

ART. XV.—*On the Treatment of the Pulps of Teeth with Sublimate.*^a By ARTHUR W. W. BAKER, M.D., F.R.C.S.I.;
University Examiner in Dental Surgery.

IT may, perhaps, be familiar to members of this Club that it is frequently necessary in dental practice, in order to save teeth, to devitalise the nerve, or tooth pulp, as it is more correctly termed. The drug we most frequently employ for this purpose is some preparation of arsenious acid (As_2O_3). The preparation which I generally use is arsenic made into a paste with creasote and a little morphia.

At subsequent visits the devitalised pulp is removed with small barbed broaches, while the root canal is rendered aseptic and filled. Under these circumstances, although the pulp is removed the root is not dead, as it still maintains its connection with the root membrane, and may be retained for a considerable period as a useful organ.

While such a method of treatment as I have mentioned is comparatively easy to carry out, as far as regards teeth with single roots, such as we have in the front of the mouth, it is not quite so simple when we come to deal with the bicuspid, and its difficulty increases in direct ratio as we approach cavities situated on the distal surface of the wisdom tooth, and as we are called upon to treat the pulp in the buccal roots of upper molars and the anterior roots of lower molars.

Consequently, dentists have for some time been experimenting in the direction of finding some substance which, when applied to the pulp, would embalm it, and at the same time leave it *in situ*, as the most perfect root-filling. I may mention that under ordinary conditions if devitalised pulp is left in the root of a tooth it sooner or later becomes septic, and suppuration follows in the root membrane.

In the August number of the *Dental Cosmos* for 1890, Professor Miller, of Berlin, published an interesting series of experiments, conducted with the object of determining what antiseptic was the most suitable for the purpose of preventing decomposition of the pulp. He employed for his experiments the pulps of calves' teeth, which he introduced into small glass tubes open at both ends, one

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end being drawn to a point—in short, there was a glass tooth in which the whole process could be observed. The pulp in this glass tooth was then infected at one or both ends, the antiseptic to be tested placed in the larger end in contact with the pulp, covered lightly with a little plug of cotton, sealed with wax, and dropped into a test tube partly filled with agar, the small tube being allowed to penetrate a short distance into the agar. The test tube was then plugged with cotton, capped with a rubber cap, and placed in an incubator. In this way the penetrating power of the antiseptic could be easily seen. After a certain time these pulps were removed from their tubes, placed on plates of agar, and the development of bacteria noted.

In this way, up to August, 1890, Professor Miller had made 393 separate experiments, in which he tested the action of chloride of lime, oil of wintergreen, oil of peppermint, oil of cinnamon, chloride of zinc, iodoform, borax, boric acid, salicylic acid, benzoic acid, thymol, carbolic acid, chlorphenol, α - and β -naphthol, hydro-naphthol, campho-phenique, sozoiodol, Lyster's new antiseptic, sulphate of copper, iodol, sulphocarbonate of zinc, cyanide of mercury, resorcin, and many other antiseptics of more or less repute.

When at the International Medical Congress in Berlin my friend, Professor Miller, kindly showed me some of his experiments then in progress in his laboratory at the Dental Institute. Believing that this method of treating pulps was likely to be of use in certain cases, I determined to try the perchloride of mercury in practice, it being the drug which seemed to offer most chance of success. The cases which, in my opinion, justify this method of treatment are those—

1st. In which it would be impossible to reach the roots without removing so much of the tooth as to materially weaken the organ and render it liable to be broke in mastication.

2nd. Where the removal of the root pulp would cause the patient an amount of pain out of proportion to the value of the tooth.

3rd. In hospital cases, where the ordinary operation of filling roots is rendered impossible by the patient being unable to attend sufficiently often.

With regard to the cases in which I have tried this method of treating pulps I have notes of 25 consecutive cases, ranging over the first ten months of 1891. As I have been unable to trace

the further history of four of these cases I have not included them in the table which I have drawn up.

The method adopted was—in the first place to devitalise the pulp with arsenic. This was done in all cases but one, to which I shall refer later. At the next visit the arsenic was removed and the cavity prepared for filling. On the devitalised pulp were placed a few crystals of sublimate, covered with a little pledget of cotton soaked in alcohol, sealed with oxyphosphate of zinc cement, and the remainder of the cavity filled in with amalgam or cement.

The 21 cases which I have tabulated vary in age from 14 to 50—of these 7 were males and 14 females. The teeth treated comprise 9 bicuspsids and 12 molars—of these teeth 15 were in the lower jaw and 6 in the upper. In 13 of these cases I have been able to verify their actual condition by personal observation, but in 8 I have had to rely on replies by letter to the following questions:—

1. Have you had any pain which you were able distinctly to refer to this tooth?

2. Has any swelling or gumboil formed close to its root?

3. Does it present any appreciable difference in colour to its neighbours?

In these cases I have been able to ascertain their subsequent history at periods varying—

Between 5 and 12 months in 12 cases.

„ 1 „ 2 years „ 5 „

„ 2 „ 3 „ „ 4 „

These records show that of the 21 cases 17 were successful—that is to say, that the tooth was perfectly comfortable, and that there was no evidence of the patient having had any inflammation about the root when last observed. Although of these cases which I think I may fairly claim as successful I was not able to observe 7 for periods longer than from 7 to 12 months, still, viewing them in the light of the cases I have been able to observe for a longer period, if inflammation were likely to occur about the root there would have been some evidence of it during the period when they were under observation.

Of the three cases in which there has been slight periodontitis it has never amounted to more than temporary inconvenience, not preventing the use of the tooth at other times, and is a condition which sometimes follows the more usual method of root-treatment. In one of these three cases I may remark that the patient had had

an attack of periodontitis prior to my treatment, which, of course, would render its recurrence extremely probable.

The application of the perchloride of mercury to a pulp is said to cause a good deal of pain for a short time. I have only observed slight pain in two cases. This absence of pain was rather striking in one case where I applied sublimate, without a previous application of arsenic. The patient was a young soldier, who came to me in a good deal of pain with a lower molar. In removing the decay I accidentally exposed the pulp, which revealed a minute abscess of the anterior cornu. I at once applied sublimate to the pulp, and filled the tooth; he returned the next day, saying he was perfectly comfortable. Thirteen months later he wrote to me saying that the tooth, while of an ashy grey colour, had always remained comfortable.

The colour which the tooth that has been treated with sublimate assumes is decidedly objectionable; but as this method is only used towards the back of the mouth, where appearance is of less consequence, and when it becomes a question between discoloration and losing the tooth, I think we may fairly put aside æsthetic considerations.

One case, however, was a complete failure; at the same time this case is so instructive, showing what takes place when there is no antiseptic in contact with the pulp, that I may be excused if I inflict on you its history:—

CASE.—In November, 1891, a medical friend came to me with an inflamed pulp in a left lower first molar; the cavity was situated at the distal surface of the tooth. I applied arsenic, and sent him away. The application of arsenic caused a considerable amount of pain for some hours—in fact, he said it was the worst pain he had ever suffered. Subsequently I treated this pulp with crystals of sublimate, covered with a little plug of cotton, sealed the pulp chamber with cement, and filled in with amalgam. This tooth was never quite comfortable, the patient constantly complained of a certain amount of inflammation in the root membrane, so that five months later I was obliged to remove the tooth, as the patient had a severe attack of throbbing pain, which, combined with tenderness on pressure over the root, indicated commencing apical abscess.

Dr. Ball kindly gave gas, and I removed the tooth. On examining the tooth I found the filling perfect in every respect; there was a patch of inflamed root membrane on the posterior root, but no evidence of pus. The tooth was of a greyish colour, but darker as regards the posterior

root. I washed it in water and placed it in sublimate lotion for a short time. I then split the tooth with a sterilised forceps, holding it in sterilised bibulous paper, and found that the lower two-thirds of each root contained pulp alive and deeply injected, while the upper third of each root and the pulp chamber contained pulp in a condition of black moist gangrene, having its characteristic odour.

From the contents of the pulp chamber I made plate, line, and stick cultures on both gelatine and agar, also potato cultures; the result gave an almost pure culture of *staphylococcus cereus albus* (of which there is an impression preparation under the microscope). The conclusion that I came to from the examination of this tooth was, that in my anxiety to place as small a quantity of sublimate as possible in the tooth I had put in almost none, or that it possibly got displaced in filling the tooth. My experience in this case pointed forcibly to the fact that crystals of sublimate were difficult to manipulate successfully in awkwardly situated cavities, and that some more convenient form of the salt must be found; also that the question of the dose necessary to permeate the pulp must be determined. With these two objects in view I repeated Professor Miller's experiments on a small scale.

For purposes of experiment I procured the lower jaw of a calf, or, more properly, what is known in the trade as a beast—that is, an animal with the first permanent molar lately erupted—the molar pulp, consisting of four or five separate lobes, each practically a pulp complete in itself, being very convenient for this sort of work. For the little glass tubes in which they were placed I am indebted to my friend, Dr. Piel, who kindly manufactured an abundant supply. The pulps were introduced with a thread into the small tubes, infected from a mixture of recently extracted teeth in water, through the larger opening of the tube, treated or not with sublimate, covered with a little ball of wool, sealed with wax, and dropped into a tube of agar, as I have already described.

In these experiments I tried the effect of a paste composed of 5 grammes of sublimate, a little gum tragacanth, and a few drops of glycerine.

I took five tubes containing pulps all infected. To No. 1, which was the control tube, no sublimate was added; it was placed in the incubator standing at 35°C., and at 10 and 24 hours later respectively its appearance was unchanged, being red and vascular. At the end of a week the agar in the test tube was partly lique-

fied, the cotton wool in the small tube nearly black, and the pulp itself gangrenous and foul-smelling. It was transferred to a plate of agar, and again placed in the incubator. At the end of two days colonies of various sorts had developed all round, while a month later the pulp had completely gone to the bad, and the colonies had extended halfway across the plate.

To tube No. 2 I applied $\frac{1}{8}$ grain of sublimate in powder, also placed in the incubator, and observations at the end of 10 and 24 hours showed that the salt had penetrated about halfway down the pulp.

To tube No. 3 $\frac{1}{4}$ grain sublimate paste was added; at the end of 10 hours this had penetrated nearly to the apex. A week later I found the agar in the test tube was infected from the outside of the small tube. On removing the pulp from the tube and placing it on a plate of agar I found no change in the cotton wool, and that the sublimate had gone quite to the end of the pulp. Two days later there was a white areola, corresponding in size and shape to the pulp, all round it, due to the diffusion of the sublimate in the agar. A month later this pulp was perfectly stiff and unchanged, surrounded by an antiseptic zone, which completely prevented colonies from the other pulps on the same plate reaching it.

To tube No. 4 I added $\frac{1}{8}$ grain of the paste; this at the end of 10 hours had penetrated three-quarters of the pulp, and at the end of a month, on the plate of agar, showed some colonies round the apex.

No. 5 tube was given $\frac{1}{4}$ grain of paste, and at the end of 10 hours it was greyish-white nearly to the apex.

The conclusions which I think may be fairly deduced from these experiments are :—

1st. That in order to obtain a satisfactory result at all, one must apply enough of the drug, for in tube No. 4, where $\frac{1}{8}$ of a grain was used, there was evidently not enough sublimate for the size of the pulp.

2nd. That for equal doses the paste penetrates more rapidly than the powder.

3rd. Taking into account the difference in size between a calves' pulp and a human pulp, the dose to apply to the latter need not exceed $\frac{1}{8}$ of a grain—that is, a portion of paste about the size of the head of a fairly large pin would be amply sufficient.

The amount of mischief which an untreated dead pulp is capable of generating will at once be seen on glancing at the story of tube No. 1.

In practice I now use the paste, and instead of applying it with a steel instrument I use a platina needle, in order to avoid a possible source of discoloration. I do not now cover the paste with a little pledget of wool as I consider it quite unnecessary. Professor Miller has recently suggested for the purpose, for use with his tabloids, a gold cylinder; to my mind gutta-percha would be better, as, of course, the mercury enters rapidly into combination with the gold, and, therefore, less is left for penetrating the pulp.

My assistant, Mr. Anderson, thinks—and I quite agree with him from a study of my own records—that, in order to obtain the best results, it is well, if possible, to remove the coronal pulp, and to apply the perchloride directly to what pulp remains in the roots.

Professor Miller, in a communication to the World's Columbian Dental Congress, held last August in Chicago, gave the results of his researches in this direction up to that date. He recommends the use of small tabloids composed of sublimate and thymol, of each 0.0075 gramme; he adds that "the thymol is designed to prevent the sublimate being so rapidly absorbed, besides giving a greater permanency to the application by reducing its solubility. Very seldom, so far, has pain followed the use of these tablets, while experiments out of the mouth show that they still possess sufficient penetrating power."

Professor Miller kindly sent me some of these tabloids, and my experience of them up to the present has been very favourable, besides their being very convenient to use.

In conclusion, I do not wish to be understood as advocating this method of treatment in other than exceptional cases, such as I have already defined; in these it is certainly deserving of trial, and, as I have endeavoured to show by the records I have brought forward, gives us a fair chance of preserving teeth for a further term of usefulness, which otherwise would be a possible source of future trouble to their owners, or be radically cured by the forceps.

Pulps treated with $HgCl_2$.

Case No.	Age	Sex	Date of operation	When last seen	Tooth	Previous Treatment	Remarks	Colour	No. of months from operation to last visit
1	25	F.	3 Jan., '91	24 Dec., '92	L. L. M. ₃	As ₂ O ₃	Has had pain in cold winds, when all teeth pained. No gum-boil or root trouble	Dark grey	24
2	40	F.	3 Feb., '91	26 Feb., '94	L. L. M. ₁	Do.	Quite comfortable. No root trouble.	Dark	36
3	21	M.	2 Feb., '91	30 Mar., '92	Do.	None	Do.	Grey	13
4	33	M.	7 Feb., '91	17 Feb., '92	R. L. B. ₃	As ₂ O ₃	Do.	Dark	12
6	45	M.	31 Jan., '91	17 Mar., '92	L. L. M. ₁	Do.	Do.	Not dark	15
7	18	F.	11 Feb., '91	19 Mar., '92	R. U. M. ₁	Do.	Do.	No change	13
8	30	F.	12 Feb., '91	Do.	R. L. B. ₂	Do.	Do.	Dark	13
10	25	F.	26 Feb., '91	24 Nov., '91	L. U. B. ₁	Do.	Do.	Do.	9
11	40	F.	15 April, '91	19 Mar., '92	L. L. B. ₂	Do.	Do.	Do.	11
12	40	F.	Do.	Do.	R. L. B. ₃	Do.	Once had slight pain.	Do.	11
13	18	F.	5 May, '91	Do.	R. L. M. ₁	Do.	Quite comfortable.	Do.	10
14	50	M.	6 May, '91	2 Mar., '94	L. L. M. ₃	Do.	Says it is sometimes a little tender; but I was unable to detect any evidence of root trouble	Dark	34
16	18	F.	13 May, '91	19 Mar., '92	L. L. M. ₁	Do.	Quite comfortable. No root trouble.	Do.	10
17	30	M.	30 May, '91	1 Mar., '94	R. U. B. ₁	Do.	Slight periodontitis occasionally. No root trouble	Dark at neck	34
18	25	M.	10 June, '91	2 Mar., '94	L. U. B. ₂	Do.	Quite comfortable. No root trouble.	Dark	33
19	15	F.	25 July, '91	21 Mar., '92	L. L. B. ₁	Do.	Slight tenderness over root. No gum-boil	Grey	8
20	14	M.	27 July, '91	9 April, '92	L. L. M. ₁	Do.	Quite comfortable. No root trouble.	—	9
21	30	F.	28 July, '91	19 Mar., '92	L. U. B. ₁	Do.	Slight pain immediately after filling; otherwise all right	Dark	8
22	40	F.	30 July, '91	17 Mar., '92	R. L. M. ₁	Do.	Quite comfortable. No root trouble.	Do.	8
23	25	F.	5 Aug., '91	18 Mar., '92	R. U. M. ₁	Do.	Quite comfortable. No root trouble.	Ash grey	7
24	30	M.	Oct., '91	24 Mar., '92	L. L. M. ₁	Do.	Complete failure	—	5

^a These patients answered by letter.^b This patient has had an abscess in the right lower jaw at the root of an adjoining tooth; the pain may have been caused by this.^c There was an attack of periodontitis in this tooth prior to my treatment.

Experiments with Calves' Pulp.

No.	Treatment.	Ten hours after.	Twenty-four hours after.
1	Infected; but no sublimate	No change in colour; red and vascular	Unchanged
2	Infected; $\frac{1}{8}$ gr. sublimate powder	Greyish white; about half way down	Same
3	Infected; $\frac{1}{8}$ gr. sublimate paste	Greyish white; nearly to apex	White down to apex
4	Infected; $\frac{1}{16}$ gr. sublimate paste	Greyish white; $\frac{3}{4}$ way down	Same
5	Infected; $\frac{1}{8}$ gr. sublimate paste	Greyish white; nearly to apex	Same

Above tubes were left for one week in an incubator at 35°C., at the end of that period three of them were removed to a plate of agar and replaced in incubator.

No.	Condition when removed.	Two days after.	A month after.
1	Agar liquefied; cotton wool nearly black; pulp gangrenous and foul-smelling	Colonies of various sorts all round	Completely gone to the bad; colonies spreading half way across plate
3	Agar infected from the tube; cotton wool unchanged; sublimate had penetrated to apex	White areola, corresponding in shape and size of pulps all round, due to HgCl_2	Stiff; unchanged; no colonies; line of demarcation due to sublimate
4	Ditto; sublimate did not get as far as apex	No development of colonies	Soft-looking; apex black; well-marked colonies round apex

ART. XVI.—*Ruptured Tubal Pregnancy, with Intra-peritoneal Hæmorrhage, successfully treated by Abdominal Section.** By ALFRED J. SMITH, Ex-Assistant-Master, Rotunda Hospital; Examiner in Midwifery, Royal University; Professor of Midwifery, R.U.I.

THE number of successful operations for the radical cure of ruptured tubal pregnancy, where the hæmorrhage was peritoneal, have been extremely few in Ireland; in fact, I can only find a

* Read before the Obstetrical Section of the Royal Academy of Medicine in Ireland, on Friday, April 13, 1894.