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A comparative Evaluation of PH, surface tension and antimicrobial efficacy of Oxum, Vancomycin, Doxorubicin drugs vs. Sodium Hypochlorite – an in vitro study

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Introduction

The presence of microorganisms and derivative toxins in the infected root canals cause the development of apical periodontitis. a number of studies (1,2) show that the endodontic infection is poly-microbial, and that in teeth with necrotic pulp it is represented by obligatory and facultative anaerobes, microaerophilic bacteria and fungi. An important stage in the successful endodontic therapy is the treatment of the microflora with endodontic irrigants, both during the biomechanical preparation of the root canal and between the visits. Sodium hypochlorite (naocl) in various concentrations is a frequently recommended endodontic irrigant in contemporary endodontics (3). Super oxidized water (sow) is an alternative root canal irrigant. during the last decade it has become widely used in endodonic practice as an effective antimicrobial means for irrigating the root canal(4,5,6). studies have shown that the local application of antibiotics (root canal irrigants)(7) within the root canal system may be a more effective mode for delivering such drugs than systemic routes of administration. the surface tension is defined as "the force between molecules that produces a tendency for the surface area of a liquid to decrease"(8). this force tends to limit the ability of the liquid to penetrate a capillary tube.the irrigants for endodontic use should have very low surface tension.the aim of the present study has been formulated on the basis of the above sources and previous results of our research.

Objectives

The aim in this study has been to evaluate PH, surface tension and antimicrobial efficacy of Oxum(SOW), Vancomycin, Doxorubicin drugs as potential root canal irrigants in comparison with Sodium Hypochlorite.

Material and Methods

Enterococcus faecalis, Streptococcus pyogenes , Candida abicans were obtained from the department of microbiology , Vishnu Dental College , Bhimavaram . samples were obtained and maintained by using nutrient agar medium for e.faecalis , c.albicans and serum agar medium for Streptococcus pyogenes. The test solutions vancomycin, doxorubicin, sodium hypochlorite and superoxidised water were prepared in distilled water with a 3% concentration (Fig 1). A single pure colony of the test organism from the nutrient agar is inoculated in 4-5ml of nutrient both and incubated at 37°c for 6-8hrs. An agar plate is cultured with the required number of organism by keeping 0.5 ml of broth on the surface of the agar medium by swabbing with sterile swab. The cultured plate were allowed to dry for 15 minutes at room temperature and four wells are made with a 6mm diameter in the agar with proper distance between the wells. The wells are numbered and required antibiotics were filled with the standard amount of test solution i.e (0.5 ml of test solution) and incubated at 37°c for 24 hrs. Around each well the inhibitory zones were measured (in mm) and results were recorded (Fig 5). The largest diameter was recorded in mm (Fig 4). The data was recorded and statistically analysed with f test .Colony counting procedure: In this study viable count procedure (or) pour plate method was used. The plates were incubated at 37°c for 24 hours (Fig 6). The colonies were calculated with colony counting meter (Shakthi Scientific, India) (Fig 7) and the result was recorded by group and was statistically analysed. The ph of test solutions were measured using ph meter (L1 120, Elico,India) (Fig 2). The surface tension of the test solutions were analysed with stalagmometer (JSGW, India) (Fig 3).

Fig. 1: Materials used in the study

Fig. 2: PH meter

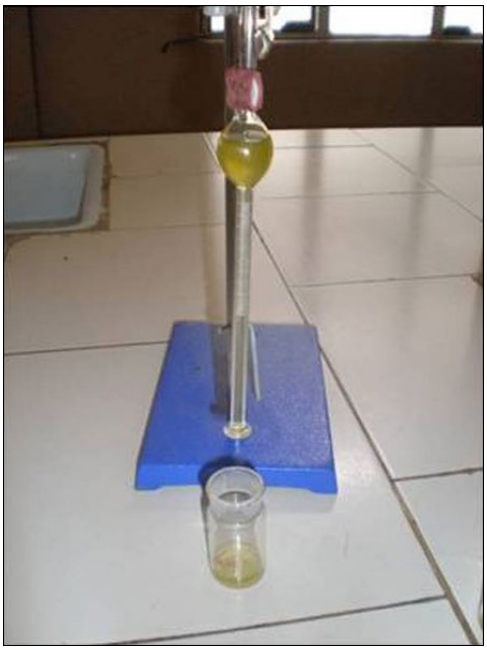

Fig. 3: Stalagmometer

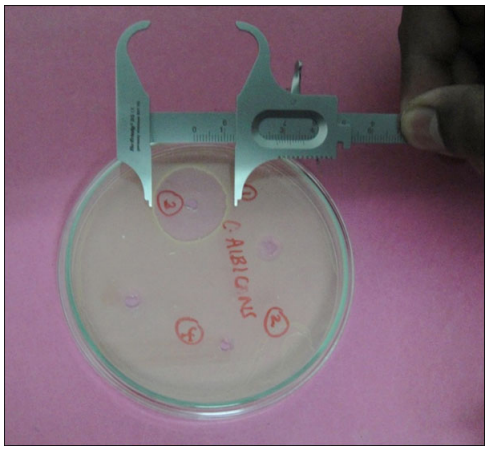

Fig. 4: Vernier Callipers to measure inhibition zones

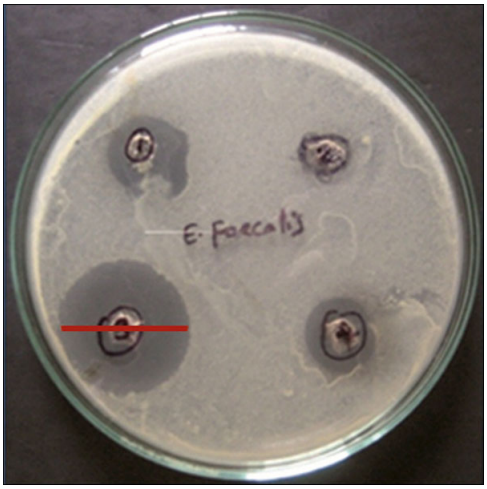

Fig. 5(I): Inhibition zones of Enterococcus faecalis

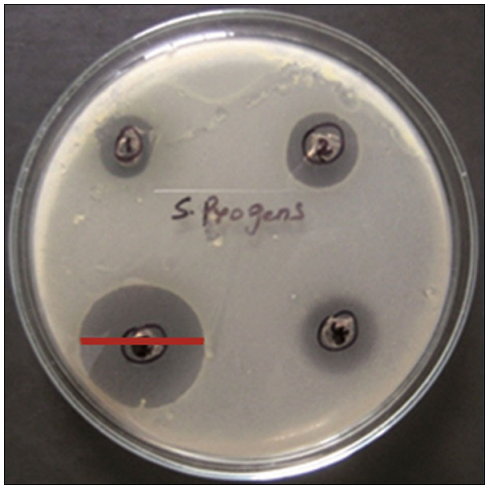

Fig. 5(II): Inhibition zones of Streptococcus pyogenes

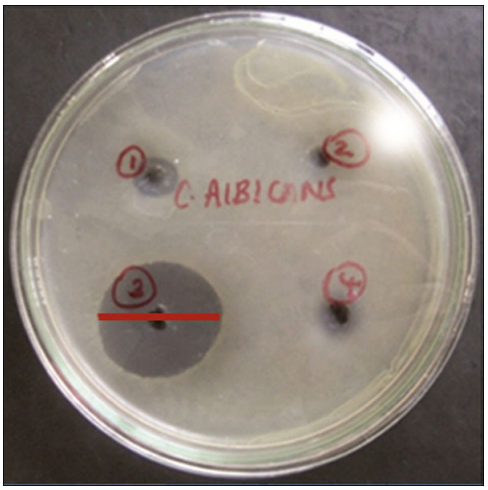

Fig. 5(III): Inhibition zones of Candida albicans

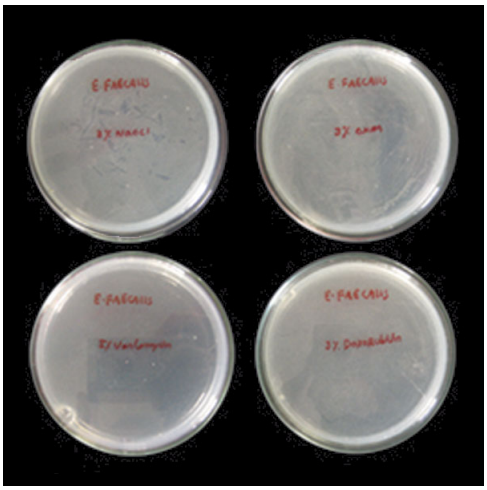

Fig. 6(I): Colony forming units of Enterococcus faecalis

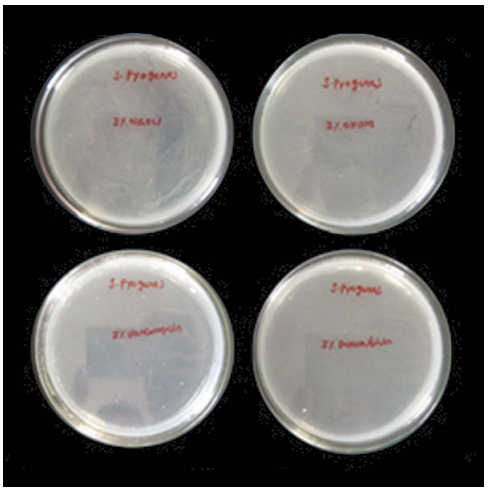

Fig. 6(II): Colony forming units of Streptococcus pyogenes

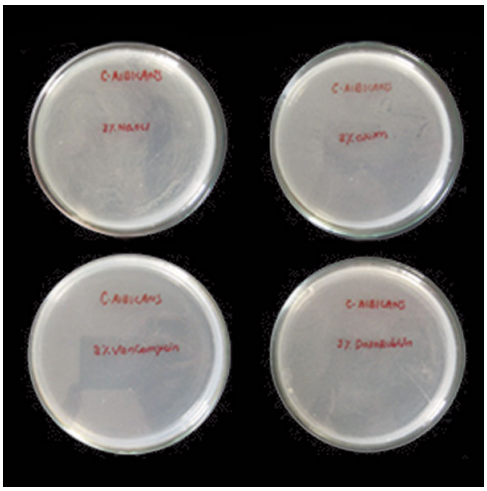

Fig. 6(III): Colony forming units of Candida albicans

Fig. 7: Colony counter

Results

Table 1 present the means of the diameters of the activity zones /in mm/ of the studied irrigants in the cases of the different microorganisms. Table II shows the results of test for colony forming units. Table III shows the pH & surface tension values of the four test solutions. As table 1 shows, vancomycin 3%had the strongest influence against all microorganisms (Fig 8). This irrigant has its largest activity zone in the case of streptococcus pyogenes (26 mm) candida albicans(26 mm), and its smallest zone in the case of enterococcus faecalis (24mm) . Doxorubicin 3%had an intermediate impact on enterococcus faecalis(12mm) and streptococcus pyogenes(12mm). Sodium hypochlorite 3%has its largest activity zone in the case of enterococcus faecalis (14 mm) and its smallest zone in the case of candida albicans (6mm) . SOW 3%had the weakest impact on enterococcus faecalis(4mm) and candida albicans(2mm). However SOW 3% had an intermediate impact on streptococcus pyogenes. Statistical analysis using f test shows that there was statistically significant difference between 3% vancomycin and remaining three test solutions.

Agar plates

	E.FAECALIS	S PYOGENES	C ALBICANS
3% NaOCl	14 mm	8 mm	6 mm
3% SOW	4 mm	12 mm	2 mm
3% VANCOMYCIN	24 mm	26 mm	26 mm
3% DOXORUBICIN	12 mm	12 mm	4 mm

Tab. 1: Inhibition zones

Agar plates

	E.FAECALIS	S PYOGENES	C ALBICANS
Control	2600-2700	2500-2600	2200-2300
3% NaOCl	100-200	400-500	700-800
3% SOW	1700-1800	1200-1300	1900-2000
3% VANCOMYCIN	20-30	5-10	10-20
3% DOXORUBICIN	200-300	300-400	1000-1100

Tab. 2: Colony forming units

	pH	surface tension (dynes/cm)
3% NaOCl	12.34	100.86
3% SOW	5.86	62.72
3% VANCOMYCIN	4.02	95.85
3% DOXORUBICIN	5.82	76.02

Tab. 3

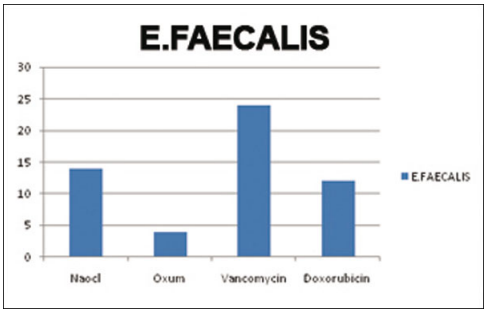

Fig. 8(I): Statistical analysis of Enterococcus faecalis

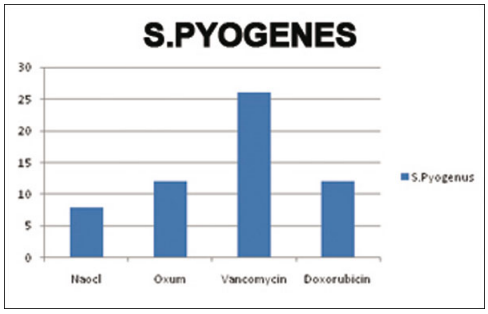

Fig. 8(II): Statistical analysis of Streptococcus pyogenes

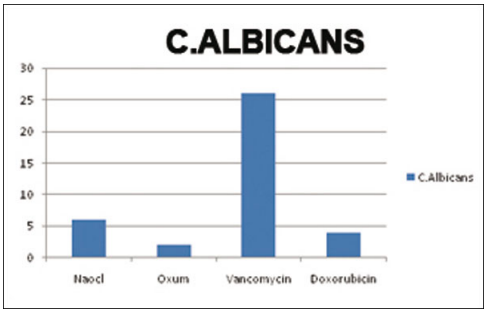

Fig. 8(II): Statistical analysis of Candida albicans

Conclusions

Vancomycin is a glycopeptide antibiotic primarily acting against gram +ve bacteria. Vancomycin inhibit the synthesis of cell wall in sensitive bacteria(9,10).In the present study when applied to streptococcus pyogenes(26mm),candida albicans(26mm), enterococcus faecalis(24mm), 3%vancomycin produce the largest area of activity. Doxorubicin is a anthracycline antibiotic and an important antitumour agent. The compounds can intercalate with DNA, directly affecting transcription and replication(9,11). In the present study 3%doxorubicin has an intermediate impact on enterococcus faecalis(12mm) and streptococcus pyogenes(12mm). Sodium hypochloride has a wide range of antimicrobial activity. By using different concentrations of sodium hypochloride substantial decrease in bacterial count was achieved(3). Despite being highly effective it does not penetrate well into difficult to access segments of microcanal systems of dentin (8). In addition, it remains in the canal for short period of time. However it is assumed that the use of larger quantity of irrigant leads to extinguishing larger quantities of micro organisms difficulty. In the present study when applied to enterococcus faecalis this endodontic irrigant produced a largest area of activity (14mm) compared to streptococci pyogenes(8mm) and candidia albicans (6mm). Super oxidized water is an alternative root canal irrigant. During the last decade it has been widely studied in the endodontic practice as an effective antimicrobial means for irrigating the root canal. 3% Super oxidized water has demostraded the weakest impact against the tested microorganisms Enterococcus faecalis (4mm) candida albicans(2mm). 3% super oxidized water showed an intermediate impact on streptococcus pyogenes(12mm). However it should be noted that undiluted super oxidized water would have given better results.
Regardless of the intracanal irrigants the bacteria can never be completely eliminated from the root canal. In order to eradicate the bacterial cells from the root canal, the irrigant has to penetrate and reach them. The irrigants for endodontic use should have very little surface tension. The wettability of the solution governs the capability of the penetration both into the lateral canals and dentinal tubules. The results in this study showed that 3%sodium hypochlorite (100.86dynes/cm) had the highest surface tension followed by 3%vancomycin (95.85 dynes/cm), 3% doxorubicin(76.02dynes/cm) and 3%super oxidized water (62.72 dynes/cm).
3%Vancomycin showed more anti microbial efficacy on microorganisms (enterococcus faecalis ,streptococcus pyogenes, candida.albicans) when compared with 3%sodium hypochlorite, 3%doxorubicin and 3%super oxidized water.

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Abbreviations

SOW: Super Oxidized Water
NaOCl: Sodium Hypochlorite

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