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MEDICATION OF ROOT CANAL INFECTIONS

ON THE BASIS OF MORE THAN 1000 SENSITIVITY DETERMINATIONS

by

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As long as no universal medicament for the treatment of root canal infections exists, it is logical to apply a drug proved to be effective by a sensitivity determination. If, however, a drug has proved effective in numerous sensitivity tests, it is simpler to use it at all times in the treatment of root canal infections and to carry out a sensitivity determination only when a favourable result is not achieved. This is the conclusion reached in our previous studies (*Parmala and Pohto,* 1954). These studies indicated that a mixture of bacitracin and neomycin was suitable for the medication of root canal infections.

In the present investigation, we compare the effectiveness of a mixture of bacitracin and neomycin with that of chloramphenicol as well as of combinations of all three in liver broth cultures of microbes taken from root canals: More than 1000 sensitivity determinations were made. In addition, we describe the medication of the same root canals with a mixture of bacitracin and neomycin, in particular, and we examine the suitability of such treatment in routine dental practice.

MATERIAL

The study was carried out using a group of patients at the Institute of Dentistry of the University of Helsinki during the

years 1954, 1955, and 1956. These patients were accepted for treatment on the basis of clinical and roentgen findings leading to the diagnosis of *gangraena pulpae, ostitis periapicalis.*

The specimens for sensitivity determinations were taken by dental students from the root canals of 1039 teeth. A second specimen was also taken from 868 of these teeth. The first specimen was cultivated on the evening of the day it was taken and the second on the following morning. In this study the former specimens are designated as first day samples, the latter as second day samples. The method used in taking specimens was that of thrusting a Hedström file onto the apical part of every root canal, giving it half a turn, so as to make material from the walls of the apical part of each canal adhere to its threads. The file was removed from the canal in such a way as to avoid any secondary infection, and its tip was broken off into the liver broth tube. All the files used to take specimens from the different canals of the same tooth were broken off into the same specimen tube. The same operation was repeated using a second tube whenever a second day sample was also involved.

The sensitivity determinations were carried out at the Department of Serology and Bacteriology, University of Helsinki. It was found that, out of the total of 1039 specimens, there was growth in 957 cases, or about 92 %. This figure may include, in addition to growth originating in the root canals, contact infection cases as well. They can neither be avoided with certainty by dental surgeons nor by dental students.

Of these 957 teeth, 744 were treated on the basis of the results of sensitivity determinations. The other 213 cases either did not come to be treated, for one reason or another, or did not fulfill the requirements of the test. In most instances this was because the root canals were not accessible to the apices of the canals or had been medicated with drugs other than those called for by the test. This category also included those comparatively few cases in which the bacteria extracted from the root canals proved to be resistant to the drugs used in the sensitivity determinations.

The 744 teeth treated were divided into different categories as follows,

+1+	+2+	+3+	+4+	+5+	+6+	+7+	+8+[1])	
153	138	71	56	59	35	8	0	= 520 maxillary teeth
—1—	—2—	—3—	—4—	—5—	—6—	—7—	—8—[1])	
24	26	20	31	55	50	18	0	= 224 mandibular teeth

The number of cases within the different categories of teeth is in inverse proportion to the difficulties of treatment. Thus, the sample is partly the result of selection, a factor that in this study, however, probably is of no significance.

The cases were distributed according to age as follows,

Below 16 yrs.	25	36—40 yrs.	79	56—60 yrs.	12
16—20 yrs.	84	41—45 yrs.	52	61—65 yrs.	10
21—25 yrs.	149	46—50 yrs.	44	66—70 yrs.	10
26—30 yrs.	135	51—55 yrs.	38	Over 70 yrs.	4
31—35 yrs.	102				

The large number of young persons indicates their greater interest, as compared to their elders, in preserving their teeth. No study has been made to ascertain to what extent the differences between the wide root canals of young people and the narrow ones of older people affect the prerequisites of life of the root canal microbes. Therefore, it is not known either whether the kind of distribution presented above has any bearing on the results of our investigation.

SENSITIVITY DETERMINATIONS

Technique

First day samples: From each of the primary tubes, into which the root canal files had been broken off in such a way as to insure sterility, four times 1 cc were moved into each of four 10 cc liver broth test tubes. Antibiotic discs were then added to three, while the fourth remained a growth control tube. The cultures were incubated for two days, after which any growth could be observed as a turbidity (or sediment at the bottom). The intensity of the growth was not taken into account in estimating the results; but in every instance where turbidness was detected, it was recorded as growth.

Second day samples: The technique used was the same except

[1]) + denotes the maxilla, — denotes the mandible.

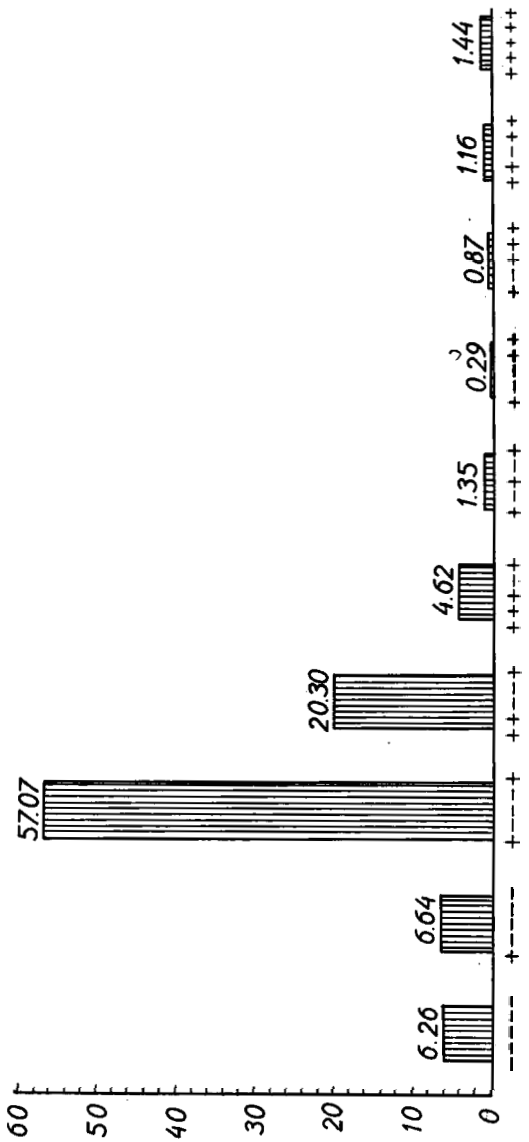


Fig. 1.

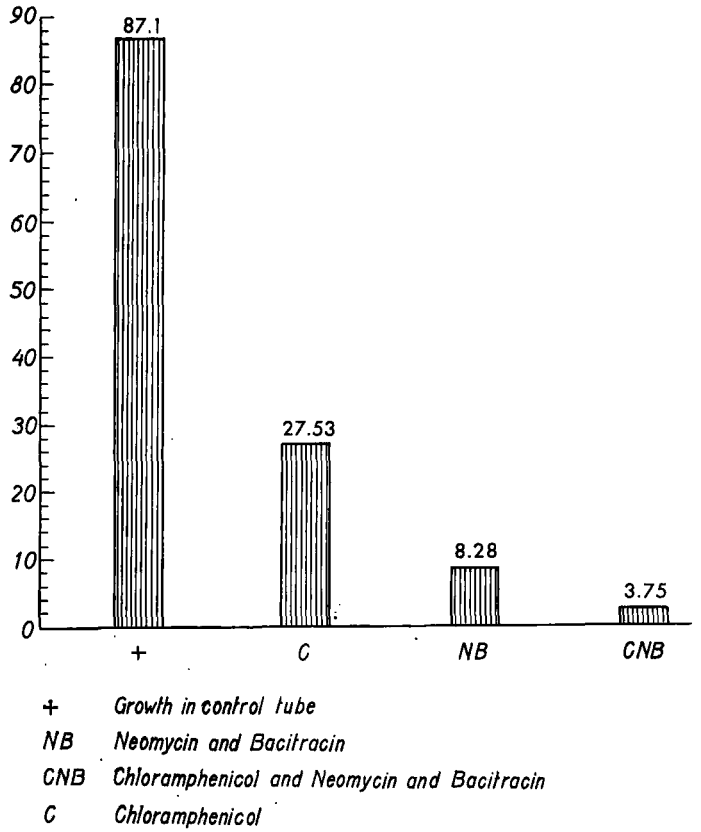


Fig. 2.

that the primary tube was incubated overnight at 37° C before the amount of 0.5 or 0.05 cc, depending on the turbidity, was transferred to the 10 cc liver broth tubes. The results were estimated after twenty-four hours' growth.

Results

The first day's specimens were prepared from the total material. Fig. 1 shows the results in percentages. Classification was made on the basis of the growth observed in the different tubes. (First tube = primary tube; second, chloramphenicol; third, neomycin + bacitracin; fourth, chloramphenicol + neomycin +

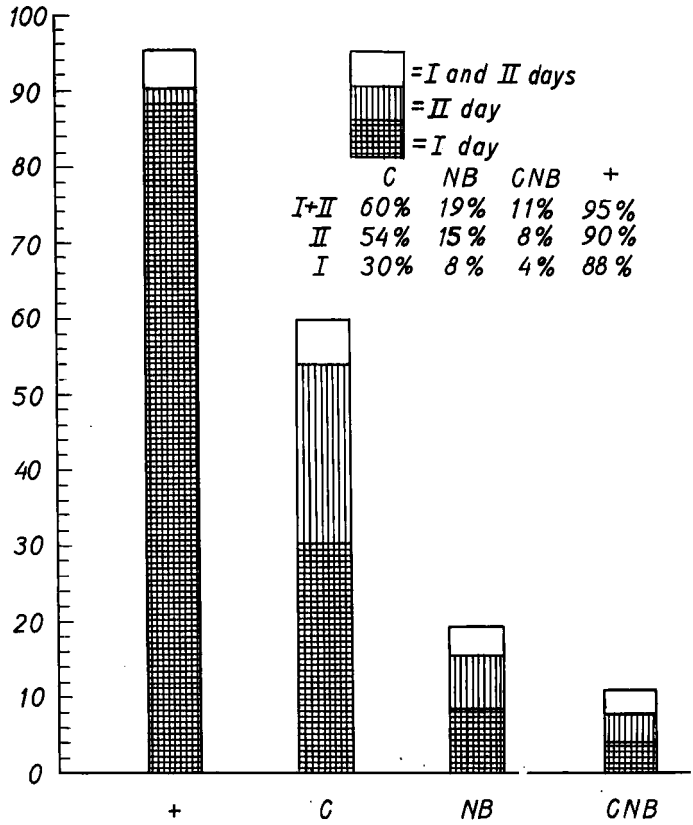


Fig. 3. + = growth in control tube.

bacitracin; fifth, growth control tube). No growth could be detected in about 6 per cent of the primary tubes. Likewise, in about 6 per cent growth was observed in the primary tube only. In more than half the samples, all three "combinations" inhibited growth; in a fifth those containing the neomycin-bacitracin combination acted preventively; while only in about 5 per cent a combination of all three antibiotics inhibited growth. Less than 1.5 per cent of the samples were such that no combination had an inhibitory effect. Figure 2 shows the proportion of the specimens in the material where tests of the first day's samples gave no indication as to possible sensitivity, i.e. no growth appeared in the control tubes (about 13 %), as well as the percentages of specimens resistant to the various combinations.

The second day's samples were prepared from 868 specimens. In 362 cases 0.05 cc was transferred from the primary tube, the growth in the primary tube thus being very marked during the period of 24 hours. In all these cases the result could be determined. In 506 instances the amount transferred was 0.5 cc; this group included all 85 in the control tubes of which no growth could be detected as well as most of those in which growth could be observed in all the tubes. For this part of the material, the results of the first day's samples and those of the second day's samples as well as both together are shown in Fig. 3. The growth in the control tube and in the tubes with different antibiotic combinations is represented by bars indicating percentages of this part of the material. More growth is observed in both samples together than in either of them taken separately. This is due to the fact that the results are not always in agreement, i.e. growth was lacking in certain cases among the second day's samples where it could be detected in corresponding tubes among the first day's samples. Parallel results were obtained in 400 cases, or 46 per cent of the total. Leaving out the cases where no growth could be observed among the first day's or, correspondingly, the second day's samples in the primary or primary and control tubes, an illogically more abundant growth could be noted among the first-day-samples in 70 cases (8.5 %) and a logically more abundant second day's growth in 290 cases (35.5 %). Fig. 3 shows that growth in the antibiotic tubes occurred approximately twice as often among the second day's samples as among the first day's samples.

Considering the material as a whole, and taking into account the results for both days, it may be seen that no growth was detected in 7.9 per cent of the control tubes, i.e. the result could not be evaluated. 48.3 per cent of the cases were resistant to chloramphenicol, 12.8 per cent to neomycin-bacitracin combination, and 7.2 per cent were resistant to all the combinations.

MEDICATION OF THE ROOT CANALS

The treatment prescribed on the basis of the results of the sensitivity determinations was given by dental students.

Since the aim was to ascertain especially the suitability of the mixture of neomycin and bacitracin in the medication of root

Table 1

Distribution of cases according to the number of treatments with antibiotics (I—VI) and total duration of each series of treatments (1—21 days).

	I treat.	II treat.	III treat.	IV treat.	V treat.	VI treat.	Over VI treat.	Total
1 day	1							1
2 days	2							2
3 »	30	2						32
4 »	24	4						28
5 »	8	5	1	1				15
6 »	9	29	2					40
7 »	8	44	13	2				67
	82	84	16	3				185
8 »	4	19	4	2				29
9 »	2	12	7	1				22
10 »	1	17	28	4				51
11 »	1	15	37	1	1	1		56
12 »	2	7	7	2	1			19
13 »	1	8	10	6	1			26
14 »	1	7	14	5	1	2		29
	12	85	107	21	4	3		232
15 »	1	5	10	2	3			21
16 »		4	6	3	3			16
17 »		7	4	3	3			17
18 »		5	15	3	4	2		29
19 »		1	6	2				9
20 »		6	13	3	2	1		25
21 »		8	11	5	2	4		30
	1	36	65	21	17	7		147
More than 21 days	2	13	51	32	19	18	42	177
Total cases	97	218	239	77	40	28	42	741

canals, the majority or 624 of the cases were treated with this mixture. Nineteen cases were treated with chloramphenicol and 101 with a combination of all three drugs. Previously, favourable results of treatment of root canal infections had been obtained with neomycin-bacitracin by *Parmala and Pohto* (1954) as well as by *Søndergaard* (1956) and with chloramphenicol by *Bender & Seltzer* (1950), *Pohto* (1952) and *Eklöf* (1955).

The neomycin-bacitracin, mixture used was the Lääke Oy's product "Neotrasin" (Neomycin sulf. 1.66 g, bacitracin 3.33 g). It was mixed in sterilized distilled water and stirred into a thick paste, which was placed with a Lentulo needle into the root canal, which had been opened to the apex and considerably widened.

The chloramphenicol was the Lääke Oy's product "Klorita" (chloramphenicol 10.0, propylenglycol ad 100.0), which was applied in the canal with cotton. When using a combination of all three drugs, the "Neotrasin" and "Klorita" were mixed into a thick paste which was applied in the canal.

Table 1, which includes all 741 cases leading to a favourable result, clearly shows the progress of the medication in the various cases comprising the material in respect to both the number and duration of treatments. In 185 cases the antibiotic was in the canal for seven days or less, in 417 cases for fourteen days or less and in 564, or more than three-quarters of the cases for 21 days or less.

The longer the study proceeded, the less frequently, calculated on a per case basis, was the application of a medicament in a root canal repeated. This is shown in Table 2, in which the successfully treated cases are grouped per academic term.

Table 2

Number of treatments	Spring 1954	Autumn 1954	Spring 1955	Autumn 1955	Spring 1956	Total
1	1	7	20	22	47	97
2	8	15	53	51	91	218
3	26	59	56	47	51	239
4	11	16	17	18	15	77
5	13	12	7	6	2	40
6	10	8	3	3	4	28
>6	15	17	6	2	2	42
	84	134	162	149	212	741

As the number of treatments decreased toward the closing stage of the study, the duration of treatment likewise decreased. Table 3 shows the number of treatments performed for the fifty cases treated last and the total length of time used.

The results of the medication were checked be means of a sterility test. A root canal needle was not used for this purpose because the walls of a widened canal are often too hard for this. Instead, a sterile paper point was kept in the root canal, which had been cleansed with 3 per cent hydrogen peroxide, for 3—5 days. The specimen was checked for growth after 3—5 days.

Greatly differing opinions and recommendations have been presented in regard to sterility tests, e.g. by *Appleton* (1932), *Prader* (1937, 1949), *Schultz* (1946), *Shay* (1947), *Grossman* (1950), *Buchbinder & Bartels* (1951), *Strindberg* (1952) and *Bender & Seltzer* (1954). In all the sterility tests applicable to practical therapeutic measures, the result is always dependent on so many factors that a comparison between different proce-

Table 3

Antibiotic in root canal	Number of treatments I	II	III	IV
3 days	10			
4 »	5			
5 »		2		
6 »	4	3		
7 »	2	4		
3— 7 days, 30 cases =	21 +	9		
8 days		1		
9 »				
10 »		2	1	
11 »		4	1	
12 »		2		
13 »				
14 »		3		
8—14 days, 14 cases =		12 +	2	
>14 days, 6 cases =		3 +		3
Total 50 cases =	21 +	24 +	2 +	3

dures is extremely difficult and, in our view, not pertinent in this connection.

Judged on the basis of the sterility test, three of the 744 cases treated were unsuccessful. All three had been medicated with

a mixture of neomycin-bacitracin. During the long period of treatment, three sterility tests had been taken in each case. Since there were 624 neomycin-bacitracin cases, about 0.5 per cent were unsuccessful.

Altogether fifty-four cases were treated with chloramphenicol. Thirty-five were unsuccessful and were then treated with a combination of all three drugs. Therefore, they are included in this group in our material. A total of 101 cases were treated with a mixture of neomycin-bacitracin. No failures were met with in that group.

DISCUSSION

Sensitivity determinations were carried out with altogether 1039 specimens. In 868 such a determination was made with both the first day's and second day's specimen. This evidently gave a clearer picture of the situation than when the first day's specimen alone was used.

Variations in the growth on the first and second day were such that two specimens taken at the same time with the same method from the same root canal did not always end up with a logical proportion of growth. For instance, in spite of a plainly observable growth in the first day's specimen, the second day's specimen might lack perceptible growth.

Such unequal and weak growths are partly due to an imperfect technique of taking specimens and partly to weak microbe strains.

Taking into account both the first day's and second day's growth, the combination of neomycin, bacitracin and chloramphenicol was effective, according to the sensitivity tests, in over 90 per cent of the cases in our material, being conspicuously more effective than chloramphenicol alone. It was also more effective than the mixture of neomycin and bacitracin, although the difference was not very great.

The adoption by our institution of the new medication treatment described in the present report did not immediately lead to a clearly observable improvement in treatment results. Earlier methods and concepts regarding the length of treatment retarded progress. For this reason, the situation underwent a change for the better only gradually, until finally, at the closing stage of

the study, it improved decisively. Thus, at the end of the study, rarely more than two treatments were needed. Correspondingly, the length of time of a drug remaining effective in the root canals shortened and seldom exceeded two weeks during the closing stage.

In the majority of our cases, the mixture of neomycin and bacitracin was applied with success. This mixture may therefore be considered suitable in the medication of infected root canals, especially in view of the fact that the present investigation was carried out under conditions closely ressembling those prevailing in daily dental practice.

SUMMARY

Sensitivity determinations of specimens taken from the root canals of 1039 teeth were performed by using chloramphenicol, a mixture of neomycin and bacitracin, and a combination of all three as medication.

Altogether 957 of the specimens showed growth in a culture of liver broth. Of the microbes 48.3 per cent were resistant to chloramphenicol, 12.8 per cent to neomycin-bacitracin and 7.2 per cent to the combination of all three antibiotics.

Inasmuch as the purpose of the investigation was to ascertain particularly the suitability of neomycin-bacitracin in the treatment of infected root canals, the largest number, viz. 624, of the cases were treated with this mixture. Three cases, or 0.5 per cent of the total number, were unsuccessful, according to sterility tests.

RÉSUMÉ

LE TRAITEMENT MÉDICAMENTEUX DES CANAUX RADICULAIRES INFECTÉS ÉTUDIE SUR LA BASE DE PLUS DE 1 000 DÉTERMINATIONS DE SENSIBILITÉ MICROBIENNE

Des déterminations de sensibilité microbienne furent faites sur des spécimens prélevés des canaux radiculaires de 1039 dents, en se servant, à titre de médicaments, de chloramphénicol, d'une mixture de néomycine et basitracine, ainsi qu'en employant tous les trois en combinaison.

957 de ces spécimens se développèrent dans le bouillon hépatique. Parmi les colonies qui s'étaient développées, 48.3 % furent

résistantes au chloramphénicol, 12.8 % à la néomycine-basitracine, et 7.2 % à une combinaison de ces trois substances.

Comme l'objet principal de cet examen était d'éclairer les résultats du traitement médicamenteux par la néomycine-basitracine des canaux radiculaires infectés, la plupart de ces cas, soit 624, furent traités par ce mélange. Parmi ceux-là 3 cas, soit 0.5 %, échouèrent selon les tests de stérilité.

ZUSAMMENFASSUNG

ÜBER DIE MEDIKAMENTÖSE BEHANDLUNG INFIZIERTER WURZELKANÄLE AN HAND VON ÜBER 1 000 WIRKSAMKEITSBESTIMMUNGEN

An Proben, die Wurzelkanälen von 1039 Zähnen entnommen waren, wurden Wirksamkeitsbestimmungen mit Chloramfenikol, Neomycin-Basitracinmischung sowie mit einer Kombination aller drei Medikamente vorgenommen.

In Leberfleischbrühe zeigte sich Wachstum bei 957 Proben. 48,3 % der gewachsenen Stämme waren resistent gegenüber Chloramfenikol, 12,8 % gegenüber Neomycin-Basitracinmischung und 7,2 % gegenüber der Kombination aller drei Antibiotica.

Da die Versuche angestellt wurden, um insbesondere festzustellen inwieweit sich die Neomycin-Basitracinmischung zur Behandlung infizierter Wurzelkanäle eignet, wurde die Mehrzahl der Fälle (624) hiermit behandelt. Nach vorgenommener Sterilitätsprobe erwiesen sich nur 3 Fälle oder 0,5 % als misslungen.

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