a heavy increase when the time of trituration is prolonged, while, as far as the copper amalgam is concerned, there is no apparent relationship between trituration time and crushing strength. In all cases of short-time trituration even a slight prolongation of the time factor will produce a marked improvement in crushing strength. At a comparatively long time of trituration a slight prolongation will, on the other hand, result in an increase of the crushing strength of only small significance. The rate of interdependence between trituration time and crushing

Table III

Crushing Strength (kg/cm²) of Brands 1, 2, 3, 4, 5, and 6 as related to Time of Trituration

Condensation pressure: 1.5 kg/mm². Specimens crushed after 3 days.

	Brand Nos.					
Trituration Time in Sec.	1	2	3	4	5	6
2			2717 ± 153			1559 ± 211
4	2690 ± 157	3644 ± 62				
5			3062 ± 94		2953 ± 107	1823 ± 240
6				2423 ± 243		
7	3199 ± 161					
10	3322 ± 129	3912 ± 77			3095 ± 215	
12				2933 ± 122		
15	3764 ± 96	4007 ± 93	3412 ± 123	3021 ± 170	3466 ± 88	2198 ± 337
20	3870 ± 91		3505 ± 61	3212 ± 95	3546 ± 103	1675 ± 322
30	4004 ± 72	4202 ± 75	3661 ± 86	3772 ± 91	3692 ± 47	1689 ± 285
50	4331 ± 123	4399 ± 75	3767 ± 119	3843 ± 134	3753 ± 115	1901 ± 374

Table IV

Crushing Strength (kg/cm²) of Brands 1, 3, 4, 6, 7, and 8 as related to Time of Trituration

Condensation pressure: 1.5 kg/mm². Specimens crushed after 30 days.

	Brand Nos.					
Trituration Time in Sec.	1	3	4	6	7	8
5		3326 ± 122		1715 ± 240		
8	3590 ± 87					
12			3241 ± 85		3738 ± 324	
17						2900 ± 95
50	4327 ± 129	4054 ± 158	4134 ± 82	1898 ± 225	4180 ± 86	3925 ± 82

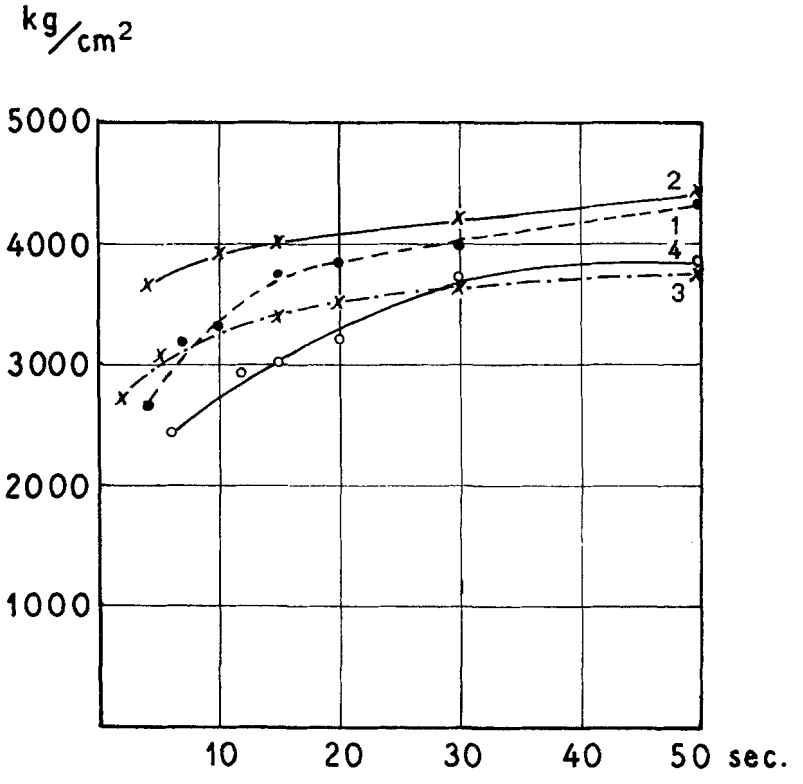

Fig. 1. Crushing strength of brands 1, 2, 3, and 4 as related to the time of trituration (Condensation pressure: 1.5 kg/mm²).

strength varies according to brand, so that one alloy which in short-time trituration shows a lower crushing strength than another brand may show a higher crushing strength than the latter brand when the time of trituration is increased. The results seem to indicate that the time of trituration has a greater effect on the crushing strength of amalgams when a coarse grain alloy is employed than when it is the question of one of a finer grain.

The crushing strength values after 30 days (Table IV) were also considerably higher at a trituration time of 50 seconds than when the amalgam was triturated in 5—17 seconds.

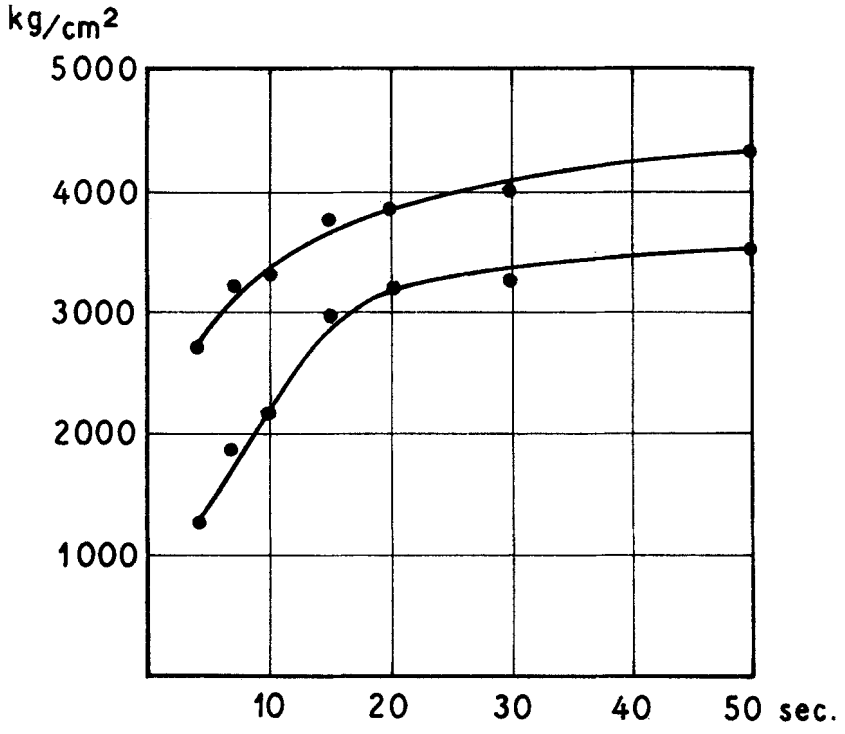

Fig. 2. Crushing strength of brand No. 1 as related to the time of trituration. The amalgam has been condensed at pressures of 0.8 kg/mm² (lower curve) and 1.5 kg/mm² (upper curve), respectively.

CONCLUSION

It seems to be a well established fact that the crushing strength of silver amalgam depends on the time of trituration, viz., that prolonged trituration produces a greater crushing strength. In all cases of trituration for 30 seconds or more in the amalgamator used for the tests, any increase beyond the mentioned time limit has produced only a slight increase in the crushing strength. When paying consideration to the crushing strength alone a trituration time of about 30 seconds would, therefore, seem desirable.

SUMMARY

An investigation of the relationship between trituration time and the crushing strength of amalgams is reported. The results

appear from Tables II, III, and IV, and from Figures 1 and 2. A definite relationship between trituration time and crushing strength was found in all the silver amalgams examined. This was found both in specimens crushed 3 days and 30 days after the preparation.

Addendum

After this manuscript was finished, a study was published in The Journal of the American Dental Association (Vol. *67*, pp. 670—678, 1963) by *H. J. Caul, R. Longton, W. T. Sweeney & G. C. Paffenbarger,* entitled: "Effect of rate of loading, time of trituration and test temperature on compressive strength values of dental amalgam". The results of this work are in perfect agreement with those of the present report.

RÉSUMÉ

DURÉE DE LA TRITURATION ET LA RÉSISTANCE À L'ÉCRASEMENT DES AMALGAMES D'ARGENT

Cet article rend compte d'une étude sur les rapports entre la durée de la trituration et la résistance à l'écrasement des amalgames. Les résultats ressortent des tableaux II, III et IV, et des figures 1 et 2. Une relation certaine entre la durée de la trituration et la résistance à l'écrasement a été trouvée dans tous les amalgames d'argent examinés. Ceci est vrai tant pour les échantillons écrasés 3 jours après la préparation que pour ceux écrasés 30 jours après la préparation.

ZUSAMMENFASSUNG

DER EINFLUSS DER ANRÜHRDAUER AUF DIE BRUCHFESTIGKEIT VON SILBERAMALGAM

Es wird über eine Untersuchung des Verhältnisses zwischen der Dauer des Anrührens von Silberamalgam und der Bruchfestigkeit des fertigen Amalgams berichtet. Die Ergebnisse sind aus Tabelle II, III und IV und aus den Kurven in Abb. 1 und 2 ersichtlich. Zwischen der Anrührdauer und der Bruchfestigkeit sämtlicher untersuchten Silberamalgame ergab sich bei der Prüfung sowohl 3 Tage nach der Herstellung wie auch 30 Tage nach der Herstellung eine positive Beziehung.

REFERENCES

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