The extreme muscular rigidity suggests that the pyramidal tracts are severely implicated.

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DRY IODINE CATGUT.

BY

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In the BRITISH MEDICAL JOURNAL of October 2nd, 1909, there appeared a very interesting article by Mr. Steward on formalin-iodine catgut. As the subject of absorbable ligature and suture material is of constant interest, an account of my experiences with catgut sterilized by means of iodine may not be out of place.

I have used iodine catgut in one form or another for more than four years. At first I used ordinary raw catgut prepared by Claudius's method and preserved in the iodine solution. The great disadvantage attending its use is the brittleness which speedily develops when the gut lies in the iodine solution for more than ten or fourteen days. Another point to which Mr. Steward refers, namely, the rough and uneven surface which the material sometimes assumes after immersion in the iodine solution, annoyed me occasionally, and it was usually noticeable that the hanks which presented this peculiarity also failed to assume the usual deep brown, almost black colour. The last mentioned defects are not, I think, due to the method of preparation, but to variations in the material itself, because it would sometimes be observed that one or two hanks in a batch were rough and light-coloured, while the others were smooth and dark. However, the defect was more apparent than real, as bacteriological investigation showed that the doubtful hanks were sterile, and the material was just as strong and easy to handle as that presenting the usual appearances. On the whole, the method is satisfactory, and I still use it in hospital practice where a batch of catgut is speedily used up and renewed, because it reduces the preparatory handling to the minimum.

In private practice, however, the conditions were somewhat different; a given quantity of catgut lasted a very much longer time, and it was therefore necessary to prepare it in relatively small quantities and more often, or to take the chance of finding that the latter part of the stock had become rotten.

After reading the memoir on dry iodine catgut by Alexis v. Moschowitz,¹ I tried the method recommended, and have adhered to it ever since. The plan I follow is this:

I prepare four dozen lengths of one size at a time, because the tins which serve for the final storage of that quantity are of a handy size.

I wrap four dozen special glass slides with notches cut at the ends in a piece of gauze, and place them in a glass jar, and sterilize jar and contents in a steam sterilizer. Of course this preliminary sterilization is not essential; indeed, it is almost superfluous, since if the iodine solution can be trusted to render the catgut aseptic, it can also be trusted to sterilize the slides and the interior of the jar; still it is just as easy to use a sterile jar and sterile slides and to do the work with clean hands as to employ the reverse conditions.

One length of catgut is then wound loosely on each slide. A certain amount of slack is essential, as the gut contracts so much in the solution.

The loaded slides are placed in the jar, and an excess of iodine solution poured over them, and the jar, which is fitted with a ground-in glass cover, is stored in a dark place.

On the tenth day the iodine solution is poured off, and, after waiting for a few hours to allow as much of the fluid as possible to drain from the catgut to the bottom of the jar, the slides are transferred to sterile test tubes.

In a copper tin I place four dozen test tubes, each tube plugged in the ordinary bacteriological fashion with cotton-wool, with a layer of Gamgee tissue above and below the tubes; the tin and its contents are sterilized in a high-pressure steam sterilizer for half an hour, and then placed in a gas oven to ensure perfect dryness of the tubes and wool plugs.

With gloved hands and sterile forceps the loaded slides are transferred from the jar to the tubes, one slide to each tube,

and the cotton-wool plugs are immediately replaced after a preliminary singeing in the flame of a spirit lamp. The covering layer of Gamgee tissue is placed over the tubes, the lid put on, and the tin put away upside down for a couple of days to allow of any remaining moisture gravitating from the interior of the tubes into the plugs. At the end of that time the catgut is perfectly dry and the plugs are more or less impregnated with iodine.

Preserved in this way the catgut will keep almost indefinitely and retain its tensile strength unimpaired for years; but perfect dryness is essential, otherwise the material is sure to become brittle.

For a time I tried sealing the tubes—after the contents were apparently dry—over the cotton-wool plugs with paraffin wax, and again I used tubes fitted with screw caps, but I found no advantage therefrom; indeed, I think that the catgut keeps best when a certain degree of ventilation is allowed through the plugs.

At one time I had some doubts as to the certainty of the tube contents remaining sterile, but repeated bacteriological examinations after the lapse of considerable periods have invariably shown that the catgut was perfectly aseptic, so that for a long time I had no further investigations made. I had in my possession, however, an unopened tube of No. 6 formalin-iodine catgut which had been intended for ligaturing pedicles, etc. The gut had been placed in iodine solution on May 7th, 1906, and transferred to the test tube on May 17th, 1906. I have not used catgut of this size for years, for reasons subsequently to be mentioned, and I felt that in any case I should not care to use this particular specimen, as its asepticity and tensile strength might be doubtful three years and five months after preparation. I therefore sent the unopened tube on October 20th, 1909, to the Clinical Research Association for investigation, and received the following report:

October 28th, 1909. After a preliminary washing to get rid of any disinfectant present, the catgut was incubated in sterile media for one week, half the time under anaërobic condition and the other half under ordinary conditions. After this time the media had remained quite sterile, proving the absence of living organisms from the catgut.

I myself tested what remained of this specimen of catgut with regard to its tensile strength, and found that it was in no way impaired, the average breaking strain of the knotted catgut being 36½ lb.

When I first adopted the dry method of preservation I used the ordinary formalin catgut supplied by the dealers as my raw material, but ultimately gave it up, for two reasons.

One was that the formalin catgut never stained deeply in the iodine solution; usually after ten days' immersion it was only of a light brown colour. This was perhaps only a very unimportant matter, as bacteriological investigation of the light-coloured strands demonstrated their asepticity, a point which was amply confirmed by clinical experience; still the deep colour provides a somewhat rough but visible guarantee that the iodine has penetrated thoroughly into the material.

The other was that it remained too long unabsorbed. In the great majority of cases this constituted no disadvantage, but in several in which operations had been performed on thin patients with but little subcutaneous tissue—particularly hernia and appendix operations—where the somewhat bulky knot formed by knotting the penultimate loop and the terminal end of the continuous suture uniting the edges of the superficial aponeurosis lay immediately under the cutaneous incision, the knot was ultimately extruded through the long-healed scar four and five weeks after the operation. This difficulty might easily have been obviated by using finer sizes of catgut than the Nos. 2 and 4 which I commonly employ, but, for reasons which I shall subsequently state, I preferred to continue to use the heavier material.

This objection of too long persistence in the tissues also applies to formalin catgut and sulpho-chromic catgut treated by the iodine method and stored in the iodine solution. I therefore returned to the use of ordinary raw catgut, and have used it continuously for three years. Prepared and stored in the way I have described it has proved exceedingly satisfactory. Even after nine months it has been found quite as strong as when first prepared; clinically, I have had no reason to doubt its asepticity. Its surface is perfectly smooth, and it has just a sufficient

degree of rigidity to render it easy to handle and to thread into the needles, and the knots are, I think, more secure than with any variety of wet catgut.

Except for sutures in the mouth I always use it dry, the glass slip carrying the catgut being simply tilted out of the tube on to the instrument tray. In the mouth, however, iodine catgut seems to cause an undue amount of pain, therefore when any intra-buccal operation is in view the catgut is placed in sterile salt solution to wash out the excess of iodine.

The sizes I use are Nos. 0, 2, and 4. No. 0 when a great number of small ligatures is required, No. 2 for the peritoneum and most ligatures, No. 4 for muscles and aponeuroses. More and more, however, I find myself using No. 2 only for all purposes, and obtaining any desired variations in additional strength by multiplying the number of strands—three strands for ligating a pedicle, two strands for the abdominal aponeuroses, one strand for ordinary ligatures, etc.

These sizes seem unnecessarily large, and were it a question simply of the material being strong enough to withstand a certain tensile strain, that would be true, but there are other important factors to be considered.

The first is the lack of uniformity in the standardization of catgut. The various sizes correspond to no definite gauge. I have made some measurements to determine the thicknesses of various samples, taken by chance, from the stock of unprepared catgut which happened to be in my possession. The nominal sizes were Nos. 0, 2, 4, and 6. The instrument I used for the measurements was an ordinary Imperial Standard wire gauge. No. 6 catgut was fairly uniform, about 21 w.g. No. 4 catgut varied from 22 w.g. to 24 w.g.; in one packet, supposed to contain No. 4, samples measuring 22, 23, and 24 w.g. were found. No. 2 catgut varied from 23 w.g. to 26 w.g.; specimens corresponding to 24 w.g. and 26 w.g. being found in the same packet. No. 0 catgut varied from 26 w.g. to something decidedly finer, which I could not measure, as the gauge does not go beyond No. 26; it would be necessary to use a micrometer to verify the thicknesses of the finer sizes. These variations in thickness of course correspond to enormous differences in tensile strength between various specimens which are nominally of the same size. These variations in thickness and in tensile strength entirely corroborate the statement of our theatre nurse, who, after having been blamed for getting her sizes mixed and for the occasional brittleness of the material, complained that the sizes put up in the same packet, and nominally of the same thickness, really varied enormously, the differences being perfectly obvious to the naked eye. A point which attracted my attention when making these measurements was that some dealers label their catgut No. — corresponding to — w.g., while others simply label it No. — and make no reference to the wire gauge to which the number is supposed to correspond, and it was further noticeable that the catgut belonging to the latter group, distinguished only by a number, showed a decided tendency to fall below the standard of thickness presented by corresponding sizes in the first group. I therefore think it would be advisable for any surgeons who are particular about the sizes they use to specify the wire gauge wanted rather than numbers, which apparently mean very little, when ordering their catgut.

Further, there are sometimes considerable variations in tensile strength owing to defects in samples of catgut of similar sizes. The tensile strengths of all materials are diminished when they are bent or kinked; this is notably the case with catgut, where a simple knot involves a very considerable diminution.

Catgut, especially the smaller sizes, tends to cut in the knots, even more than fine silk does; this is often the cause of breaking in cases where the material shows a quite satisfactory degree of resistance to a direct strain.

Of all materials used for surgical ligatures and sutures, with the exception of silkworm gut, catgut is the one in which the knots are most insecure. There is some difference, according to the variety of catgut, but all suffer from the same defect. Any one can demonstrate this for himself by tying two pieces of catgut together and then pulling on the long ends. If the catgut is fairly strong the knot is just as likely to slip as the material is to break, whereas with silk or linen the knot will always jam and the thread break if the strain is continued. The type of knot—

surgical knot, reef knot, or granny knot—makes very little difference—one is just as likely to slip as the other; to my thinking the greatest security is obtained by tying the second turn of the knot very tightly, by adding a third turn to the knot, by using two finer strands rather than a single heavier one, and by leaving the ends fairly long.

For these reasons I think it is advisable to have a considerable margin of strength in the catgut employed, and, after all, the thickness is not of much moment if the material is soon absorbed.

With regard to the length of time plain iodine catgut lasts in the tissues, I am unable to speak very definitely; clinically I can say that I have no reason to think that it has in any case been absorbed too soon. When No. 2 dry iodine catgut was used experimentally as a skin suture to determine its resistance to absorption, the subcutaneous parts of the loops showed signs of erosion, but were still strong after fourteen days. In one case, where the abdomen was reopened on the eighth day, both No. 2 and No. 4 catgut were found to be perfectly distinct and strong. In another case, where the abdomen was reopened on the twelfth day, parts of both Nos. 2 and 4 were found to be still quite strong, but the sutures were so closely blended with the healed tissues that it was not possible without undue waste of time to follow them up. On the whole, I think that No. 2 plain iodine catgut lasts for about fourteen days in the tissues, and No. 4 for a few days longer.

To sum up, my experience of dry iodine catgut prepared and preserved as above described is:

1. It is aseptic.
2. Its tensile strength is satisfactory.
3. It remains aseptic and strong for years.
4. It is smooth, does not kink, is easily handled, and is easily threaded into the needles.
5. The knots are as secure as with any kind of catgut.
6. The iodine with which it is impregnated causes no trouble in the tissues.
7. It resists absorption for a sufficient time.
8. In private work it does away with the necessity for carrying about a jar containing iodine solution; I think that this is a decided advantage, although some very handy little jars with metal cases and spring caps to prevent leakage have been devised.
9. As each hank occupies a separate tube there is no possible risk of the stock being contaminated when taking out a portion for use; this is a point of considerable importance, in view of the absence of a protecting antiseptic solution.
10. The preparation is simple and easy.
11. It is not a good material for skin or intestinal suturing.

For a very thorough detailed account of the qualities of dry iodine catgut I would refer any one who is interested in the subject to the paper by Moschowitz which I have already mentioned.

At one time I tried the Salkindsohn catgut, but soon gave it up. If it lay for any length of time in the iodine spirit it became too hard; if when about to be used it was placed in water or an aqueous antiseptic solution, it quickly swelled, kinked, and became very elastic; and if not immersed in fluid, it became so dry and hard as to be unmanageable.

REFERENCE.

- ¹ *Annals of Surgery*, September, 1905.

A CASE OF OSTEITIS DEFORMANS TERMINATING WITH CEREBRAL SYMPTOMS.

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LEEDS.

THE patient came under observation in 1902 at the age of 60. She was married at 22, had her only child (a daughter) at 24, and enjoyed good health until she was 40, when the right clavicle became prominent and rapidly attained its maximum growth. It caused no discomfort, and she paid no attention to it. At this time her limbs and body were undoubtedly perfectly straight. At 51 she began to ail, and from that time onwards was never in even moderately good health; she suffered from constant