

https://dspace.org/

# The effects of two chelating agents on smear layer removal from cavity preparations: An in vivo study

**Jodaikin, A.; Austin, J. C.; Vieira, E.**

**1981**

http://hdl.handle.net/10539/19663

Downloaded from a DSpace repository. https://dspace.org/

Journal of the Dental Association of South Africa, **36**, 615 - 617

# The effects of two chelating agents on smear layer removal from cavity preparations: An *in vivo* study.

A Jodaikin* J C Austin** and E Vieira**

* Department of Conservative Dentistry, University of the Witwatersrand.
** MRC/University of the Witwatersrand Dental Research Institute, 1, Jan Smuts Avenue, Johannesburg 2001

*Keywords: Chelating agents*

## SUMMARY

*The effects of a 17 per cent disodium EDTA commercially prepared agent, REDTA®, a 0,2 per cent disodium EDTA commercially prepared agent Tubulicid® blue label and a distilled water control on cavity smear layer removal were determined in experimental cavities. The results of this study suggest that the 17 per cent disodium EDTA solution has the potential to perform well as a smear layer removing agent without the need for mechanical agitation or surface scrubbing.*

## OPSOMMING

*Die geskiktheid van kommersieelvoorbereide 17 persent tinatrium EDTA, REDTA®, en 2 persent tinatrium EDTA (Tubulicid® blue label) om smeerlae in eksperimentele kaviteite te verwyder, is getoets. Gedistileerde water is as kontrole gebruik. Die resultate van die studie toon dat die 17 persent tinatrium EDTA oplossing smeerlae doeltreffend kan verwyder, sonder dat dit die kaviteitsvlakke hardhandig daarmee afgevryf hoef te word.*

## INTRODUCTION

Extensive research efforts are currently being directed towards the development of genuinely adhesive dental materials, the advent of which should initiate a new era in dental practice (Phillips, 1967 and Retief, 1973). Various factors which may affect the performance of a truly adhesive restorative material are also being studied in detail. One of these is the deposition of debris on cavity walls and floors in the form of a smear layer during cavity preparation (Figure 1). This smear layer will almost certainly interfere with adhesion (Retief, 1973).

Jodaikin and Austin (in press) have shown that a commercially prepared 17 per cent disodium EDTA chelating cleansing agent* performed well as a smear layer remover on experimentally prepared cavities in newly extracted teeth, whilst another commercial 0,2 per cent disodium EDTA cleansing agent** showed disappointing results. Brännström, Nordenvall and Glantz (1980), however, showed that an experimental solution identical to the Tubulicid®** blue label removed most of the smear layer from ground dentine surfaces on vital teeth.

The different results obtained in the two studies may be

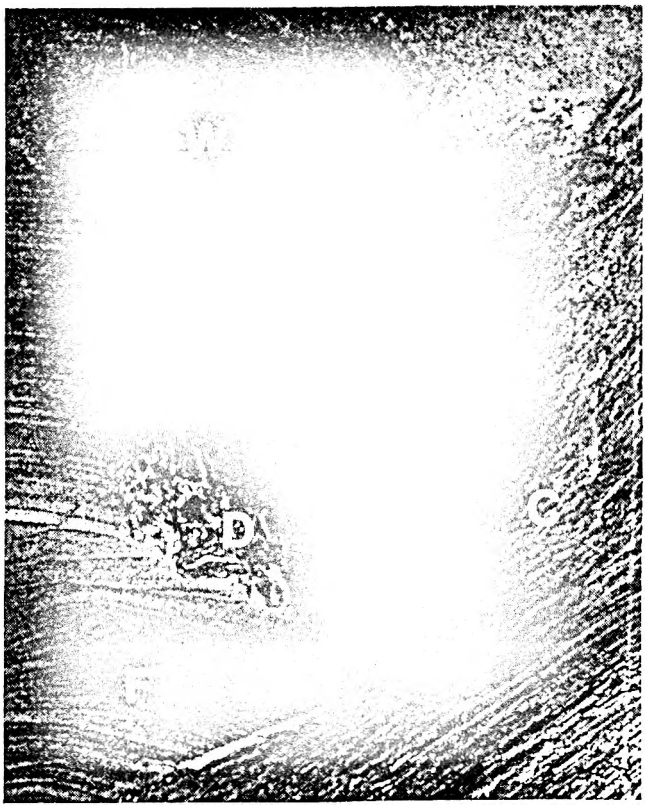


*Fig. 1.* A cross-sectional fracture (C) through a vervet monkey tooth with a cavity preparation. The cavity wall (W) and floor (F) surfaces are covered with a smear layer. Loose debris (D) is also visible at the junction of the cavity wall and floor (X 75).

* REDTA® — Disodium ethylene diamine tetra acetate (EDTA) 17gm, cetyl trimethyl ammonium bromide 0,84gm, 5N sodium hydroxide solution, 9,25ml and distilled water 100ml. Roth Drug Co. Chicago, Illinois, U.S.A.

** Tubulicid® (blue label) Amphoteric — 2; 0,3g; Benzalkon Chloride 0,1g; Disodium edetate dehydrate 0,2g; Phosphate buffer soln. ad pH 7,3 aqua dest. ad 100g. Dental Therapeutics AB, Nacka 1, Sweden.

model, tooth vitality or the differences in the method of due to either the difference in smear layer formation related to the method of dentine exposure, the animal application of the smear layer removing agent.

The purpose of this study was to determine the effects of a 17 per cent disodium EDTA commercially prepared agent, REDTA®, a 0,2 per cent disodium EDTA commercially prepared agent, Tubulicid® blue label and a distilled water control on cavity smear layer removal in experimental cavities prepared in monkey teeth.

## METHOD AND MATERIALS

REDTA®, Tubulicid® blue label and a distilled water control were placed in brown glass bottles and coded for use in this study. Anaesthetised vervet monkeys, which were to be nephrectomized to provide tissue for the production of poliomyelitis vaccine were then made available for the study. Cervical grooves were cut on the proximal and labial surfaces of 30 caries free incisor teeth in order to facilitate the recovery of crown specimens by cervical fracture. The oral cavities of the monkeys were thoroughly rinsed with water to remove loose cutting debris, saliva and blood. Experimental cavities were then cut with a 1158*** dome ended straight fissure tungsten carbide friction grip bur on the labial surfaces of the selected teeth. After preparation the cavities were thoroughly rinsed and dried with short blasts of air using a syringe. Each of the coded solutions was then randomly applied with a saturated sponge pellet to 10 cavities. The pellets were packed in the cavity and left in place for 60 seconds. Thereafter, they were removed and the cavities rinsed for 30 seconds with a water spray. The crowns were then, in turn, fractured through the pre-cut cervical grooves and fixed by immersion in a 10 per cent neutral buffered formol saline. The specimens were then dehydrated in a graded series of alcohols and dried using the critical point method. The teeth were mounted on aluminium stubs with colloidal graphite suspension and finally coated with gold palladium. The cavities were then examined with a scanning electron microscope by a single examiner.

Electronmicrographs of representative surfaces of the dentine walls were recorded at a standard of magnification of 1000X. Six of the specimens had to be discarded because of damage arising from the crown fracture method of specimen retrieval.

The smear layer removal for dentine cavity wall surfaces was evaluated and scored by two independent examiners using a previously described scoring system (Jodaikin and Austin, in press). Fig 2 is an example of a zero score, Fig 3 an example of a score of one, Fig 4 an example of a score of two and Fig 5 an example of a score of three. Scores of less than two were considered to reflect inadequate removal of the smear layer.

After each of the specimens subjected to the control or experimental treatments had been scored, they were identified. The degree of smear layer removal recorded by the two examiners was tabulated and the mean score was calculated for each experimental treatment of the



*Fig. 2.* A cavity dentine wall surface where no smear layer removal has occurred after having been treated with the distilled water control solution. The smear layer completely obscures the underlying cut dentinal tubules (X1000)

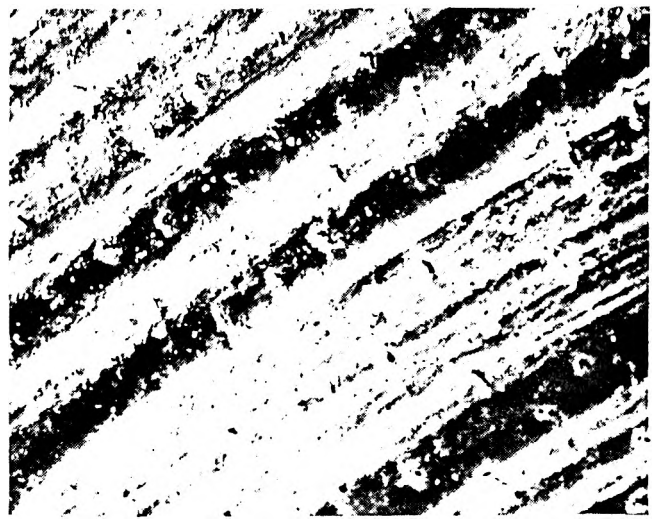


*Fig. 3.* A cavity dentine wall surface which was treated with Tubulicid® blue label (0,2 per cent disodium EDTA). Thinning of the smear layer enabled the position of some of the dentinal tubules to be detected under the remaining thin smear layer (X1000).



*Fig. 4.* The cut ends of most of the dentinal tubules are clearly visible whereas the intertubular dentine has not been etched. This dentine cavity surface was treated with REDTA® (17 per cent disodium EDTA) (X1000).

*** S.S. White Ltd. Harrow., Middlesex, HA1 1LR, England.

dentine surfaces. Before the data was evaluated the sign test was used to test for inter-examiner differences in the scoring of smear layer removal carried out by the two evaluators. No significant inter-examiner difference was found.

## RESULTS

The mean smear layer removal scores of the examiners' pooled data was recorded as shown in Table 1, together with the percentage of specimens in which smear layer removal scores greater than one were obtained. The distilled water control did not remove the smear layer, the Tubulicid® blue label (0,2 per cent disodium EDTA) had a mean score of 0,25 and the REDTA® (17 per cent disodium EDTA) a mean score of 2.1. Only 12,5 per cent of the cavities treated with Tubulicid® blue label had scores greater than one and 78 per cent of the cavities treated with REDTA® had scores greater than one.

## DISCUSSION

The results of this study did not appear to differ from the results of the study on newly extracted teeth (Jodaikin and Austin, in press). This suggests that the action of the effective cavity cleanser is not affected by tooth viability.

Although the smear layer removing performance of the REDTA® was slightly worse than that recorded in an earlier study on newly extracted teeth (Jodaikin and Austin, in press) no statistically significant difference was found when the results of the two studies (Tabel 1) were compared using the Fisher's exact probability test.

The smear layer removing properties of the Tubulicid® blue label were disappointing in view of the favourable results which were reported by Brännström, Nordenvall and Glantz (1980). Reasons for these differences may have arisen due to the method of agent application of the smear layer removing agent. In Brännström, Nordenvall and Glantz's (1980) study the mode of application of the agent (0,2 per cent disodium EDTA) included mechanical scrubbing. Their study was carried out on ground dentine surfaces as opposed to the cavity preparation (dentine) surfaces used in this study. Differing tooth models and storage factors may also have played a role in the different results obtained.

The results of this study suggest that the REDTA® (17 per cent disodium EDTA) solution has the potential to perform well as a smear layer removing agent in clinical practice without the need for mechanical agitation or surface scrubbing.

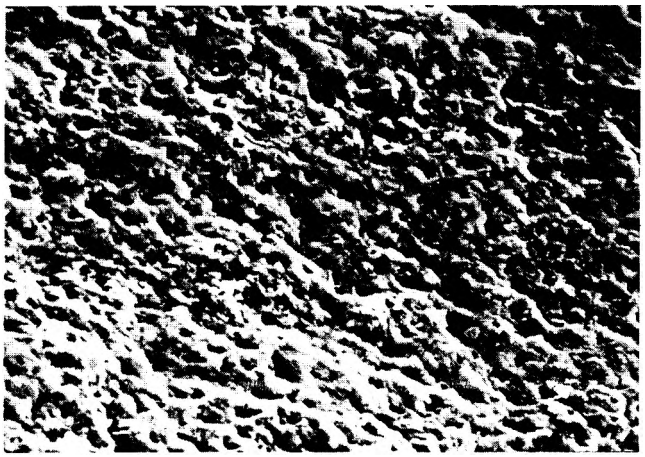


*Fig. 5.* The smear layer was removed from the surface of this dentine cavity surface by REDTA® (17 per cent disodium EDTA) which also etched the intertubular dentine (X1000).

The pulpal response to 17 per cent disodium EDTA (REDTA®) still needs to be determined before the procedure can be recommended for routine smear layer removal. These studies are currently in progress.

## ACKNOWLEDGEMENTS

We wish to express our appreciation to the staff of the Electron Microscope Unit, University of the Witwatersrand, Miss C. Sam of the Dental Research Institute, University of the Witwatersrand and Mrs. S. Wiggins of the National Institute for Virology for their technical assistance with the performance of this study and to Mrs. J. Long for typing this manuscript.

## REFERENCES

Brännström, M. Nordenvall, K.J. and Glantz, P.O. (1980) The effect of EDTA — containing surface-active solutions on the morphology of prepared dentin: An in vivo Study. *Journal of Dental Research*, **59**, 1127-1131.

Jodaikin, A. and Austin, J.C. (in press) Smear layer removal with chelating agents after cavity preparation. *Journal of Prosthetic Dentistry*.

Phillips, R.W. (1967) Advances in adhesive restorative dental materials. *Journal of Dental Research*, **47**, 1662-1667.

Retief, D.H. (1973) Adhesion in Dentistry. *Journal of the Dental Association of South Africa*, **28**, 11-24.

*Table I.* Mean smear layer removal scores of experimental and control treatments applied in this and a previous study+.

| Treatments | Non-Vital tooth study scores+ | | | | Vital tooth study score | | | |
|---|---|---|---|---|---|---|---|---|
| | n | x̄ | ±SD | % ++ | n | x̄ | ±SD | % ++ |
| Control distill water | 10 | 0 | 0 | 0 | 7 | 0 | 0 | 0 |
| Tubulicid® blu abel (0,2 % disodiu EDTA) | 10 | 0,5 | 0,8 | 10 | 8 | 0,25 | 0,7 | 12,5 |
| REDTA® (17% disodium EDTA) | 10 | 2,1 | 0,3 | 90 | 9 | 2,1 | 0,6 | 78 |

+ Jodaikin ai Austin (in press).
++ Percentage specimens with smear layer removal scores greater than one.