

A Comparison of Tooth Discoloration When Using Ledermix Paste and Odontopaste as Medicaments

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Introduction

Medicaments play an integral role in root canal treatment. Their main properties include being antibacterial, anti-inflammatory, able to stimulate hard tissue repair, and the prevention and reduction of pain. They should be non-irritant to the periapical and periodontal tissues. There have been reports that some medicaments can cause discoloration of teeth. Ledermix paste (Sigma Pharmaceuticals Pty Ltd, Victoria, Australia) and Odontopaste (Australian Dental Manufacturing, Brisbane, Australia) are intracanal medicaments with similar therapeutic properties. Ledermix paste discolors the tooth if it is exposed to sunlight and if the paste has been placed in the crown of the tooth. The manufacturers of Odontopaste claim that their paste does not discolor teeth.

Ledermix paste is a glucocorticosteroid-antibiotic compound which was first developed by Schroeder and Triadan in 1960 and released by Lederle Pharmaceuticals in 1962. Since then it has been one of the most commonly used medicaments in root canal treatment in several countries. The formula has not changed since the material was first marketed and despite many criticisms, the material remains the material of choice as an intracanal dressing at the initial visit¹⁻⁵. Ledermix paste contains a highly effective anti-inflammatory cortisone derivative, triamcinolone acetonide at a concentration of 1% combined with a broad spectrum antibiotic, demethylchlortetracycline calcium, (3.021%, also known as demeclocycline) for antibacterial action². Demeclocycline is a synthetic tetracycline. Its mechanism of action is through interfering with protein synthesis and it also reduces bone resorption by inhibiting osteoclast and dentinoclast activity⁶.

The reason for adding the antibiotic component to Ledermix paste was to compensate for what was perceived in 1960 to be a possible corticoid-induced reduced host immune response⁷. Its broad spectrum makes it effective against susceptible species of bacteria. However, its inhibitory effects against bacteria are most effective for the first day of application and then decrease to 1/10 within a week of application in the mid-root and apical third regions⁷. On the other hand, Mohammadi and Abbott⁸ stated that tetracycline was bacteriostatic with antibacterial substantivity for up to 12 weeks. Discoloration is an undesirable result of tetracyclines² that is caused by the deposition of tetracycline molecules into the dental hard tissues⁹. The initial bright-yellow appearance becomes dark-yellow to brown, as a result of degradation products of the incorporated molecules under the effects of sunlight.

It has also been stated that completely mineralized tissue will not take up tetracycline, and that discoloration only occurs during mineralization and demineralization⁹. Similarly Hilton et al¹⁰ also proved that tetracycline is deposited in human deciduous teeth and bones producing pigmentation and hypoplasia.

Tetracycline chelates with calcium ions and can localize in bone and teeth which leads to fluorescence and discoloration⁸. Previously it was believed that the effect depended on the stage of tooth development when exposed to the drug. However, other research has demonstrated that it was possible for fully mineralized teeth to uptake tetracycline which caused discoloration upon exposure to sunlight¹¹.

Kim et al² showed Ledermix paste caused severe staining of teeth upon exposure to sunlight. They also reported that this could be reduced by limiting the application of the Ledermix paste to below the gingival margin (that is below the cemento-enamel junction [CEJ]). In a similar study¹² done with immature teeth, the same authors reported more severe staining than with mature teeth. This is due to the increased number and the wider diameter of the dentinal tubules in immature teeth both of which allow greater diffusion of the demeclocycline through the dentine¹².

Odontopaste was released in February 2008 and its manufacturers have stated that this product has the advantage of not discoloring teeth¹³. Its components include triamcinolone acetonide (1%) which is similar to Ledermix paste, but the antibiotic is clindamycin hydrochloride (5%). Its original formula has changed and it now includes 1-2% calcium hydroxide.

Odontopaste contains clindamycin which is effective against many endodontic pathogens, including *Actinomyces*, *eubacterium*, *fusobacterium*, *propionobacterium*, *microaerophilic*, *peptococcus*, *peptostreptococci*, *veillonella*, *provotella* and *porphyromonas*⁷. Furthermore, clindamycin paste has been shown to be successful in eliminating bacterial growth by the 14th day in 21 of 25 teeth tested⁷. Clindamycin in comparison to tetracycline has superior antibacterial effect⁷. Its use significantly reduced the amount of viable bacteria in each dentine layer in comparison to tetracycline⁷. However, it does not have the anti-resorptive properties that tetracycline has.

The aim of this study was to compare grey discoloration effects of Ledermix paste and Odontopaste when used as intracanal medicaments.

Materials and Method

This was an interventional study using the following steps. Forty extracted human maxillary and mandibular anterior teeth were collected from unknown donors of different age and gender. Teeth were initially stored in diluted sodium hypochlorite solution and then later transferred to normal saline, away from sunlight.

Access cavities were cut in each tooth and the root canals were biomechanically prepared using Hedström files to a size 35 file with an apical stop 1mm from the apical foramen. The irrigants used during canal preparation were sodium hypochlorite (1%) (Milton Procter & Gamble Australia, Parramatta, Australia) and ethylene diamine tetracetic acid with cetrimide (EDTAC 15%) solutions (EndoPrep Solution, Professional Dental Supplies, Bayswater North, Australia).

The teeth were divided into four groups of ten teeth in each group as follows:

Groups 1 and 2: Odontopaste

Groups 3 and 4: Ledermix paste

Paper points were used to dry the canals and then the medicaments were placed in the root canals up to the cemento-enamel junction (CEJ). In every tooth, the medicament was limited strictly to the root portion of the canal (below the cemento-enamel junction). After placement of the medicament, a small piece of cotton wool and then a temporary filling using Cavit (ESPE, Seefeld, Germany) were placed into the pulp chambers to simulate the typical clinical scenario.

All teeth were kept in sealed plastic containers with saline moistened gauze. The labial surface of each tooth was positioned so that it was facing upward. The gauze was moistened every week with saline in order ensure they were always moist.

At room temperature, teeth in Groups 1 and 3 were placed near a window for 12 weeks so that the teeth were exposed to the effects of sunlight every day. Teeth in Groups 2 and 4 were placed in the dark as controls for 12 weeks. Immediately before placing the medicaments and then at 2, 4, 6, 8, 10 and 12 weeks the teeth were examined for any discoloration and the shade of each tooth was recorded using a Venus shade guide (Heraeus Dental International, Hanau, Germany). Photographs were also taken at each time interval. Grey discoloration at the end of 12 weeks was assessed as either being present or absent. Two observers viewed the teeth at each time interval.

In order to prevent bias, blinding was done and the two observers were unaware which medicaments had been placed in the teeth.

The shade guide scores were statistically analyzed using a t-test (two-tailed) for significant color changes for each tooth over the twelve week period.

Results

Table 1 shows the number of teeth observed with grey discoloration at each time interval. The grey discoloration was observed only in the teeth with Ledermix paste that were exposed to sunlight. This discoloration was noted after one week. The discoloration increased gradually over the first four weeks and then it decreased thereafter.

Table 2 shows the mean color changes observed with the shade guide over the twelve week period. As the shade guide was used, these color changes reflect changes in the lightness or yellowness of the teeth. The t-test (two-tailed) indicated that color changes were present in all four groups with a p-value of <0.05. The color change was the change in lightness (or yellowness) of the teeth. Different groups had different degrees of discoloration. However it could not be stated that the teeth increased in their yellowness or lightness using this test. Groups 1 and 3 decreased in yellowness and became lighter in appearance whereas Groups 2 and 4 increased in yellowness.

Discussion

The shade guide readings varied amongst the groups as color change measurement using a shade guide is a subjective way of measuring color change^{13,14}. It is dependent upon many factors including age, gender, lighting conditions, fatigue of the human eye and the room décor¹³. Other methods that can be used include spectrophotometry and colorimetry. Ideally, a spectrophotometer would be the best method as it is considered a reference instrument in the field of color science.

After 12 weeks, definite grey changes were noted in Group 3. However no significant changes in greyness were noted in the other groups. Groups 1, 2 and 4 showed slight yellow color changes; however, Group 3 also had a whitening effect. These observations are consistent with the studies by Kim et al^{2, 12} who also reported discoloration of teeth when exposed to sunlight with Ledermix paste as intracanal medicament. These results confirm that the demeclocycline component of Ledermix paste is the cause of the discoloration, but only when exposed to light.

Group 1, which contained Odontopaste and was left in sunlight, showed a yellowing effect when compared to Group 3 which contained Ledermix paste. Odontopaste contains clindamycin hydrochloride which binds to the 50S ribosomal sub-unit of bacteria and disrupts protein synthesis by interfering with the transpeptidation reaction, inhibiting early chain reaction. It does not chelate with calcium or undergo photo-oxidation to produce complexes which cause discoloration as occurs with tetracyclines. A whitening effect was also noted when compared to the controls (Group 4) containing Odontopaste that were left in the dark. This whitening effect could possibly be due to color changes caused by sunlight itself on the tooth as suggested by Kim et al^{2, 12} in their studies. This effect was also noticed in the Group 3 teeth which contained Ledermix paste and were left in sunlight.

Group 3 had significant grey color changes. Studies have shown that Ledermix paste causes discoloration to teeth and Kim et al^{2, 12} concluded that this discoloration was a result of a photo-oxidation reaction occurring when tetracycline was exposed to sunlight. In other studies^{11,15}, the discoloration due to chelation of tetracycline with calcium producing a tetracycline-calcium complex became apparent due to light activated oxidation of tetracycline⁹. In the control for Ledermix paste (Group 4) there were no color changes which was the same result as that observed with Group 2 (Odontopaste control). The results suggest that there are no grey color changes when using Odontopaste as an intracanal medicament. However, it cannot be said that Odontopaste does not discolor teeth at all as there were some changes in the yellowness and lightening of these teeth. Due to the limitations of the study, it was not possible to measure or quantify these slight color changes.

Conclusion

There were no significant grey color changes when using Odontopaste as an intracanal medicament. However, it cannot be said that Odontopaste does not discolor at all as it caused yellowing of the teeth. Ledermix paste caused grey color changes in teeth when exposed to sunlight.

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Appendix 1

Table 1

The grey Test: 0= not present, 1= present

Number of teeth showing grey discoloration				
	Group 1 Odontopaste Light	Group 2 Odontopaste Dark	Group 3 Ledermix Light	Group 4 Ledermix Dark
Baseline	0	0	0	0
1 week	0	0	10	0
2 weeks	0	0	10	0
4 weeks	0	0	10	0
6 weeks	0	0	10	0
8 weeks	0	0	10	0
10 weeks	0	0	10	0
12 weeks	0	0	10	0

The values represent the number of teeth in the group which had definite grey discoloration present

Table 2: Color changes over week period of same shade of teeth in the four groups

	Baseline	Week 2	Week 4	Week 6	Week 8	Week 10	Week 12
Group 1	8	5	7	5	5	5	4
Group 2	8	12	12	11	12	12	11
Group 3	8	16	4	2	3	5	3
Group 4	8	13	11	7	8	7	8

The shade values over the 12 week period of teeth of same shade from 4 different groups. The shade ranged from 1-17, 1 being the lightest and 17 being the darkest of the shade. (Note shade guide was used to measure the lightness or yellowness of the tooth over the twelve weeks)