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Analysis of the antiseptic effects on root canal microbiota in acute pulpitis of primary teeth

The aim of the study. To substantiate the choice of antiseptic drugs considering the sensitivity of the pathogenic microbiota of root canals in acute forms of pulpitis of primary teeth and to determine the minimum inhibitory concentrations of antiseptics against clinical and typical microorganisms.

Materials and methods. The study analyzes the effectiveness of antiseptics on the microbiota of root canals in acute pulpitis of primary teeth. Various antiseptic solutions, including sodium hypochlorite, chlorhexidine, iodine, and creosote, were tested against clinical and typical strains of bacteria and fungi. For the study, typical museum cultures and clinical cultures isolated from root canals in pulpitis of primary teeth were used: microscopic fungi C. albicans, S. aureus, S. epidermidis, E. coli, K. Oxitoca, S. viridans, S. pyogenes, E. faecalis.The antibacterial and antimycotic effects of the studied compounds were also evaluated by the minimum inhibitory concentration (MIC).

Results. Results showed that chlorhexidine bigluconate 2%, iodine 5%, and creosote 0.01% had the highest antimicrobial activity, while sodium hypochlorite was effective against gram-negative bacteria. Some antiseptics exhibited limited or no effect on specific pathogens. The study highlights the need for optimized antiseptic concentrations to ensure effective disinfection and improve endodontic treatment outcomes in pediatric dentistry, helping prevent reinfections and enhance long-term success. Against E. coli and K. oxitoca, the highest activity was shown by chlorhexidine bigluconate 2%, iodine 5% and creosote 0.01%. Sodium hydrochlorit 3% and 5% had high activity against typical and clinical strains of E. coli. Against K. oxitoca, 5% Sodium hydrochlorit had moderate antimicrobial activity and 3% Sodium hydrochlorit had low activity. Furacilin solution 0.06%, chlorophyllipt 1%, the drug "Hepilor" (choline salicylate 5%) and chlorhexidine 5% had no antimicrobial effect on gram-negative microorganisms taken into the experiment. These findings support evidence-based antiseptic selection for safe and efficient root canal disinfection, reducing complications and improving patient care in clinical practice.

Key words: children, primary teeth, acute pulpitis of primary teeth, antiseptic solutions, pathogenic microflora, root canals, antimicrobial activity of antiseptics.

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Аналіз ефективності впливу антисептиків на мікробіоту кореневих каналів тимчасових зубів при гострих формах пульпітів

Дослідження аналізує ефективність антисептиків щодо мікробіоти кореневих каналів при гострому пульпіті тимчасових зубів. Випробувано різні антисептичні розчини, зокрема гіпохлорит натрію, хлоргексидин, йод та крезол, на клінічні й типові штами бактерій і грибів. Встановлено, що хлоргексидину біглюконат 2%, йод 5% і крезол 0,01% мають найвищу антимікробну активність, тоді як гіпохлорит натрію ефективний проти грамнегативних бактерій. Деякі антисептики демонстрували обмежену або відсутню дію щодо певних патогенів. Дослідження підкреслює важливість оптимізації концентрації антисептиків для ефективної дезінфекції

та покращення ендодонтичного лікування у дітей, запобігаючи реінфекціям і підвищуючи довготривалу успішність. Отримані результати сприяють доказовому вибору антисептиків для безпечної та ефективної дезінфекції кореневих каналів, зниження ускладнень та підвищення якості лікування в клінічній практиці.

Ключові слова: діти, тимчасові зуби, гострий пульпіт тимчасових зубів, антисептичні розчини, патогенна мікрофлора, кореневі канали, протимікробна активність антисептиків.

Introduction. In the present day, the study of the oral microbiota plays an important role in diagnosing, preventing, and treating dental diseases. The oral microbiota is a collection of various taxonomic groups of microorganisms that inhabit the oral cavity and engage in biochemical, immunological, and other relationships with the macroorganism and with each other [1, 2].

The microbial landscape of the oral cavity is divided into two types of microbiota: obligate, which is constantly present in the oral cavity and is mainly saprophytic, providing metabolic processes and the function of protecting the body from virulent infectious agents; and facultative, which is represented by opportunistic microorganisms that acquire aggressive properties with a decrease in immune defense and contribute to the development of diseases [3, 4].

Due to the topographic and anatomical variations of root canals, it is not possible to ensure their complete cleaning using mechanical removal of infected dentin and pulp residues alone. Therefore, during endodontic treatment, the dentist must accomplish the following tasks:

1) cleaning and disinfecting the root canal to remove pulp tissue, microorganisms, and their waste products;

2) preparing the root canal by mechanically removing infected dentin;

3) creating a three-dimensional seal of the root canal system to establish a biological barrier and prevent reinfection [5].

Upon analyzing numerous literature sources, it becomes clear that a significant emphasis in endodontic procedures is placed on the instrumental processing of root canals, the technique of their filling using various techniques, and the constant improvement of drug therapy for infected root canals [6].

Objective of the study. To substantiate the choice of antiseptic drugs considering the sensitivity of the pathogenic microbiota of root canals in acute forms of pulpitis of primary teeth and to determine the minimum inhibitory concentrations (MIC) of antiseptics against clinical and typical microorganisms.

Materials and methods. The material for the study was collected on the basis of the University Dental Polyclinic LLC (head physician – M. V. Lyakhina) and the Transcarpathian Regional Clinical Dental Polyclinic (head physician – R. A. Lesiv), under the agreement on joint activities.

For the study, typical museum cultures of ATCC (American Type Culture Collection, USA) *Candida albicans* ATCC 885-653; *Staphylococcus aureus* ATCC 25923*; Escherichia coli* ATCC 25922*, Enterococcus faecalis* ATCC 29212, *Streptococcus pyogenes* ATCC 19615 and clinical cultures isolated from root canals in pulpitis of primary teeth were used: microscopic fungi of the genus *Candida* (*C. albicans), Staphylococcus aureus (S. aureus), Staphylococcus epidermidis (S. epidermidis), Escherichia coli (E. coli), Klebsiella oxitoca* (*K. oxitoca)*, *Streptococcus viridans (S. viridans), Streptococcus pyogenes (S. pyogenes)*, *Enterococcus faecalis (E. faecalis).*

The following antiseptics were used in the study: 3% and 5% solutions of sodium hypochlorite, Hepilor (100 ml of solution: hexetidine – 0.1 g, choline salicylate – 0.5 g, chlorobutanol – 0.25 g), chlorophyllite 0.1%, chlorhexidine 0.05%, chlorhexidine bigluconate 2%, iodine alcohol solution 1%, oil solution of creosote (1:2), isotonic furacilin solution 0.02%, each of which showed different results in delaying the growth of pathogenic microorganisms.

The sensitivity of microorganisms to the drugs was determined by the method of diffusion into agar (well diameter 8 mm). An inoculum of bacteria or microscopic fungi in an amount of 0.1 ml in saline sterile solution of 0.5Mc Farland standard was sown on Mueller-Hinton agar (HiMedia) for bacteria and Sabouraud agar for *Candida*. The test drug was added to the well in an amount of 20 mcl. The results were recorded 24 hours after incubation in a thermostat at 37^0 C for bacteria and 48 hours at 35^0C for microscopic fungi. The diameter of the growth inhibition zones was measured in mm, including the diameter of the well. All experiments were performed in triplicate. The result was evaluated by the diameter of the growth retardation of microorganisms around the well. Diameter up to 15 mm – microorganisms insensitive to antiseptics, from 16 to 20 mm – microorganisms moderately sensitive to antiseptics, from 21 to 25 mm – microorganisms sensitive to antiseptics, from 26 mm and more – microorganisms highly sensitive to antiseptics [7].

The antibacterial and antimycotic effects of the studied compounds were also evaluated by the minimum inhibitory concentration (MIC) [7].

To determine the MIC, a solution of the test substances was prepared in sterile water; creatine was prepared in alcohol. Dilutions of the test substances in meat-peptone broth (MPB) were made in a ratio of 1:2; 1:4; 1:6; 1:8; 1:10. A bacterial suspension in the amount of 100 mcl, corresponding to 0.5 of the McFarland standards (1.5 x 108 CFU/ml) from a 24-hour culture of microorganisms in sterile saline, was added to each tube.

The tubes were incubated at 37 °C for 24 hours for bacterial cultivation and at 35 °C for 48 hours for microscopic fungal cultivation. After incubation, each tube was inoculated onto meat-peptone agar (MPA). The minimum inhibitory concentration (MIC) was determined based on the last dilution at which no culture growth was observed. Negative controls included a bacterial suspension with sterile water and a bacterial suspension with alcohol [8, 9].

Results. Based on the results obtained, we proposed the following minimum inhibitory concentrations (MICs) of antiseptics against clinical and typical forms of microorganisms that will help to achieve positive delayed treatment results (Table 1, Table 2).

Discussion. Currently, modern endodontics does not have a universal antiseptic that meets all necessary requirements and ensures 100% destruction of pathogenic microflora. However, there are a number of features that a selected antiseptic used in daily practice should have including:

Table 1

Minimum inhibitory concentrations (MIC) of antiseptics

Culture test	Sodium hydrohlorite 3%	Sodium hydrohlorite 5%	Hepilor	Chlorophyllite 1%	Chlorhexidine 0.05%
S. aureus ATCC 25923	1:6	1:6	1:4	concentrated solution	-
S. aureus clinical	1:4	1:4	15,0±0,5 1:2	concentrated solution	-
S. epidermidis clinical	1:4	1:6	1:4	concentrated solution	1:4
5. pyogenes ATCC 19615	0	0	concentrated solution	0	concentrated solution
5. pyogenes clinical	0	0	concentrated solution	0	concentrated solution
S. viridans clinical	0	0	concentrated solution	0	concentrated solution
E. coli ATCC 25922	1:6	1:6	0	0	0
E. coli clinical	1:6	1:6	0	0	0
Klebsiella oxitoca clinical	concentrated solution	1:4	0	0	0
E. faecalis ATCC 29212	concentrated solution	1:4	concentrated solution	0	1:4
E. faecalis clinical	concentrated solution	1:2	concentrated solution	-	1:2
C. albicans ATCC 885-653	concentrated solution	1:2	0	0	concentrated solution
C. Albicans clinical clinical	0	1:2	0	0	0

Table 2

Minimum inhibitory concentrations (MIC) of antiseptics

Culture test	Chlorohexidine bigluconate, 2%	Iodine, 5%	Fura-cylin solution, 0.06%	Creosote, 0.01%	Alcohol, 96%	Saline solution
S. aureus ATCC 25923	1:8	1:8	1:6	1:6	0	0
S. aureus clinical	1:8	1:8	1:4	1:6	0	0
S. epidermidis Clinical	1:8	1:8	1:4	1:8	0	0
S. pyogenes ATCC 19615	1:4	1:6	0	1:6	0	0
S. pyogenes clinical	1:4	1:6	0	1:6	0	0
S. viridans clinical	1:4	1:6	0	1:6	0	0
E. coli ATCC 25922	1:6	1:8	1:4	1:8	0	0
E. coli clinical	1:4	1:8	1:2	1:8	0	0
Klebsiella oxitoca clinical	1:4	1:6	1:4	1:8	0	0
E. faecalis ATCC 29212	1:4	1:8	0	1:8	0	0
E. faecalis clinical	1:4	1:6	0	1:6	0	0
C. albicans ATCC 885653	1:4	1:8	0	1:8	0	0
C. albicans clinical	1:4	1:8	0	1:8	0	0

– the ability to provide bactericidal properties against microorganisms in root canals,

– be non-toxic to periapical tissues,

– not have a sensitizing effect or cause the emergence of resistant forms of microorganisms, act quickly and penetrate deeply enough into the dentinal tubules,

– not lose its effectiveness in the presence of organic matter,

– have receptive organoleptic properties,

– be chemically resistant and retain its activity during long-term storage [7].

The purpose of antiseptic treatment of root canals is to ensure maximum removal of bacteria from the canal system, including anastomoses, lateral canals and deltas, removal of organic substrate and lubricated layer, as well as disinfection of the root canal system, taking into account the characteristics of the intracanal biofilm [8].

Table 3

Antimicrobial effect of antiseptics against typical and clinical isolates, growth retardation zone, mm, M±m

Culture test	Sodium hydrohlorite 3%	Sodium hydrohlorite 5%	Hepilor	Chlorophyllite, 1%	Chlorhexidine 0.05%
S. aureus ATCC 25923	30,0±1,0	34,0±1,5	18,0±1,0	10,0±0,8	- (bacteriostatic effect)
S. aureus clinical	24,0±1,25	21,0±0,75	15,0±0,5	10,0±0,75	-
S. epidermidis clinical	25,0±0,5	34,0±0,75	21,0±0,5	11,0±0,25	22,0±0,1
Micrococcus spp.	23,0±0,5	35,5±1,25	23,5±0,5	17,0±0,5	24,5±0,5
S. pyogenes ATCC 19615	0	0	14,0±1,25	0	10,5±0,75
S. pyogenes clinical	0	0	13,0±0,5	0	10,8±0,5
S. viridans clinical	0	0	14,5,0±1,0	0	10,0±1,0
E. coli ATCC 25922	40,0±1,5	33,0±1,25	0	0	0
E. coli clinical	34,0±1,0	30,0±1,5	0	0	0
K. oxitoca clinical	12,0±0,4	19,0±0,3	0	0	0
E. faecalis ATCC 29212	12,0±0,25	19,0±0,4	10,0±0,5	0	19,5±1,25
E. faecalis clinical	10,0±0,25	15,0±0,75	9,0±0,5	0	15,0±0,25
C. albicans ATCC 885653	13,5±0,25	16,5±0,75	0	0	11,5±0,5
C. albicans clinical	0	16	0	0	0

Notes: "-" no growth retardation zone; control – saline.

Table 4

Antimicrobial effect of antiseptics against typical and clinical isolates, growth retardation zone, mm, M±m

Culture test	Chlorhexydin bigluconate 2%	Iodine, 5%	Furacylin solution, 0.06%	Creosote, 0.01%	Creosote solution 1:2	Alcohol, 96%	Saline solution
S. aureus ATCC 25923	40,0±1,25	35,0±1,5	22,0±1,0	31,0±0,7 5	28,0±1,4	0	0
S. aureus clinical	35,0±0,75	33,0±0,7 5	18,0±0,5	27,0±0,5	25,0±0,5	0	0
S.epidermidis clinical	40,0±0,25	41,0±1,0	18,0±1,2 5	42,0±1,2 5	43,0±1,0	0	0
Micrococcus spp.	45,0±1,25	44,0±1,2 5	22,0±1,0	45,0±1,2 5	43,0±0,75	0	0
S. pyogenes ATCC 19615	23,0±1,0	33,0±0,7 5	0	31,0±0,7 5	29,0±0,5	0	0
S. pyogenes clinical	22,0±1,25	32,0±1,0	0	30,0±1,0	28,0±0,5 5	0	0
S. viridans clinical	23,5±1,0	32,0±0,5	0	30,0±1,0	28,0±	0	0
E. coli ATCC 25922	27,5±0,5	42,0±1,2 5	19,0±0,7 5	41,0±0,2 5	37,0±0,5	0	0
E. coli clinical	25,5±0,5	41,0±1,2 5	19,0±1,0	40,0±0,75	36,0±1,0	0	0
K. oxitoca clinical	21,0±1,2	34,0±1,1	18,0±0,5	45,0±0,25	47,0±0,8	0	0
E. faecalis ATCC 29212	28,0±1,0	35,0±1,2	0	38,0±1,4	32,0±1,2	0	0
E. faecalis clinical	27,0±0,8	33,0±1,0	0	35,0±1,1	30,0±0,7	0	0
C. albicans ATCC 885653	25,5±0,5	42,7±0,1	0	47,0±0,5	44,0±0,1	0	0
C. albicans clinical	23,0±0,75	40,5±0,5	0	43,0±0,2 5	40,5±0,5	0	0

Root canal irrigation is the most common method used for antiseptic treatment [9]. The following solutions are often used:

– Halogen-containing drugs (solutions of sodium hypochlorite, chloramine, iodinol);

– Derivatives of quaternary ammonium compounds (solutions of chlorhexidine, decamine, decamethoxine);

– Oxidizing agents (hydrogen peroxide solution, urea);

– Chelated compounds.

During the study, the antiseptic solutions used showed delayed growth of pathogenic microorganisms taken from the root canals of teeth with pulpitis (Table 3 and Table 4).

Analyzing the results of the study, we note that iodine and creatine solutions had the highest antimycotic activity. Chlorhexidine biogluconate 2% also had a high antimycotic effect, but its activity was lower. Sodium hydrohlorite 5% had a moderate antimycotic effect, sodium hydrohlorite 3% and chlorhexidine 0.05% had a low antimycotic effect, but only on museum cultures. Other substances used in the experiment did not show antifungal effect against typical and clinical isolates of fungi of the genus *Candida*.

Clinical and typical species of bacteria of the genus *Staphylococcus* were selected for the experiment. The analysis of antistaphylococcal activity of antiseptics showed the highest activity of chlorhexidine digluconate 2%, iodine, and creatine. A high level of antistaphylococcal activity was also observed with 5% and 3% sodium hypochlorite solutions. Hepilor and furacilin solutions had a moderate antimicrobial effect. Chlorhexidine 0.05% showed high antimicrobial activity only against epidermal staphylococcus and had no antimicrobial effect on Staphylococcus aureus isolates. *Chlorophyllipt* was characterized by a low antimicrobial effect against isolates of bacteria of the genus *Staphylococcus*. It should be noted that the antiseptics had a higher antimicrobial effect on epidermal staphylococci than Staphylococcus aureus.

The analysis of antistreptococcal activity of antiseptics showed that sodium hypochlorite, furacilin solution, and chlorhexidine had no antimicrobial effect on bacteria of the genus Streptococcus. High antimicrobial activity was observed with chlorhexidine digluconate 2%, iodine, and creosote. Hepilor and chlorophyllite were characterized by low antimicrobial activity against streptococci.

The highest activity against *E. faecalis* was found when studying the effect of chlorhexidine digluconate 2%, iodine, and creosote. Sodium hypochlorite 5% and chlorhexidine 0.05% had a moderate antimicrobial effect. Sodium hypochlorite 3% and Hepilor had low activity against Enterococcus faecalis. Chlorophyllite and furacilin solution had no antimicrobial effect against *E. faecalis*.

The study of the effect of antiseptics on gram-negative microorganisms – *E. coli* and *Klebsiella oxytoca* – showed the highest activity of chlorhexidine digluconate 2%, iodine, and creosote. Sodium hypochlorite 3% and 5% had high activity against typical and clinical E. coli strains. At the same time, 5% sodium hypochlorite and low 3% sodium hypochlorite had a moderate antimicrobial effect against the clinical isolate of K. oxytoca. Furacilin solution, chlorophyllipt, Hepilor, and chlorhexidine 0.05% had no antimicrobial effect on gram-negative microorganisms taken in the experiment.

It should be noted that all antiseptics that exhibited antimicrobial activity had a more pronounced effect on typical strains than on clinical ones. A wide spectrum of antimicrobial action with high activity was observed with solutions of chlorhexidine digluconate, iodine, and creosote.

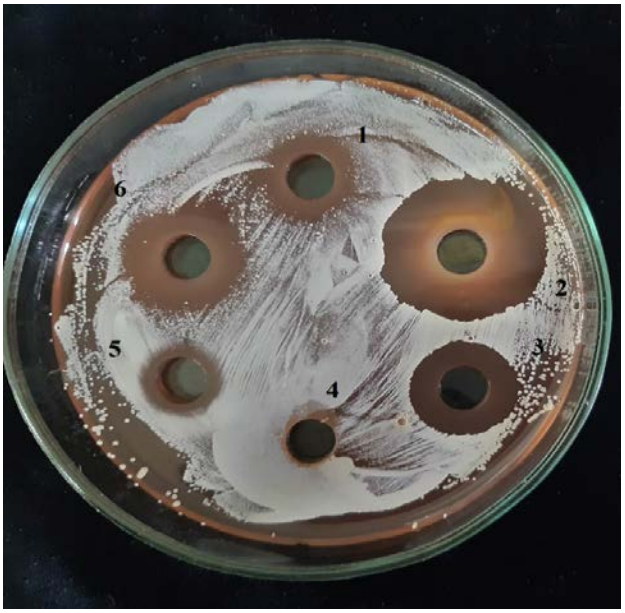

Fig. 1. Effect of antiseptics on the growth of *E.faecalis*: 1 – sodium hypochlorite 3%; 2 –sodium hypochlorite 5%; 3 – hepilor; 4 – chlorophyllipt 1%; 5 – chlorhexidine 0.05%; 6 – chlorhexidine bigluconate 2%

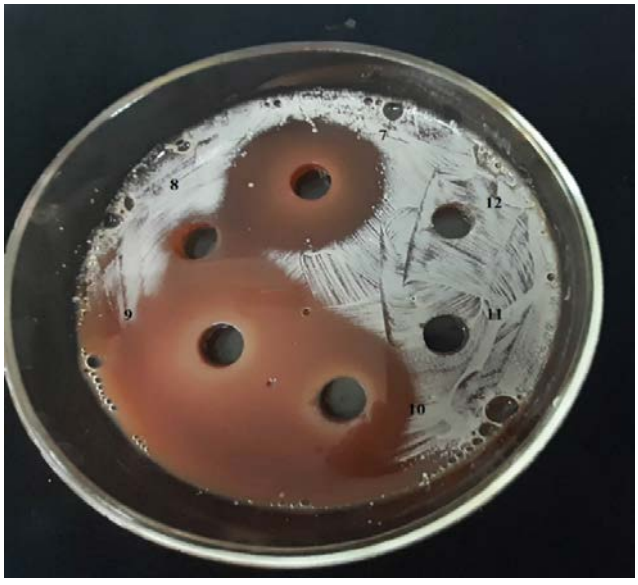

Fig. 2. Effect of antiseptics on the growth of *E.faecalis*: 7 – iodine 5%; 8 – furacilin solution 0.06%; creosote conc; 9 – creosote solution 0.01%; 11 – 96% ethanol; 12 – saline solution 0.9%

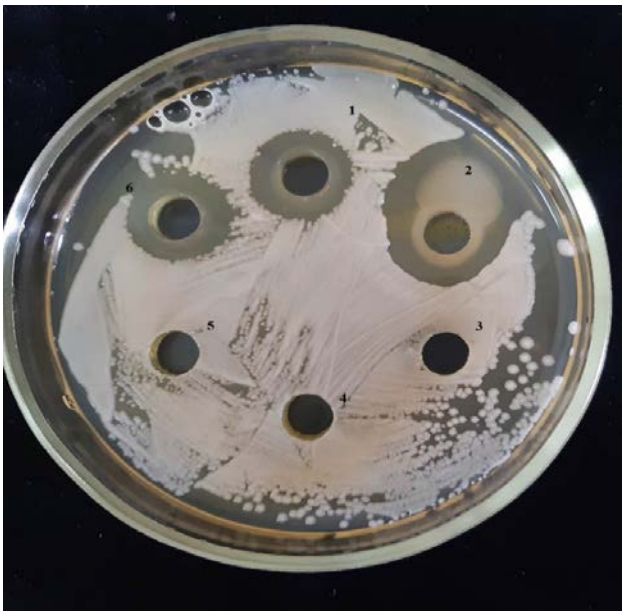

Fig. 3. Effect of antiseptics on the growth of *K.oxitoca*: 1 – sodium hypochlorite 3%; 2 – sodium hypochlorite 5%; 3 – hepilor; 4 – chlorophyllipt 1%; 5 – chlorhexidine 0.05%; 6 – chlorhexidine bigluconate 2%

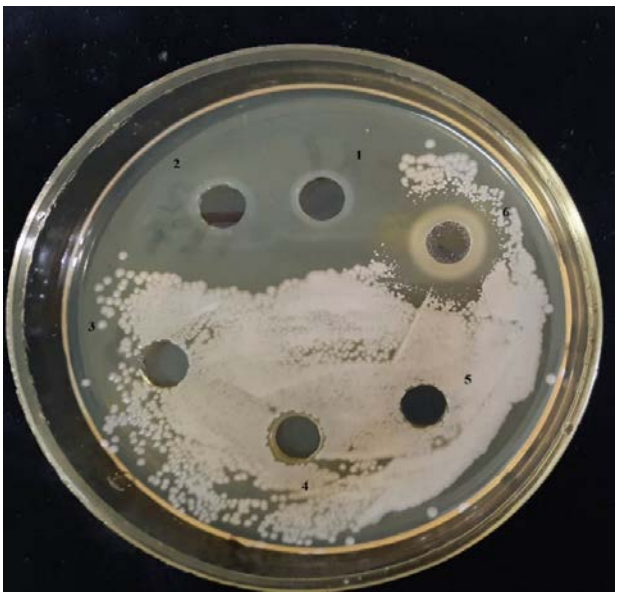

Fig. 4. Effect of antiseptics on the growth of *E. coli*: 1 – sodium hypochlorite 3%; 2 – sodium hypochlorite 5%; 3 – hepilor; 4 – chlorophyllipt 1%; 5 – chlorhexidine 0.05%; 6 – chlorhexidine bigluconate 2%

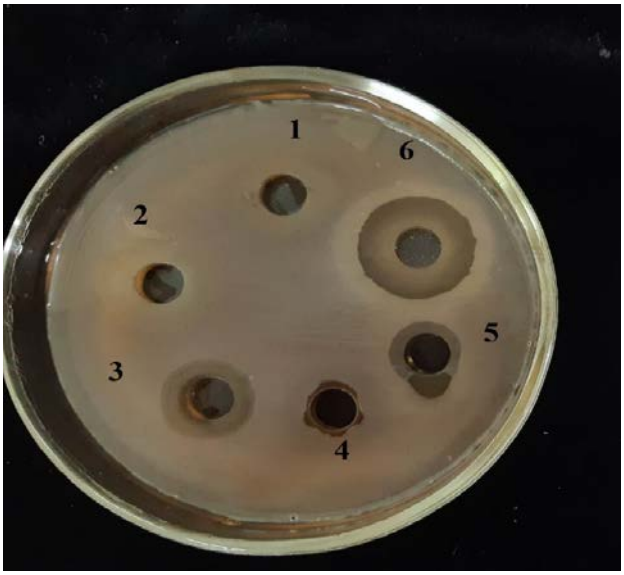

Fig. 5. Effect of antiseptics on the growth of *S.pyogenes*: 1 – sodium hypochlorite 3%; 2 – sodium hypochlorite 5%; 3 – hepilor; 4 – chlorophyllipt 1%; 5 – chlorhexidine 0.05%; 6 – chlorhexidine bigluconate 2%

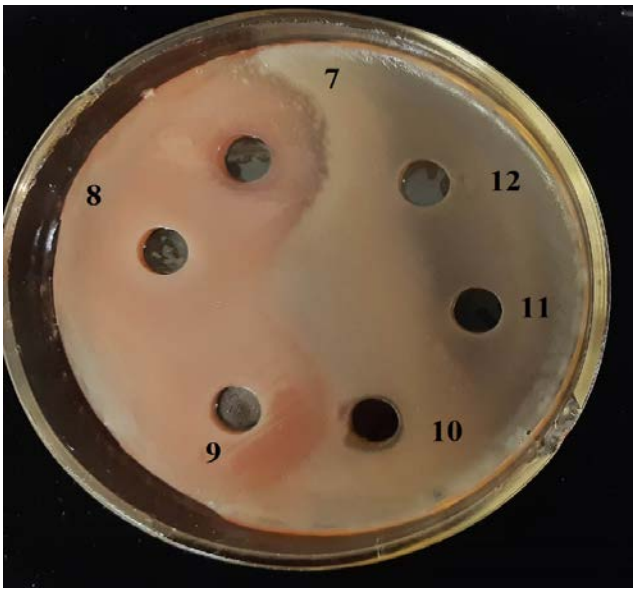

Fig. 6. Effect of antiseptics on the growth of *E.faecalis*: 7 – iodine 5%; 8 – furacilin solution 0.06%; creosote conc; 9 – creosote solution 0.01%; 11 – 96% ethanol; 12 – saline solution 0.9%

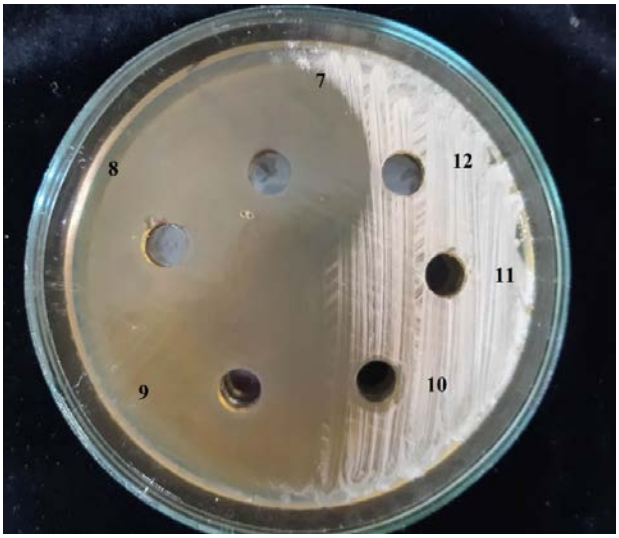

Fig. 7. Effect of antiseptics on the growth of *C.albicans*: 7 – iodine 5%; 8 – furacilin solution 0.06%; creosote conc; 9 – creosote solution 0.01%; 11 – 96% ethanol; 12 – saline solution 0.9%

Based on the results obtained, the following minimum inhibitory concentrations (MICs) of antiseptics against clinical and typical microorganisms were proposed.

It was noted that iodine solutions (42.7±0.1) and creosote solutions (47.0±0.5) had the highest antimycotic properties. Chlorhexidine biogluconate 2% also had a high antimycotic effect, but its activity was lower (25.5±0.5). Sodium hydrohlorite 5% had a moderate antimycotic effect (16.5±0.75), sodium hydrohlorite 3% (13.5±0.25) and chlorhexidine 0.05% (11.5±0.5) had a low antimycotic effect, but this was only in relation to museum cultures. The other substances used in the experiment did not show antimycotic effect against typical and clinical isolates of fungi of the genus *Candida*.

Regarding antistaphylococcal activity, we obtained the following results: the highest activity of chlorhexidine bigluconate 2% (40.0±1.25), iodine (35.0±1.5) and creosote (31.0±0.75). A high level of antistaphylococcal activity was characteristic of 5% and 3% Sodium hydrohlorite solution – 34.0±1.5 and 30.0±1.0, respectively. Hepilor (18.0±1.0) and Furacilin solution (18.0±0.5) had a moderate antimicrobial effect. Chlorhexidine 0.05% showed high antimicrobial activity only against epidermal staphylococcus and had no antimicrobial effect on Staphylococcus aureus isolates. Chlorophyllipt *was* characterized by a low antimicrobial effect against isolates of bacteria of the genus *Staphylococcus* (10.0±0.8). It is worth noting that the antiseptics had a higher antimicrobial effect on epidermal staphylococcus than on Staphylococcus aureus.

The analysis of antistreptococcal activity of antiseptics showed that Sodium hydrohlorite, Furacilin solution and chlorhexidine 0.05% had no antimicrobial effect on bacteria of the genus *Streptococcus*. High antimicrobial activity was characterized by chlorhexidine bigluconate 2% (23.0±1.0), iodine (33.0±0.75) and creosote (31.0±0.75). Hepilor and chlorophyllite were characterized by a low antimicrobial effect against streptococci – 13.0–14.0±1.25.

The highest activity against *E. faecalis was* found when studying the effect of chlorhexidine bigluconate 2% (28.0±0.1), iodine (35.0±1.2) and creosote (38.0±1.4). Sodium hydrohlorite 5% (19.0±0.4) and chlorhexidine 0.05% (19.5±1.25) had a moderate antimicrobial effect. Low activity against enterococcus was characterized by Sodium hydrohlorite 3% and Hepilor. Chlorophyllite and furacilin solution had no antimicrobial effect against *E. faecalis.*

The study of the effect of antiseptics on gram-negative microorganisms – *E. coli* and *Klebsiella oxitoca,* showed the highest activity of chlorhexidine bigluconate 2% (21.0±1.2), iodine (34.0±1.1) and creosote (45.0±0.25). Sodium hydrohlorite 3% and 5% had high activity against typical and clinical strains of E. coli. At the same time, 5% Sodium hydrohlorite and low 3% Sodium hydrohlorite had a moderate antimicrobial effect against the clinical isolate of *K.oxitoca*. Furacilin solution, chlorophyllipt, Hepilor and chlorhexidine had no antimicrobial effect on gram-negative microorganisms taken in the experiment.

Conclusions. In the present study, we evaluated the effectiveness of antiseptic agents with regard to the resistance of microorganisms to drugs.

The study revealed the antimicrobial effect of the following antiseptics:

– 3% and 5% solutions of sodium hypochlorite are highly active against typical and clinical strains of Escherichia coli, but have no antimicrobial effect on bacteria of the genus *Streptococcus;*

– Chlorhexidine bigluconate 2% showed the highest activity against gramnegative microorganisms, such as E. *coli* and *Klebsiella oxitoca, and E. Faecalis and has no* antimicrobial effect on bacteria of the genus *Streptococcus;*

– 1% iodine alcohol solution showed the highest activity against gramnegative microorganisms such as E. *coli* and *Klebsiella oxitoca, and E. Faecalis and* bacteria of the genus *Streptococcus and* fungi of the genus *Candida*;

– oil solution of creosote (1:2) showed the highest activity against gramnegative microorganisms such as E. *coli* and *Klebsiella oxitoca, and E. Faecalis and* bacteria of the genus *Streptococcus and* fungi of the genus *Candida*.

Based on the results obtained, we propose the minimum inhibitory concentrations for adequate disinfection and sterilization of root canals, which will further facilitate adequate root canal treatment and effective delayed results.

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