

Replace on the used one and wrap the plate and die with one covering of cheese cloth or thin paper, place in the Parker shot-swaging device and swage.

The plate cannot now be removed from the die but by placing the same in hot water the metal will run out of the plate, leaving it unchanged in shape.

It can now be polished and after transferring the relief from the old die to the unused one, the plate is sprung onto it and swaging with shot and melting the metal out as before will leave the plate with an adaptation that cannot be procured by any other method. In taking an impression for metal castings, it should be a little thicker than usual and any number of dies can be made from the same impression, all of which will be alike.

The compounding of this alloy requires the greatest of care in protecting it from the action of the air during the first melting and in the manner of adding the metals as it never again approaches the first heat except by carelessness, the metal will remain permanent in composition and working qualities indefinitely.

The necessary expense of this alloy, which at first may seem unreasonable, will be saved in the saving of time in one difficult case.

After two years of constant use of this metal I can positively state that it will meet all the claims of this clinic.

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Some Hard Cases for Cataphoresis With Suggestions.*

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THIS paper should be prefaced by a chapter on the general principles underlying and governing the practical application of cataphoresis to the dental organs, which has been omitted.

This subject was chosen for two reasons: First, to bring out a discussion upon this practical subject; and second, to answer some of the many inquiries that have come to me.

In the following, where the expression occurs that "the pain limit is low," we mean that a very weak current produces pain,

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and when "high," a very strong current will be required before pain is produced.

Suppose a bi-cuspid, with large buccal cavity, including the loss of the buccal cusp, from a line extending from the sulcus to the gingivæ. The resistance of the tooth high, say 75000 ohms, and the pain limit very low, say 0.00002 amperes, or one fiftieth of a milliamperes of current the maximum the tooth will tolerate. In this case, the distance to the pulp is short, and relatively the resistance from the surface to the pulp at a point right over it is very much less than at a point near the margin of the dentin; probably not more than 1-10 as great. In this particular case we are to get anchorage grooves for a metallic filling, and of course they must be made near the margins, otherwise the life of the pulp would be endangered. The conditions existing are as follows,—an extremely sensitive tooth with a very low pain limit, and high resistance, which means that necessarily the process of anesthesia will be slow, and more certainly it would take place most rapidly in the path of least resistance, viz.: directly toward the pulp. This is just the part that cannot be utilized, and the margins, where the retaining forms must be obtained, are but slightly obtunded. Of course the obtunding of the whole tooth will be secured with the anesthesia of the pulp, but that, in this case of so low a pain limit, would be a very long operation; probably not less than thirty or forty minutes. Besides it is going away around to produce what we want, viz.: the obtunding of the dentin at its margins. We will suppose the decay to be removed if necessary by a short treatment in the ordinary way. Now cover all the dentin with oxyphosphate cement or chloropercha, except where the retaining grooves are to be made, and apply as usual, and it will be found that in very much less time, these grooves can be cut painlessly. This simply concentrates the energy to the part we wish to anesthetize.

ONE OF THE MOST DIFFICULT CONDITIONS TO COMBAT

is that of a secondary deposit of dentin, either in the pulp chamber, or the tubuli. In these cases, and especially the latter, the sensitiveness is sometimes very acute, even extreme, notwithstanding the fact that the dentinal fibres have been reduced in size to a very great extent. In typical cases of this condition the resistance through the tooth to the pulp, runs up to hundreds of thousands of ohms.

A typical case was as follows: A superior left cuspid in which both mechanical and chemical abrasion had denuded the entire occlusal surface almost to the pulp line. The dentin exhibited a surface almost as hard and smooth as glass, and extremely sensitive. The bite was such that no protection could be put over the nearly exposed pulp, which was the source of extreme discomfort and inconvenience to the patient, who was about fifty years of age. Two things were indicated: the protection of the tooth by a gold filling and the previous destruction of the pulp. Everything was adjusted as usual, and the current allowed to run while inserting a large gold filling in another tooth. The current was increased to 42 volts from dry cells and the patient felt no sensation. A milliampere meter, reading in fifths, showed no accurate reading, but the Rowland D. Arsonval galvanometer, which is adjusted to read in decimals of amperes, registered 0.000093, making the resistance of the tooth approximately 450,050 ohms. The current was allowed to run for an hour, while completing the other operation, when to my great surprise, only the surface, and to a very slight depth was anesthetized, and below that it was positively unbearable. Of course I was chagrined and disappointed, and especially so that it had happened with this particular patient. A new appointment was made, to give me an opportunity to study the case. The next application was made as follows: The entire surface was covered with cement, quite thick, and a small bur, about No. 5, used to drill a hole through it, directly over the pulp. We were forcibly reassured of the extreme sensitiveness of the dentin when the bur reached it. The anode was placed in this small hole, which was a very small platinum wire twisted with some fibres of cotton, and was kept moist with an aqueous solution of cocaine nearly saturated. The voltage was increased to 72 from dry cells, without pain. The amperage was 0.00013, showing the resistance to be about 550,000 ohms; the increase of resistance over the first application, is of course explained by the diminished cross sectional area of the path through the dentin. In ten minutes I drilled almost to the pulp without sensation, and reduced the resistance just half, viz.: to 275,000 ohms. Another application was made of 0.00026 amp. at 72 volts, for fifteen minutes, when the entire pulp was removed with the drill and a broach, without a particle of sensation, and the operation completed at once. This method

comes into service very often, as for example the rapid anesthesia of a pulp in any denuded and broken-down tooth, requiring to be crowned, or where a great deal of sensitive surface must be operated upon, as in chemical abrasion of a molar. In this latter case, the pulp may be anesthetized for a time, and not injured nor approached, thereby allowing the tooth to be worked upon at will for the time.

The other form of secondary deposit, viz.: within the pulp chamber, thereby forming a dense protection, is occasionally the source of much hindrance to cataphoresis. As these are best demonstrated by actual cases, the following is a typical case: A right superior lateral which had been the source of constant neuralgia for months, and extremely sensitive to thermal changes applied to the tooth at any point; caries was so extensive that anchorage could not be had for a gold filling without using the pulp chamber, which with the above abnormal conditions, indicated the destruction of the pulp. Application was made while inserting another gold filling. The pain limit was found at 0.00002 amperes, or 1.50 of a milliamperere and 26 volts, making the resistance 130,000 ohms. This was surprisingly high. When I undertook to drill into the pulp chamber, I found it receded, and although the current had been running long enough to anesthetize perfectly, I found that directly toward the pulp it was still sensitive, though in some directions around this point, there seemed to be perfect anesthesia. This was apparently a perfect failure. From the figures and the conditions, I decided after studying the case, that the resistance to the pulp was greater than the resistance to the margins around the tooth, and the current was probably mostly going in that direction instead of towards the pulp. Accordingly the rubber cloth was forced up under the gum and a piece of gutta-percha placed between the gum and the tooth where the shortest circuit seemed probable, and another application was made with good success in a few minutes.

THE PAIN LIMIT.

It occasionally happens that we want to remove the pulp for immediate filling, in a bicuspid or sometimes a molar. Probably the patient has come some distance and it will be a great convenience to complete the operation at the same sitting. It frequently happens that after using cataphoresis for some time, which we

think should be long enough, we try to drill out the pulp, and find suddenly at some point there is very definite sensation. Perhaps we make another long application, and this point is but slightly improved. This is certainly discouraging, and I confess I have been quite inconvenienced by it. What is the explanation of it? Perhaps it is a crown cavity where we are sure our insulation is perfect. I have never found just this condition in a single rooted tooth. Time will not permit us to discuss in this paper the conditions which determine the pain limit. It is a fact, however, that nearly every root of a two or three-rooted tooth has a distinct and different pain limit from the others. It will not follow that the one, with the lowest pain limit, or is the most sensitive to the current, is getting the most current; indeed it may be quite the reverse, as is easily demonstrated. In the case we will suppose, which is like many I have detailed records of, the resistance in the most sensitive root is probably several times that in the other root, say it is ten times as great. Of course, then, ten times as much current is passing through the other root, and on account of the greater density of current, that root of least resistance is anesthetized much more rapidly. All the time the total amount of current used is determined by the pain limit of the tooth, which simply means, by the pain limit of the most sensitive root, which in this case, is the one getting the least current. As the process of anesthesia advances, it is not proportional in the different roots, consequently the rise of pain limit is not proportional. Probably in one root it has advanced from 1.10 of a milliampere to one-half in twelve minutes, while in another root from 1.50 to 1.45 of a milliampere. Here, clearly, the root of lowest pain limit, or greatest sensitiveness, is determining the rate of increase for the whole tooth, and long before this root is perfectly anesthetized, the other is so complete, that we have been losing great quantities of energy to no avail, or probably to a deleterious effect at the apex of one of the other roots. I have almost always found in these cases that after twelve or fifteen minutes I could remove the pulp without sensation from one root of a two-rooted tooth or probably two from a three-rooted tooth. Now just here lies our opportunity to save time. Plug these roots up with some cotton and sandarac, or gutta-percha, and concentrate the energy on the remaining root, and the results will be very gratifying.

One of this class was as follows: Tooth, lower left first permanent molar, patient about twenty-five. Large suppurating exposure had been giving considerable trouble. Operation had to be completed at the same sitting. On applying cataphoresis the pain limit was reached at .12 milliampere or twelve one hundred thousandths of an ampere. The voltage was 4 and the resistance 33330 ohms. The medicament used was a saturated solution of cocain in guaiacol, though I generally use hydrochlorate of cocain in distilled water. On using for ten minutes the pain limit was raised to .25 milliampere and the voltage to 8, making the resistance of the circuit 32000 ohms. The contents of the pulp-chamber were removed with a drill without sensation, except one place which was over the anterior root; a second application was made when the pain limit was reached at 0.23 milliampere, with a voltage of 5.3, making the resistance of the circuit 26840 ohms. On examination I found the anterior root still sensitive, and no sensation in the posterior root, even beyond the apex, which had a large foramen. The tissue was entirely removed from this, and the root filled with a gutta-percha plug, and a new application made, when the pain limit was found at 0.15 milliampere, with 9.3 volts, making the resistance of this root 62000 ohms. In eight minutes the pain limit had raised so that the current was increased to 0.7 milliampere, and the tissue of this root entirely removed without sensation, and both filled at once. I have had this condition duplicated several times in two-rooted bicuspid, and have used this treatment to good advantage.

DIFFICULT CASES.

Probably one of the most common difficult cases is found where there is confined suppurative inflammation in the pulp, and in which the current produces pain apparently by the pressure of the gas developed. These cases are very easily recognized with the milliampere meter, for instead of the pain limit getting higher it recedes. If it is not pronounced it will probably turn in a few minutes and proceed normally, but if very marked lowering of the pain limit is present, it has been almost always the case in my experience that on removing the anode, and carefully raising the residual decay over the nearest point to the pulp, pus will escape. This is a very strong indication of this condition, and with a very sharp excavator, the decay is easily raised without pain. After

the escape of the pressure, the cataphoric application will be usually normal.

IS COCAIN DISORGANIZED BY THE ACIDS OF PUS ?

Considerable study has been made, to see if the organic acids of the pus did not disorganize the alkaloid cocain, thereby destroying its therapeutic action. In passing 0.00025 amperes through a layer of first 10 per cent. solution of cocain hydrochlorate, then a layer of pus and a layer of surface water, separated by porous partitions in a long glass tube, as also at the same time a series with blood, and one with water instead of pus, for twenty-five minutes, we found no great difference in the amount of cocain present in each, though apparently some less in the pus tube. I am not satisfied yet as to the perfection of this test, having made but one. Sometimes we get

CASES WHERE IT IS PRACTICALLY IMPOSSIBLE TO RETAIN THE ANODE.

For example, a broken down bicuspid or lower molar with large sensitive exposure. The patient could not endure to have an electrode held on the exposed pulp. A convenient method of retaining it is, after drying; lay a piece of dry cotton over the point of exposure, and flow cement over it. As soon as it stiffens, puncture a hole through the cement to the dry cotton. Saturate it through the hole with medicament and wedge with cotton the small soft wire anode in the hole. This perfectly insulates the tooth from the surrounding gum and clamp, and holds the anode perfectly. I think it is seldom advisable to try to do two cavities at once; have a double apparatus, and do them separately, it saves lots of time.

MAJORITY OF FAILURES ARE FROM SIMPLE CASES.

The cases I have just cited are quite exceptional and are only a very few of the exceptional cases. However, in my judgment by far the great majority of failures come from the simple easy cases through nothing more nor less than imperfect insulation. Gentlemen, I do not believe there are a dozen operators in the state, who in a score of cases actually get fifty per cent. of the current they use through the tooth they are obtunding. I very often find ten times as much current leaking as is going through the tooth. The fact is that putting a rubber over a wet

tooth, and fastening it with a clamp, and perhaps a single or double waxed ligature to assist in holding the rubber is not, except in the rarest cases, an insulation to the current.

The ligature soon gets wet, the clamp touches the wet tooth and gum, and if you will test one hundred of the cases adjusted in this way, I am sure you will find fully 95 that will have much less resistance than the average tooth. It is an easy matter to test them; of course a milliamperere meter is essential. And by the way, I believe the time is not far distant and should be here now, when it will be considered positively malpractice for a dentist to use cataphoresis without a milliamperere meter. It would be just as reasonable to send a locomotive engineer out with his load of human freight without a steam guage or a safety valve. But some one says the pain limit is the safety valve. Oh, no, it isn't. Suppose a nerve is saturated with cocain, what power has it of crying out when a destructive amount of current is passing through it? Let me cite a case: A large buccal cavity in superior left third molar presented which had been aching intensely and had apparently a large congested exposure. Very sensitive to suction and positively unbearable to touch. I agreed with the patient that it should be devitalized, which I proceeded to do with cataphoresis. The toothache stopped, and although I started with one-tenth of a milliamperere of current, in ten minutes the pain limit had raised to one milliamperere. I removed anode and took large bur to cut out the main portion of the pulp when to my surprise it did not fall through. I examined and found the aprarent exposed pulp to be a piece of an apple. On removing all of the decay there was no exposure. I filled, using a non-conductor liberally beneath the filling. In just three months the patient came tearing into the office holding his face with the regulation abcessed tooth. The current had killed the pulp. This was bad diagnosing, but showed that the current in excess destroyed the pulp.

Cataphoresis in the hands of the lazy, reckless, unskilled dentist, will be a positive curse to humanity; while in the hands of the earnest, thoughtful, skillful dentist, it is one of the greatest blessings that has ever come to us.

SUCCESS WITH CATAPHORESIS

is synonomous with competency, and this will always be the case. You show me in the coming decades a man who is practising den-

tistry simply for what he can get out of it, while putting just as little as he can into it, and I will show you a man who isn't having success with cataphoresis. Time will develop two things, viz. : a clear conception of all the phenomena of cataphoresis, and the most consistent practical application of the process. If any critic is unsuccessful the reflection will not be upon cataphoresis, but entirely upon himself.

Is it not truly wonderful that a subject which has taken months and months of careful investigation on the part of some earnest investigators to secure a few fundamental principles, with very accurate and delicate apparatus, could be weighed and appreciated and its future prescribed by some others in a few weeks, with very inferior apparatus. I mention this because I have taken the trouble to investigate to find with what authority some critics have spoken, and have found that scarcely any had milliamperemeters, and most had such crude apparatus as the present stage of advancement would deem a guarantee of failure owing to their deficiency. We know that many teeth have so delicate a sense of pain to variation of current that they will respond with severe pain to the variation of the two-hundred-thousandth of an ampere, and some to much less. Now suppose we try to use some of the early instruments on this case. For example, a short column of surface water, say five inches. This would have a total variation of about 5000 ohms. Now to give a variation of current less than the above, at say 10 volts, the plunge would have to drop less than the one-hundredth of an inch through the first inch, which was a mechanical impossibility as they were adjusted. If it dropped one-tenth of an inch the current would raise away beyond the pain limit and produce intense pain. They could not give success in such cases, nor could any of the early instruments, and I have not seen a modern type that has as fine adjustment as very many teeth demand. The future must furnish these two things: instruments of a greater total and more gradual variation, and more knowledge, for as yet we scarcely know the alphabet of the subject. It was my purpose to publish a quantity of data showing the extent of time and the amount of current required at the beginning and ending of each operation and size of cavity and medicine used for a great variety of cases, but the length of the paper will not permit.