BONE ABSCESS TREATED WITH MOORHOF'S BONE WAX.

A REPORT OF FIVE CASES.*

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THE following report is based on five cases of chronic osteomyelitis with bone abscess treated with the iodoform bone wax advocated by Mosetig-Moorhof.[1] Moorhof,[2 3] Silbermark,[4] and others have reported such good results following the use of the wax, with shortening of the convalescence, absence of painful dressings, etc., that it should, if the report of these cases were correct, be a distinct improvement on the usual method of treatment.

The author has used the wax in two other cases more recently which are not included here, which have so far done well, although it is too early to draw any conclusions as to the end result. Moorhof advocates his wax in all chronic osteomyelitis cases with bone abscess, in tubercular bone cavities, and as an injection after the excision of a joint. It serves only as a temporary plug to replace the tissue removed and later is either absorbed or extruded. It is of no use in acute or diffuse osteomyelitis, and in the chronic cases one should wait until the acute exacerbation has subsided before applying the filling.

As a rule, the use of foreign substances to fill cavities in the body, although strongly advocated by the originator of a method, has in the hands of the general surgeon given poor results and has gradually been discarded, giving way to the older method of packing and draining.

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Among the many substances that have been advocated may be mentioned blood-clot, decalcified bone chips, muscle flaps by transplantation, skin flaps by plastics, and Beck's bismuth paste. Blood-clot has been used by the author with perfect success in three cases of bone cyst in which there had never been suppuration and sterilization of the cavity was unnecessary, and in two cases of long-standing osteomyelitis, in which the cavity contained only clear fluid. The main disadvantage in the use of blood-clot is that it is an ideal culture medium, but, on the other hand, it is not a foreign body and is well tolerated.

This report does not deal with the use of the wax in tuberculosis or in the soft parts, but only with bone abscess. In children these almost invariably do well under the ordinary treatment, opening and drainage, but the operation necessitates for a greater or lesser period of time packing or the insertion of a wick, which is painful, and there may be a free discharge of pus. In addition, the common history is profuse discharge for a long time and frequent painful dressings.

Moorhof's first report [1] appeared in 1903. Since then the component parts of the wax have been modified by some men, and Moorhof himself substitutes dermatol for iodoform in certain cases.

The wax is usually made as follows: equal parts of spermaceti and oil of sesame are sterilized in a water bath, and later 60 parts of this is mixed with 40 parts of iodoform. This gives a yellowish, brittle wax, melting at about 50° Centigrade. When used it is heated to just above the melting point and kept constantly stirred, or the iodoform will settle to the bottom of the flask. Care must be taken also not to overheat the mixture or the iodoform will be decomposed.

Quite a number of articles have been published reporting cases treated with the wax with, on the whole, good results. Meurer,[5] who gives a good bibliography, describes in detail 45 cases, and concludes that its use permits of a more conservative treatment of these cases and insures prompt healing. Nine of his cases were osteomyelitis, with six perfect results and three failures. Of the total number treated, 34 were

"successes" and 25 of these healed by first intention. Moorhof reports 195 cases treated with the filling, all with good results; 79 of these were osteomyelitis. The report is detailed and is accompanied by a large number of good radiographs.

Histology.—Silbermark [6] has done a series of experiments on dogs, making bone cavities, filling them with the wax, and examining them at varying lengths of time up to three weeks. As a result of these he concludes that the cavity is slowly filled with granulation tissue, later forming fibrous tissue and new bone, the wax being absorbed; but the process takes place so slowly there is little danger of iodoform poisoning. Iodine can, however, be demonstrated in the urine for some time, and cases of iodoform poisoning have been reported (Kotzenberg).[7] This observer gives the results of 11 cases operated upon by him. One of these cases was a cyst of the lower jaw, three were tubercular cavities (all healing by first intention), and eight osteomyelitis cases. Of these last, two healed by primary union, three went somewhat septic, and three had a sinus discharging only serum for some time. He considers that the success of the operation rests on the asepsis and that the sepsis in his cases was not the result of the wax.

The operation should be performed as follows, and the success depends on the attention to details and the care with which the various steps are carried out. Silbermark [4] has devised many special instruments, such as a saw attached to a dental engine, a burr, and a hot-air apparatus for drying the cavity.

The operation described below presumes the cavity to be in the tibia, and should be modified as occasion and the bone involved demands. The leg should be elevated and an Esmarch bandage and tourniquet applied to render it bloodless.

An incision, four or five inches long, curved to the inner or outer side, is made and carried down to the bone. The flap is then dissected back, with the opening of the sinus in the centre if one is present. A flap of periosteum is turned back, or this may be done with the skin flap, and the bone with the cloacæ in it exposed. The cortical bone is then removed

with a chisel or circular saw, and the cavity freely exposed, so that all parts are accessible. It is usually necessary to remove a large portion of the cortex to accomplish this, which may be difficult and tedious on account of the eburnation. The cavity when opened is usually filled with thick yellow pus and indolent granulation tissue. Every portion of the cavity should then be cleaned until firm, healthy bone is reached, curettes of varying shapes and sizes being used and later, if necessary, a burr. The object is to get it as clean and in as good condition as a dentist would a cavity in a tooth for filling. After removing all dead tissue, the cavity should be rendered sterile and dry in order that the wax may stick to the walls, and if this is done thoroughly, subsequent ooze is effectually stopped by the wax. Sterilization is best accomplished by swabbing out with 95 per cent. carbolic acid followed by alcohol. The cavity may then be douched with a 1 per cent. solution of formalin, adrenalin, or salt solution, to stop any ooze from the bone, a slight amount of which will occur in spite of the tourniquet. Drying was best accomplished in the cases reported by treating the walls of the cavity on the principle that one would use to dehydrate a microscopic specimen. It was first washed out with alcohol, then alcohol and ether, and lastly with ether. This was followed by a hot air blast, which, in the author's hands, has not been very satisfactory. The hot air apparatus used consisted of a foot pump which forced air through a coil of $\frac{3}{8}$ in. copper tubing, which was kept red hot over a Bunsen flame. The air was filtered through cotton to remove the dust and was presumed to be sterile. To the ends of the copper tubing a piece of sterile rubber tubing having a glass nozzle was attached. This drying process is by far the most difficult step in the operation and is quite important. Once dry, the cavity is filled with the wax, which is kept constantly agitated in the flask to prevent the settling of the iodoform, the laws of gravity being observed in the process. It is usually more satisfactory to let the leg hang down while the lower portion is being filled, and as soon as the wax is partially set, to tilt it up and

fill the upper portion. The flap is then drawn over and the periosteum and skin sutured, a small gutta-percha wick being left in from 24 to 48 hours if necessary. The line of the skin incision should not be directly over the cavity in the bone. Before suturing the flap in place, all sinuses and granulating areas should be either excised or sterilized with carbolic acid and alcohol. A firm dressing is applied and the tourniquet taken off, what little bleeding there is being controlled by pressure. Dressings should be done at intervals of two or three days.

Healing in the ideal cases and in many of those reported has been by first intention, but primary union was not obtained in any of the cases herein reported. The later history has been in all a sinus that has discharged a small amount of clear serum and filling, not pus, for a varying length of time up to four months.

ABSTRACT OF CASES.

CASE I (Dec. 16, 1908).—Male, aged thirty-three. Twenty years ago kicked below the knee by a horse. The place became red, swollen, and tender, and in two months broke open, discharging pus for three months. Four years later without cause it broke again, discharging for two months. For past 15 years has caused no symptoms. Denies venereal disease.

One year ago leg again began to pain and was opened by a physician. It healed in a few weeks. One month ago the same thing happened. The incision is now healed, but the leg is painful and tender.

Physical examination unimportant, except as regards leg. Over the head of the left tibia is a red, tender, semifluctuant swelling, three inches in diameter. The bone is considerably thickened and the skin shows scars of the previous operations. Radiograph shows an indefinite cavity in the head of the tibia, surrounded by thickened cortical bone, and considerable periostitis.

December 18: Operation. Incision over head of tibia and considerable serum evacuated; no pus. Culture showed pure staphylococcus.

December 22: Esmarch bandage, tourniquet. Incision over

head of tibia carried down to bone. Periosteum thickened. Flap dissected free, and cortex removed with chisel, opening a cavity 1 x 2 inches in diameter filled with pus. Cavity cleaned with curette, gauze, etc., till all infected parts removed. Sterilized with carbolic acid, alcohol, and adrenalin (for ooze). Dried with alcohol and ether and hot air blast. Filled with wax and wound closed tight. This was done with difficulty, as the soft parts were so swollen they came together with considerable tension. Culture showed *Staphylococcus aureus.*

Subsequent History.—Convalescence was uneventful. There was considerable ooze from between the stitches, the serum containing flakes of iodoform. Eventually the wound healed by first intention, except a small sinus, which continued to discharge serum and filling for about four months. At no time was there any pus, and the patient learned to dress his leg himself with gauze. From the time the wound healed till the present date, 15 months from the time of operation, there has been no trouble.

X-rays were taken before (Fig. 1) and immediately (Fig. 2) and three months after operation, and also one year after operation (Fig. 3). They show the gradual diminution in size of the cavity and the final replacement of the wax by normal bone. The halo around the filling in Fig. 2 is the granulation tissue in the cavity which has not yet become bony.

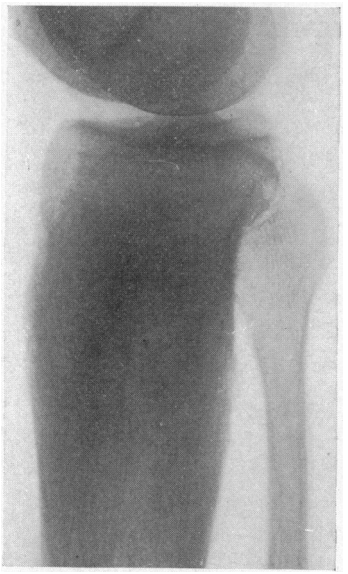
CASE II (March 10, 1909).—Male, aged fourteen years. When four years of age sores broke out on his legs, and since then has had discharging sores on the leg about once a year. Has also had sores break out over the left scapula, on the left wrist, and over the ribs on the right side at various times. Three months before entrance sore broke on right leg and has not healed.

Examination.—Scars of old wounds over left scapula, to outer side of left thigh, over the seventh rib on the right, on the inner side of right thigh just above knee, and two others over the head of the right tibia. Over lower third of right tibia, soft parts swollen, red, tender, and fluctuant. Radiograph shows a bone abscess about 4 in. above the ankle in the tibia on the right (Fig. 4).

March 13: Incision and considerable pus evacuated.

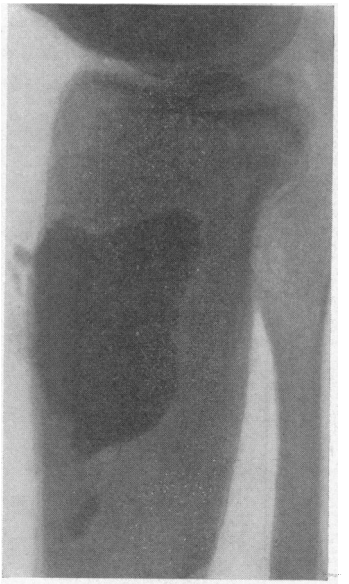
March 26: Esmarch bandage, tourniquet. Old incision and sinus excised. Considerable bare cortical bone found. Cortex removed and cavity opened. Curetted, sterilized with carbolic

FIG. 1.



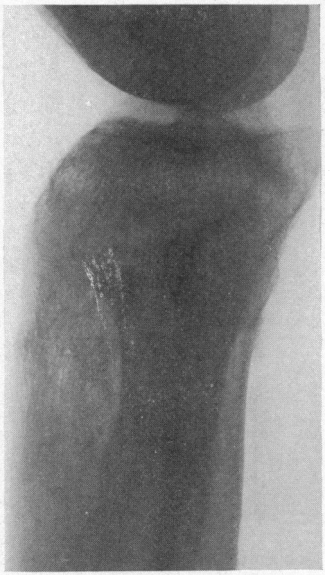
Case I before operation. Abscess head of tibia. Some periosteal and marked cortical thickening which obscures the cavity in the radiograph.

FIG. 2.



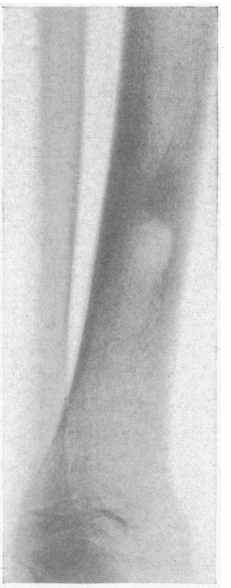
Case I a few weeks after operation, showing the cavity filled with wax.

FIG. 3.



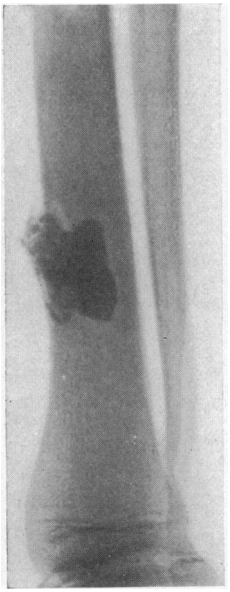
Case I one year after operation. Wax discharged or absorbed and cavity filled with normal cancellated bone.

FIG. 4.



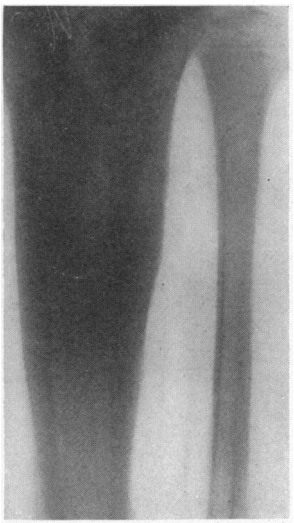
Case II before operation. Abscess cavity shows plainly in the shaft of the tibia. There is some periostitis.

FIG. 5.



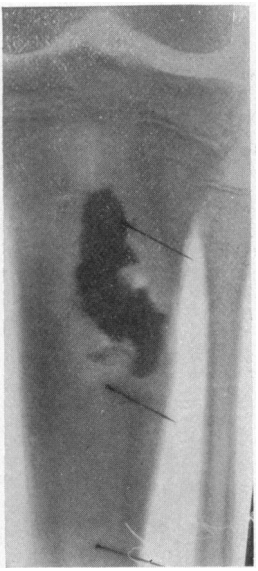
Case II after operation. The cavity filled with wax.

FIG. 6.



Case III before operation. Marked cortical and periosteal thickening. Abscess cavity seen indistinctly.

FIG. 7.



Case III some weeks after operation. The light area around the wax is granulation tissue which is replacing the filling.

acid and alcohol, dried with ether, and filled with wax. Skin flap and periosteum sutured in place with some difficulty, because of tension. Culture showed *Staphylococcus aureus.*

Recovery uneventful. Wound healed by first intention with a small sinus, which discharged serum and flakes of wax (Fig. 5). Discharged from hospital April 12, 1909.

May 5, 1910, thirteen months later, reports by letter that the leg is "all right," but the wound discharged some during the winter. The letter was very unsatisfactory, and the questions asked not answered.

CASE III (May 6, 1909).—Male, twelve years of age.

Nine months ago went to bed with "rheumatism" in the right knee, which persisted for five months. Four months ago hit his right knee, the trauma being followed by pain and swelling, and an abscess formed and broke. This has been discharging ever since.

Examination.—Opening of discharging sinus 2 in. below right knee, through which dead bone may be felt. Head of tibia thickened. Radiograph shows the knee-joint sound, considerable thickening of the cortex, with periostitis and a distinct cavity in the head of the tibia (Fig. 6).

Operation (May 13).—Esmarch bandage, tourniquet. Incisions over head of tibia and sinus excised. Periosteum dissected back and cortex removed with chisel, opening a cavity 2 x 1½ in. in diameter filled with thick pus. Curetted clean and sterilized with carbolic acid and alcohol. Dried with alcohol, ether, and hot air. Filled with wax, and skin and periosteum sutured over, there being too great tension to allow complete closure.

Culture showed *Staphylococcus aureus.*

Following the operation there were several pockets of pus in the soft parts about the knee, but the bone cavity did well.

Discharged from hospital July 3, 1909, with a small sinus discharging serum and filling (Fig. 7).

November 17: Good use of leg. Sinus closed for some time.

April 30, 1910: Wound solid. No pain. Function of knee perfect.

CASE IV (May 12, 1909).—Male, nine years of age. Three weeks ago sprained left ankle. Since then it has been swollen, red, and tender, and he has not been able to use the leg.

Examination.—Over left internal malleolus is a tender, red

swelling, evidently connected with the bone, hard, and non-fluctuating. Foot swollen. Radiograph shows an irregular cavity in the lower end of the diaphysis and a possible smaller one in the epiphysis. There is considerable periostitis.

Operation (May 19, 1909).—Esmarch bandage, tourniquet. Three-inch incisions over lower end of tibia carried to bone, and periosteum dissected back. Cortex removed with chisel, and a cavity one inch in diameter filled with thick yellow pus opened. Cleaned out, sterilized, and dried as in previous cases. Filled with wax, and periosteum sutured. Wound closed without drainage. Culture sterile.

Wound apparently healed by first intention, but three weeks after operation a sinus opened which discharged a small amount of serum and filling for about three months.

May 2, 1910: Wound solid. No interference with motion. Perfect result. X-ray taken.

CASE V (May 12, 1909).—Male, twenty-six years of age.

Nine years ago left knee became swollen and tender without known cause, and broke open, discharging pus. He was in bed nine months at this time. Since then the sore has broken open once or twice a year, discharging each time for a few weeks.

Present Attack.—Nine weeks ago the leg became painful and tender, and has confined him to bed until the present time.

Examination.—Over anterior inner aspect of left tibia a short distance above the ankle is a dull red, tender, fluctuant swelling, several inches in diameter. Radiograph shows considerable periostitis and a cavity in the bone at this point.

Operation (May 24).—Esmarch bandage, tourniquet. Incision to bone. Periosteum elevated and cortex removed with chisel, opening a cavity 1 x 2 in. in diameter filled with pus; cleaned, sterilized, and dried as in previous cases. Filled with wax, and soft parts approximated with difficulty, leaving a considerable defect in which a small wick was inserted. Culture showed *Staphylococcus aureus.*

Recovery uneventful. The sutured portion of the wound healed by first intention, and at discharge there was a small sinus discharging serum and some of the filling.

May 31, 1910: Examination shows wound solid. No pain or discomfort since operation. Motions of ankle perfect. Sinus continued to discharge before healing for about six months.

REMARKS.—An analysis of these cases shows the following results:

None healed absolutely by first intention.

The bone cavity in all of the cases was evidently rendered sterile by the cleaning process, and the wound in three, the only ones closed without drainage, healed by primary union, with the formation later of a sinus discharging serum and wax. Culture from four of these cases showed *Staphylococcus aureus,* while the other was sterile.

Case III was operated upon while there was considerable inflammation, and it would have been better to have waited until this had quieted down. Although following operation there was pocketing of pus in the soft parts, the cavity in the bone gave no trouble, the wax apparently keeping the pus out. On leaving the hospital the discharge from the sinus was of serum and filling, as in the other cases, and the end result has been good.

In Case V there was no attempt to get primary union as the tension of the soft parts was too great, but at discharge the leg was in the same condition as the other cases.

The wax in all the cases made a remarkably good dressing, obviating the necessity of changing wicks, and making the dressing easy and painless.

As to the end results, Cases I, III, and IV and V may be called perfect at the end of one year. There is no interference with the function of the limb, the wound is solid, and in Cases I and V, X-ray shows the cavity evidently filled with normal bone. There is no trace of the wax, which has been either absorbed or discharged.

What the result would have been if the abscesses had been treated in the usual way, by opening and packing, cannot be said, but it seems improbable that they would have done as well.

Case II may now be considered well, although the progress of the case was not as satisfactory, judging from the letter received, as in the others.

More or less difficulty was experienced in all of the cases

in closing the wounds, due to tension, which could have been obviated to some extent if the incisions had been made more curved and the flap, therefore, larger, although in no case was the opening into the bone made directly under that through the skin.

CONCLUSIONS.

Moorhof's iodoform plombe or bone wax is of value as a filling, in selected cases of circumscribed abscess cavities in bone.

Its use shortens the convalescence and makes the dressings easy and painless.

The success of the operation depends on painstaking care and attention to detail.

In the above cases, at least, the wax was treated by the body as a foreign substance and discharged.

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