

Surface Tension of Several Drugs Used in Endodontics

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Surface tension of various drugs used in endodontic therapy was studied by the capillary method. Drugs of the phenol group - eugenol, paramonochlorophenol, tricresol-formalin and phenol - presented very low surface tension. The association of a detergent to the solution of calcium hydroxide reduced its surface tension by half.

Key Words: surface tension, drugs, endodontics.

Introduction

In various situations, endodontic therapy requires the application of a drug to aid in the instrumentation and disinfection of root canals. One of the fundamental requisites of a drug used in root canal therapy is low surface tension so that intimate contact between the drug and the dentin walls can occur.

By definition, surface tension is one of the most important physico-chemical properties of drugs used in endodontics. Surface tension is a force existing between the surface molecules which causes a drop of liquid to spread or to concentrate when placed on a surface. This phenomenon depends on the values of its cohesive forces (force of attraction resulting from the forces that the liquid molecules exert between themselves) and adhesive forces (forces that the surface molecules exert on contact with those of a liquid).

Naumovich (1963), Milano et al. (1983) and Guimarães et al. (1988) studied surface tension of various root canal irrigating solutions and drugs used in endodontics.

Due to the scarcity of literature on this topic, we proposed this present study which investigated the surface tension of several drugs used in endodontic therapy.

Material and Methods

The surface tensions of the solutions studied and their manufacturers are shown in Table 1.

Table 1 - Surface tension of drugs and their manufacturers.

Drug	Manufacturer	Surface tension (dynes / cm)
Cresofo	Prodonto Ltda.	26.06
Camphorated paramonochlorophenol	Prodonto Ltda.	25.12
Glutaraldehyde	Merck	59.38
Phenol	SS White	39.25 ^a
Neodex	Prodonto Ltda.	59.67
Otosporin	Wellcome	40.90
Tricresol formalin	Prodonto Ltda.	37.33
Eugenol	SS White	33.83
Xylol	Merck	29.85
Hydrogen peroxide 10%	Rio Química	70.42
Water with calcium hydroxide	*	66.82
Irrigoeal	SS White	37.52
Chloroform	Merck	26.72
Citric acid 10%	Fermenta	68.34
Ethylene alcohol 96 GL	*	23.51
Eucaliptol	SS White	30.20
Dakin's Solution	*	71.34
Distilled water	*	72.73

* Prepared in the Endodontic Laboratory of the Dental School of Ribeirão Preto.

Distilled water, ethylene alcohol and chloroform were used as controls.

Superficial tension measurements were carried out at 25°C using the capillary method (Bueno and Degreve, 1980). Two glass capillary tubes with different internal diameters (0.58 and 0.56 mm) were used. The surface tension values were calculated from the mean of the values encountered for each of the tubes.

Results

The results show that the drugs used in endodontic therapy have lower surface tensions than that of water. The phenol group drugs have surface tensions similar to those of detergents. The mixture of a detergent with a solution of water and calcium hydroxide lowered the surface tension in half.

Table 2 compares the surface tension values for various drugs obtained by other researchers with those obtained in this study.

Table 2 - Surface tension (dynes/cm) of drugs used in endodontic therapy determined by various authors using different methods.

Drugs	Naumovich (1963)	Milano et al. (1963)	Guimarães et al. (1985)	Present study
	Ring method	Ring method	Capillary method	Capillary method
Distilled water	72.8	71.9	72.72	72.73
Milton solution	63.5	-	-	-
Dakin's solution	-	62.9	31.34	71.34
Hydrogen peroxide 10%	65.1	63.7	-	70.42
Hydrogen peroxide 30%	68.1	-	-	-
Calcium hydroxide 14 g/l	-	58.9	-	66.82
Irrigocal	-	-	-	37.52
Camphorated paramonochlorophenol	-	37.2	-	25.12
Eugenol	36.9	-	-	33.83
Dehyquart A 2%	-	42.1	-	-
Dehyquart A 0.1%	-	-	33.27	-
Tergentol	-	33.7	33.41	-
EDTA	54.0	-	69.25	-
EDTA + Tergentol	-	-	31.09	-
EDTA + Cetavlon	39.7	-	33.92	-
Cetavlon	-	-	33.62	-
Phiso hex	-	35.1	-	-
Xylol	-	-	-	29.85
Eucaliptol	-	-	-	30.20
Chloroform	29.8	-	28.24	26.72
Glutaraldehyde	-	-	-	59.38
Phenol	39.7	-	-	39.25
Camphorated phenol	36.7	-	-	-
Tricresol-formalin	-	-	-	37.33
Creso for	-	-	-	26.06
Otosporin	-	-	-	40.90
Neodex	-	-	-	59.67
Citric acid 10%	-	-	-	68.34
Benzal conic chloride 1%	29.5	-	-	-
Physiologic saline	68.9	54.0	-	-
Sodium chloride	-	49.7	-	-
Alcohol 70%	27.5	-	-	-
Alcohol 96%	24.1	23.0	23.06	23.51

Discussion

Analyzing Table 1, observe that the solutions tested had lower surface tensions than distilled water.

Paiva and Antoniazzi (1985) and Pécora et al. (1988) observed that water presents difficulties in wetting a solid body in comparison with the other solutions used in endodontics.

Drugs which have phenol groups in their formulas present very low surface tension, i.e., camphorated paramonochlorophenol (25.12 dynes/cm), Cresofor (26.06 dynes/cm), tricresol formalin (37.33 dynes/cm) and phenol (39.25 dynes/cm). Cresofor showed a surface tension similar to that of camphorated paramonochlorophenol because its chemical composition differs only by an increase of 0.2% dexamethasone. This data ought to alert the clinician since these drugs need to be used with great care due to their low surface tensions which can cause a rapid wetting of the walls of the root canals. If these drugs are used in excess, they can rapidly affect the periapical region causing intense inflammatory reactions.

Water with calcium hydroxide (14 g/l) presents a high surface tension (66.82 dynes/cm), similar to distilled water. The solution Irrigocal, produced by SS White, which consists of an association of an anionic detergent (lauryl diethyleneglycol ether sodium sulfate) with calcium hydroxide, presents a low surface tension (37.52 dynes/cm). The reduction of surface tension of calcium hydroxide aids in the contact of this drug with the walls of the root canal.

Xylol (29.85 dynes/cm) is frequently used in endodontic therapy since it is an excellent solvent of gutta-percha. Its low surface tension allows it to rapidly wet the cones of gutta-percha dissolving them. Eucaliptol, also used as a solvent of gutta-percha, shows low surface tension (30.20 dynes/cm).

Among the drugs used as dressings in pulpectomies, Neodex (neomycin sulfate and dexamethasone) and Otsoporin (neomycin sulfate and polymycin) show surface tensions of 59.67 dynes/cm and 40.90 dynes/cm, respectively. These drugs present higher surface tensions than those of the phenol group.

Dakin's solution (71.34 dynes/cm) and 10% hydrogen peroxide (70.42 dynes/cm) have surface tensions similar to water (72.73 dynes/cm).

Table 2 compares the findings of other researchers with the data of the present study. Drugs which contain phenol groups have much lower surface tensions than halogen drugs and hydrogen peroxide.

Conclusions

The following can be concluded from this study:

1. Distilled water has the highest surface tension (72.73 dynes/cm) of the drugs used in endodontics.

2. Drugs with phenol groups have low surface tensions, i.e., camphorated paramonochlorophenol, Cresofor, eugenol, tricresol-formalin, phenol, xylol, and Eucaliptol.

3. The association of a detergent with a solution of calcium hydroxide greatly reduces the surface tension. Irrigocal has a surface tension 50% lower than a mixture of water with calcium hydroxide.

4. Xylol and Eucaliptol, used as solvents of gutta-percha, have very low surface tensions (29.85 and 30.20 dynes/cm, respectively).

5. Drugs used as long-term dressings in the treatment of pulpectomies (Neodex and Otosporin) have high surface tension, similar to distilled water.

5. Dakin's solution has a surface tension similar to that of water.

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