

## Original Articles.

## A STUDY OF CERTAIN CASES OF SARCOMA OF THE LONG BONES FROM THE MASSACHUSETTS GENERAL HOSPITAL CLINIC.

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THE final results in this series of cases under the care of certain members of the surgical staff represent all those patients who could be traced or whose records were complete after several years. Most of these cases came to the hospital after having had the disease for some months, and in whom there was no doubt as to the diagnosis. This group of cases is made up of unselected instances of sarcoma of the long bones. I have avoided speaking of any of the cases which are well to-day as "cured cases," no matter how long a time may have elapsed since the operation for the removal of the disease, for it has seemed to me hardly accurate to place a time limit within which any case may be regarded as cured, for it is common knowledge that metastases occur after many months or several years. There is one case recorded in which metastases became evident even five years following the operation.

I was led to a study of these cases because of the findings offered by several authors (König, Kramer, Mikulicz, Wiesinger) in demonstration of the proposition that there is a group of malignant tumors of bone which should be treated by excision and preservation of the extremity, rather than by amputation. There is no doubt that the sarcomata of bone are of varying degrees of malignancy. Should these differences in malignancy influence surgical treatment?

In this series of cases there were five giant-cell sarcomata.<sup>1</sup> All of these are at present in good health, three years and four months, three years and two months, three years and two months, six years, fifteen years, respectively, after operation. In one of these cases the sarcoma was in the upper third of the humerus and an amputation was done at the shoulder joint. In two of the cases the sarcoma was in the tibia. In one of these resection was done and in one amputation of the thigh. In one of these cases the lower end of the ulna was involved. In this case resection was done. In one case the lower end of the radius was involved and amputation above the elbow was done.

In the remaining ten cases the disease was located in the lower end of the femur once, and this case died with metastases in the lungs about thirteen months after the operation. The disease was in the tibia four times. In three of these amputation was done, in one a partial operation.

Of the three amputated cases, one was in good health two years and five months after the opera-

tion; a second was in good health three years and six months after the operation; and a third died with lung metastasis one year and three months following the operation. The case of partial operation is living, five years and three months having elapsed since the operation. There is local recurrence in the wound and the general health is poor.

The sarcoma was located four times in the humerus. In all these cases amputation at the shoulder was done. One of the cases did not reply. In one case there was a recurrence in the axilla ten months after operation. In another case death occurred from metastasis in the lung two years and four months following operation. In still another, death occurred from metastases in the lung.

In one of these ten cases the sarcoma was in the forearm. Amputation of the upper arm was done. A local recurrence took place in the stump and an amputation at the shoulder joint was done. This patient was well four years after operation and died then of acute pneumonia.

To summarize this group of cases:

There were *six amputations at the shoulder joint* for sarcoma of the humerus. There was no reply from one case. There was recurrence in the axilla in one case. There was one case of giant-cell sarcoma, in apparent health three years and four months after the operation. There were metastases in the lungs in two cases and probably in a third.

There were *four amputations of the thigh* for sarcoma of the tibia. One giant-cell sarcoma, in good health six years after the operation. One lived two years and five months and was drowned. One is living three years and six months, in good health. One died of metastases in the lungs.

There was *one amputation at the hip joint* for disease in the lower end of the femur. This patient died thirteen months after the operation.

There were *two resections*,—one of the tibia, one of the ulna; each a case of giant-cell sarcoma. Each is at present well,—one three years and two months after the operation and the other also three years and two months after the operation. There was *one partial operation* upon the tibia. This case is in fair health five years after the operation, although a probable recurrence is present in the leg; there was *one amputation above the elbow* in perfect health fifteen years later.

In case fourteen the small metastatic foci discovered at autopsy were not only not detected in the very careful examination of the patient previous to operation, but they were not even suspected; death probably was due to shock and not to these metastases. Cases six, eight and thirteen all died with lung metastases, thirteen, fifteen and twenty-eight months, respectively, after operation. Case fifteen is said to have died of acute pneumonia; it is not known by autopsy whether or not there was lung sarcoma in this case; it was thought at the time, by the attending physician, to be a simple acute pneumonia. There were no metastases in the giant-cell sarcoma cases.

<sup>1</sup> The microscopical preparations from four of these cases have been recently examined, with special reference to this paper, by Dr. J. H. Wright, Director of the laboratory of the Massachusetts General Hospital.

Dr. Wright states that they all have essentially the same histological structure; that they are all typical examples of that definite form of sarcoma with giant cells, which is the typical giant-cell sarcoma of the textbooks, and which may be readily differentiated histologically from other forms of sarcoma with giant cells.

Cases one, two, four, five, six, eight and ten gave a history of trauma to the part in which the new growth subsequently developed; in other words, seven out of fifteen cases gave a history of trauma preceding the appearance of the tumor. The etiological relationship between trauma and the development of sarcoma is an interesting one, but not yet satisfactorily demonstrated.

That there is a difference in the malignancy of the sarcomata of bone has for some time been recognized (König). The giant-cell sarcoma is less malignant than the round- and spindle-cell sarcomata. The series of cases here recorded illustrates this anew. In view of this fact the very important question arises, Is it wise for the surgeon to treat the giant-cell sarcoma of the long bones by an operation less extensive than has formerly been adopted in this type of malignant disease? Hitherto, as illustrated in a number of the cases of this series, the surgeon has removed the extremity well above the disease, making no distinction in his treatment between the giant-cell sarcoma and the more malignant spindle- and round-cell sarcoma. From a study of the facts, emphasized by Kramer<sup>2</sup> in a paper upon the treatment of sarcoma of the hollow bones, and a paper by Jenckel,<sup>3</sup> who studied the sarcoma of the femur, and from the cases reported by Bloodgood, from Halstead's clinic,<sup>4</sup> and from the series of cases here reported from the Massachusetts General Hospital clinic, it seems to me that if the giant-cell sarcoma of a long bone is limited to the bone and is localized in the bone, involving only a small area, a resection or partial operation is justifiable, *vide* Greenough's case; but if the soft parts are in any way involved, or the disease in the bone is extensive and of long duration, that then an amputation is the best treatment; an amputation in the continuity of the bone, if the lower end of the diaphysis is involved, or an amputation at the joint above the disease, if the disease is high in the shaft. Exarticulation at the joint above the disease, at the shoulder or at the hip, is indicated only in those cases in which the disease cannot otherwise be completely removed. I should limit the excision or partial operation to a considerably narrower class than it is limited by Bloodgood. It is true that it has been pointed out that local recurrences after the conservative treatment can be satisfactorily handled. There appears also to be no increase in the likelihood of metastases following local recurrence. A careful study of the evidence presented does not, however, make me enthusiastic for the employment of the partial operation, excepting in the most carefully selected cases. It is always to be kept in mind that metastases may exist, and in the large proportion of late cases coming to the hospital clinic do already exist in the lung, only to make themselves known some time after operation. Exploratory incisions for diagnostic purposes in this group of cases is to be avoided. It is possible that metastases have been occa-

sioned by these exploratory incisions. The x-ray is of great value in diagnosis, particularly early in the development of the disease, and in those cases in which no positive diagnosis has been made. The value of the x-ray in the diagnosis of bone lesions has been especially studied by Dr. E. A. Codman. [See Johns Hopkin Bulletin May, 1903.] The cases of this group are here presented in detail:

**CASE 1. Woman.** Tumor of upper arm, probably malignant. Amputation at the shoulder joint. Recovery. Result three and one-third years after operation.

R. B., fifty-nine years old. Service of Dr. S. J. Mixter. Four months ago, after a fall, she noticed a weakness and limitation of motion of the right arm, which have increased gradually. Three months ago she first saw a swelling of the upper arm, which has increased a little since that time.

Examination finds, at the junction of the middle and upper thirds of the right humerus, a hard fusiform swelling of the bone. The movements of the forearm are limited. The x-ray shows a fusiform swelling of the bone and a thinning of the cortex by pressure of the tumor from within.

**Operation.** — Amputation at the shoulder joint.

**Pathological Report** by Dr. Jas. Homer Wright:

**Diagnosis.** — Myelogenous round-celled sarcoma.

The shaft of the humerus is the situation of a tumor growth, largely replacing the bone so that fracture has occurred. The tumor growth is situated in the upper half of the shaft of the bone and involves a length of the bone about 8 cm. The bone, over a great part of the area involved in the tumor, is somewhat greater in diameter than normal. On sawing through the bone and the tumor in a longitudinal direction, the following appearances are noted: Occupying the marrow cavity of the bone and to a great extent replacing the cortical bone is a tissue which is partly grayish to reddish, translucent and partly dark red in color. The tumor, on section, has a fusiform or oblong outline and measures in the longitudinal direction 8 cm. as before stated. The central portion of the tumor is softer than the periphery, and dark red to blackish, and moist in appearance as from hemorrhage. In consistency the tumor mass is generally soft and somewhat elastic, but not diffuent. It is also somewhat fleshy. It contains no bony spicules. Throughout the greater portion of its length, it pushes before it the remains of the cortical portion of the bone and the periosteum. The cortical bone in this situation is very much thinned, being represented, over a greater portion of the length of the tumor, as spicules, or thin plates, beneath the periosteum. At the upper extremity of the growth the marrow cavity is invaded without distortion of the outward appearances of the bone for a length of a few millimeters. The upper extremity of the growth reaches to about 3 cm. of the anatomical neck. The growth generally can be well separated and differentiated from the marrow and from the cortical bone. It can also be sharply differentiated from the spongy bone, which abuts upon it near the surgical neck at the upper extremity of the growth.

**Microscopical Examination.** — Sections of the tissue hardened in Zenker's fluid and afterward decalcified. The tumor tissue consists of closely packed, medium-sized polyhedral cells with a moderate amount of cytoplasm. The polyhedral shape of the cells seems to be due to mutual pressure, and it seems possible that in the fresh state they were spherical. There is little or no stroma. Here and there among the cells are spaces more

<sup>2</sup> Archiv. f. klin. Chirurgie, 1902, Band 7, xvi, p. 792.

<sup>3</sup> Deutsche Zeitschrift f. Chirurgie, 1902, Band 7, xiv, p. 66.

<sup>4</sup> Bulletin of the Johns Hopkins Hospital, May, 1903, p. 134.

or less completely lined with thin cells, resembling endothelium. The nuclei of the tumor cells vary somewhat in size, are generally oval in shape and do not contain a large amount of chromatin. The nuclear membrane is very thin and not prominent. The cells are clearly not plasma cells and not like the cells described by J. H. Wright in a case of so-called "Multiple Myeloma."<sup>5</sup>

The thin and more or less perfect shell of bone investing the tumor seems to be, not the remains of the original bone, but a new formed bone.

*End Result.* — Three years and four months after the operation the patient replies to inquiry, "I am used up by rheumatism and pleurisy for a year." Friends of the patient write that her general health is excellent. There is no recurrence of the disease.

**CASE II.** Child; girl. Injured knee; tumor of upper end of the tibia; malignant disease suspected. Partial operation at two different times. Recovery. Well after three years.

L. T., service of Dr. W. M. Conant; sixteen years old. One year ago she fell downstairs striking the left knee. Two months ago she noticed a small hard swelling just below the left knee, over the tibia. There has been tenderness in this region for eight months; the swelling has increased very slowly. She has lost no weight, but rather gained in weight.

*Examination.* — Well-developed and well-nourished girl. Anteriorly just below the knee is a swelling of the tibia 3 by 2 inches in size. This swelling is tender. The overlying skin is normal in appearance. Two small glands are felt in the groin.

*Operation.* — At operation the external layer of bone over the tibia was found to be a mere shell. Beneath the bone was a cavity the size of an egg. The softened bone was chiselled away, the material within was curetted out, the cavity remaining was wiped dry and painted with tincture of iodine and packed with iodoform gauze. The pathologist reported giant-celled sarcoma.

One month later a second curetting was done and the material removed at this time was reported to show no evidence of malignant disease. One year later the wound is reported as entirely closed for six months previously, with no evidence of malignant disease. She has some little pain at the seat of the wound.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.* — Typical giant-celled sarcoma.

A few small bits of bone and soft tissue received for examination.

Microscopical examination shows typical giant-celled sarcoma.

*End Result.* — Three years and two months after the first operation and three years and one month after the second operation the general health is good, and there is no trouble with the wound. She considers herself well.

**CASE III.** Young adult; woman. Tumor of the lower end of the ulna. Excision of tumor. Recovery. No recurrence three years and two months after operation.

M. C., twenty-four years old. Patient of Dr. R. B. Greenough, service of Dr. J. C. Warren. For three months there has been soreness in the wrist. On the ulna side of the right wrist is a hard swelling. There is no redness of the skin. Over the swelling there is some tenderness on deep palpation. The bone feels thickened for a distance of 2 or 3 inches. The x-ray

shows a disease of the head of the ulna. There is a suggestion of fluctuation over the swelling.

*Operation.* — An excision of the tumor was done. There has been no recurrence of this growth, three years and two months after operation.

*Pathological Report* by Dr. James Homer Wright:

*Diagnosis.* — Typical giant-celled sarcoma.

A portion of the ulna about 5 cm. long, including its lower extremity, received for examination. The lower extremity is about twice the normal size and is the seat of a neoplasm which largely replaces the substance of the bone, but does not extend beyond the periosteum. It extends only a very short distance into the shaft.

Microscopical examination shows typical giant-celled sarcoma.

*End Result.* — There has been no recurrence after three years and two months. The patient is in good health.

**CASE IV.** Young adult; man. Injury to knee; tumor of head of the tibia; malignant growth. Amputation of thigh. Recovery; at present general health good, six years after operation.

R. O., twenty-four years old. Service of Dr. S. J. Mixter. Sixteen months ago he fell while running upstairs and struck his knee right. Three or four months later pain appeared in the knee. Six months ago he fell on the same knee. The knee was incased in plaster of Paris. Since then the pain has been getting worse.

*Examination.* — There is a swelling on the outer side of the head of the tibia about 2 inches in diameter. This swelling is hard and bone-like. Just above the tumor there is a semi-fluctuating spot. A button of bone was removed from the tibia and a red, soft, pulsating mass was discovered inside a thin shell of bone. The diagnosis was made of a giant-celled sarcoma. Patient was discharged untreated as he refused amputation. He received the Coley treatment for three weeks.

Amputation on account of the great vascularity of the tumor and because its growth was apparently not controlled by the toxins.

*Pathological Report* by Dr. J. H. Wright:

*Diagnosis.* — Giant-celled sarcoma.

Microscopical examination of a section of the neoplasm shows typical giant-celled sarcoma like that of an epulis.

*End Result.* — Six years after operation general health is good. There is no trouble with the stump wound. Has had some pain in hip and back when lying a long time at night. Has had this aching for a long time; otherwise perfectly well.

**CASE V.** Man. Tumor lower end of the radius. Curetting and cauterization; then amputation above the elbow. Well fifteen years later.

C. D. S., thirty-three years old. Service of Dr. C. B. Porter. One month previously wrenched his hand, which swelled considerably and was painful for a few days. For two weeks past the hand continued swollen and more pain has been felt, sufficient to keep him awake.

Examination finds a small diffused swelling of the lower end of the radius, near the wrist. The swelling is tender to touch. There was an indistinct sense of fluctuation and pulsation of the swelling. The swelling was aspirated. Nothing was obtained from the aspirating needle.

*Operation I.* — Whole lower end of the radius was occupied by a semi-solid mass of vascular medullary tissue. Whole cavity was curetted out and cauterized

<sup>5</sup> "Contribution to the Science of Medicine dedicated by his Pupils to William Henry Welch upon the Twenty-fifth Anniversary of his Doctorate and Volume IX of the Johns Hopkins Hospital Reports."

with the actual cautery and packed with iodoform gauze.

*Operation II.* — Amputation two days later above the elbow joint.

*Pathological Report* by Dr. W. F. Whitney:

Soft, slightly translucent medullary looking masses. Microscopical examination showed it made up of a mass of large oval cells with a slight fibrillated or granular intercellular substance between them, and large multinucleated giant-cells.

*Diagnosis.* — Myelogenous giant-cell sarcoma.

*End Result.* — The patient is alive and perfectly well fifteen years after operation.

**CASE VI.** A young adult. Injury to knee; tumor of femur, close to knee joint. Amputation at hip joint. Recovery.

J. C., nineteen years old. Service of Dr. J. C. Warren. Three months ago he stepped in a hole and wrenched his knee. After this he had slight pain in the knee, in the morning, on attempting to straighten the leg. He was gradually unable to completely straighten the leg and for two weeks past he could just bend the leg to a right angle. He has been on crutches for six weeks.

*Examination.* — The left leg is bent at a right angle. Upon attempting to passively extend the leg he complains of pain. There is a swelling over the external condyle of the femur. The skin over this swelling is slightly blue, tender, and there is a sense of fluctuation. There are a few glands to be felt in the left groin. The tumor is regarded as malignant.

*Operation.* — Amputation at the hip joint. Recovered from the operation and returned to his home.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.* — Osteo-sarcoma originating in the trabeculae of the bone.

Fragments removed from a hemorrhagic new growth apparently originating in the neighborhood of the condyles of the femur and just above the knee posteriorly.

Microscopic examination showed the trabeculae of bone almost entirely decalcified and replaced by a growth of irregular round cells, many of them of large size and occasionally distinctly spindle shaped. There was extensive hemorrhagic areas among these which seem to have originated in the medullary cavity of the bone and infiltrated this new growth, which, in places, was very necrotic. The cells of this new growth have neither the characteristic shape of cartilage, nor of bone corpuscles, but in places it seems as if they originated in a proliferation of the bone corpuscles.

The lymph nodes removed from the groin showed nothing but a proliferation of the endothelium of the lymph spaces to account for their increased size.

*The End Result.* — This boy could not be found after careful inquiry.

**CASE VII.** Child; a boy. Tumor of the head of the tibia. Amputation of the thigh. Recovery. Accidental death two years and five months after operation.

R. L. T., fifteen years old. Service of Dr. John Homans. Three months ago there was tenderness below the right knee over the tibia. A tumor developed at this point. For two months he has been unable to walk upon his leg. He has lost considerable flesh.

*Examination* found a well-developed but somewhat emaciated boy. A globular swelling is seen just below the head of the right tibia; the circumference of the right leg at the seat of the tumor is 12½ inches; the left leg 11½ inches. The tumor is soft, elastic, and the skin is not adherent to it. Tumor is apparently of the bone; tumor extends back toward the popliteal

space but is most prominent in front at the head of the fibula. The surface temperature of the tumor is considerably increased. The glands of the right groin are slightly enlarged.

*Operation.* — Amputation of the thigh just above the knee. A bit of the tumor removed before the amputation was examined and found to be a large, round-celled sarcoma.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.* — Round-celled sarcoma, probably of periosteal origin.

A piece removed by the Mixer punch, showing the growth to be composed of a solid mass of large round cells with a little intercellular substance, here and there; buried in the growth were spiculae of bone, evidently extensively destroyed.

*End Result.* — This boy wore an artificial leg, had no trouble from the stump and was always well after the operation. He lived two years and five months after the operation and then was drowned.

**CASE VIII.** Young adult; man. Fracture of leg below the knee; tumor at seat of fracture; malignant. Amputation of thigh. Recovery; lived one year and three months.

J. D., thirty-three years old. Service of Dr. F. B. Harrington. Three and one-half years ago the left leg was broken just below the knee. He was then laid up for three or four months. Six months later he noticed a lump over the left tibia anteriorly, which has been growing slowly ever since. There is not much pain. Eight weeks ago this swelling was incised by a country doctor, and the bony mass scraped. The wound has never healed. There is considerable discharge and hemorrhage from this wound.

*Examination.* — Well-developed and well-nourished. The leg is considerable enlarged just below the knee. The tibia is increased in size. There is a large ulcerating surface which bleeds easily, at the center of this swelling. The skin is considerably discolored. The skin is infiltrated with firm nodules in the immediate vicinity of the ulcerated part. No enlarged glands can be felt in either groin or along the iliac vessels.

*Operation.* — Amputation of thigh.

*Pathological Report* by Dr. William F. Whitney:

A soft, grayish growth filling a cavity which it had apparently excavated in head of the tibia, breaking through the articulating surface and infiltrating the tissues about the joint. Spindle-celled sarcoma.

*End Result.* — He lived one year and three months. He died with "the disease" in the other thigh and leg. He had much pain for six months previous to his death.

**CASE IX.** Young adult; woman. Tumor of the leg below the knee; malignant. Amputation of the thigh. Recovery; good health at present.

K. M., twenty-six years old. Service of Dr. A. T. Cabot. Five months ago she first noticed a swelling of the left leg extending from the knee to the ankle. Four months ago the upper third of the tibia began to enlarge. There was great pain of a grinding character, particularly at night. One month ago she was obliged to give up work because of the pain and loss of sleep. A bit of the growth removed from the head of the tibia was found to be sarcomatous.

*Examination.* — The upper third of the right tibia is uniformly enlarged; there is no fluid in the knee joint; there is no glandular enlargement. The x-ray shows a bony thickening of the upper end of the tibia. The center of the tumor is of great density.

*Operation.* — Amputation above the condyles of the femur.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.* — Osteo-sarcoma.

The head of the tibia invaded by a new growth which had increased it to about the size of the fist. The section showed a very dense bone replacing the spongy tissue and filling the medullary cavity for the distance of several centimeters.

Between it and the medullary cavity was a zone of grayish, opaque tissue of distinctly different character from the medulla and composed microscopically of a mass of large round cells with a little intercellular substance.

Enlargement of the bone was chiefly caused by an irregular deposit of new bone. On the outside of the outer surface was a zone of the same soft grayish tissue seen in the medulla and composed of the same structure.

*End Result.* — Three years and six months after the operation the patient is in good health, with no local trouble.

**CASE X.** Adult; male. Fracture of leg; injury to seat of fracture. Tumor at seat of fracture; malignant. Partial operation; recovery; general health good.

M. B., fifty years old. Service of Dr. J. W. Elliot. Nine years ago the left leg was broken at the junction of the lower and middle thirds by the kick of a horse. Four years ago he was kicked by a horse in the same place and has been unable to put any weight upon the leg for some time. One year and a half ago he noticed a swelling over the site of the old fracture; this swelling increased slightly, was moderately tender, but not painful. A little less than a year ago the surface of the swelling ulcerated. The glands in the groin have been tender and somewhat enlarged; he has had some pain at night in the leg.

*Examination.* — Marked thickening of the left leg in the lower third. The skin over this area is bluish in color. At the center of this bluish and discolored area is an ulcerating and fungus mass about the size of a silver dollar. The glands in the groin are not particularly enlarged.

*Operation.* — An elliptical area of skin surrounding the disease was incised and granulation tissue was removed with the curette; bits of diseased bone and old granulation tissue were found in the depths of the wound; the diseased parts were removed with the bone chisel and curette; the wound was cleansed with peroxide and corrosive. The diagnosis of osteoid sarcoma was made.

*Pathological Report* by Dr. James Homer Wright:

*Diagnosis.* — Osteoid sarcoma.

The sections of the tissue received for examination Aug. 31, 1898, show a sarcomatous neoplasm identical with that in the specimen described below.

Specimen received Sept. 4, 1901. The tibia in its lower third is greatly thickened and is the seat of a tumor growth occupying the narrow cavity over a length of perhaps 8 or 9 cm. This tumor growth extends into the shaft of the bone and involves the skin on the anterior aspect of the leg where there is considerable ulceration.

The tumor growth consists of a firm, grayish, translucent tissue in parts of which a few fine, bone-like spicules are perceptible to the touch. At the periphery of the tumor, where it impinges upon the thickened bone, the tumor tissue occupies rounded depressions, with smooth walls, in the bone.

Microscopical examination of hardened sections shows that the new growth consists essentially of a tissue that at first sight resembles spongy bone. A large part of the tissue consists of closely packed cells, which cells are divided into larger and smaller groups

by columns and trabeculae of a tissue very suggestive of the trabeculae of spongy bone and regarded as a form of osteoid tissue. These trabeculae are composed of a fibrillary substance staining with eosin in which well separated, elongated, vesicular nuclei are distributed. With Mallory's connective tissue stain these trabeculae take a deep blue coloration and are seen to consist mostly of fibrillary substance. In one of the sections the tissue of the trabeculae is seen to become continuous with a small mass of bone. The other constituent of the tumor lying between the trabeculae consists of closely packed cells. These cells contain elongated faintly staining vesicular nuclei of good size and a very small amount of cytoplasm, which is seen with difficulty as a more or less reticular substance between the nuclei. The nuclei show a marked tendency to be arranged with their long axes parallel to one another.

*End Result.* — Five years after operation the wound was still open. The general health was good except for a sore upon the leg. During the past three months — that is, three years since the first operation — he has had more or less trouble with the wound and is not feeling well. Patient will not consent to amputation.

**CASE XI.** Young adult. Tumor of humerus, thought to be malignant. Amputation at the shoulder joint; recovery.

L. S., sixteen years old. Service of Dr. J. C. Warren. One year ago the patient first noticed a swelling of the right arm above the elbow. Six weeks ago this swelling began to be painful. The swelling has grown steadily larger.

Examination finds the entire humerus uniformly much enlarged. There are glands in the axilla.

*Operation.* — Amputation at the shoulder joint. The mass of new growth is found to infiltrate the muscles without a sharp boundary line. The periosteum is very much thickened. The medullary cavity is involved by the new growth. The axillary glands are also involved.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.* — Large round-celled sarcoma.

A spindle-shaped growth surrounding the humerus at its middle and about 6 cm. in diameter. It is of a grayish, slightly opaque, homogeneous surface and infiltrates the muscles without a sharp boundary line. The shaft of the bone is roughened but not destroyed, and in places shows a distinct periosteal thickening. In the medullary cavity is a similar new growth. The axillary lymph glands are also infected.

Microscopic examination shows it to be a large, round-celled sarcoma.

*End Result.* — No reply received after careful inquiry.

**CASE XII.** An adult. Swelling of the whole upper extremity, thought to be a periostitis. Amputation at the shoulder joint; recovery.

J. I. C., thirty-three years old. Service of Dr. H. H. A. Beach. Sharp shooting pains in the limbs for many years. Three months ago this pain was most marked in the right upper extremity. The pain was sharp, localized at different times in the elbow, forearm and upper arm. Four weeks ago the arm began to swell; there were soreness and tenderness.

Examination finds the whole upper extremity swollen. There is marked tenderness on the inner side of the arm above the elbow. The superficial veins are prominent over the arm. The disease is thought to be a periostitis. There is limitation of motion at the elbow-joint due to the swelling of the upper arm.

*Operation.*—Amputation at the shoulder joint. Axillary vein involved in malignant thrombus. Pronounced malignant by the pathologist. Recurrence in the axilla after a little over a month. The Coley serum was used without benefit after the operation.

*Pathological Report.*—Pronounced malignant by the pathologist. The axillary vein was filled with a thrombus which was thought by the pathologist to be malignant. No glands were found enlarged in the axilla.

*End Result.*—In ten months recurrence in axilla.

**CASE XIII.** Woman. Tumor of the upper arm. Partial operation; Coley treatment; amputation at the shoulder joint; recovery. Died three months later from lung metastases.

C. O., thirty-eight years old. Service of Dr. F. B. Harrington. Sixteen months ago she had pain in the right arm. Six months later she was operated upon for tumor of the soft parts and later the humerus was curetted. An x-ray was taken then and the patient told that she had malignant bone disease, and a radical operation was advised. This was refused and she was treated in New York by the Coley serum. She now has great pain at night, which keeps her awake. The swelling of the arm is slowly increasing.

Examination finds, upon the outer aspect of the upper arm, a little below the head of the humerus, a hard, firm swelling, not tender, not movable, and apparently connected with the bone. The x-ray shows a thickening of the bone like a periostitis.

*Operation.*—Amputation at the shoulder joint. One year after the amputation re-entered the hospital for a short time, with some trouble with the chest. Two years after the operation re-entered the hospital for recurrence in the stump.

Microscopical examination of this specimen showed a spindle-celled sarcoma.

A partial operation was done. The patient died three months later, evidently from metastases in the lung and stomach.

*Pathological Report* by Dr. James Homer Wright:

*Diagnosis.*—Periosteal fibro-sarcoma with metastasis in a regionary lymphatic gland.

Dissection shows a tumor involving the periosteum of the humerus and the insertion of the deltoid.

This tumor consists of an elongated mass continuous with the periosteum, about 6 cm. in length and 2½ cm. in greatest width. It is not sharply defined from the surrounding muscular tissue. It has been partly separated from the bone by the surgeon. On section through the tumor in a longitudinal direction, it is seen to consist of a grayish, translucent, gristle-like, fibrillated tissue fading out into the muscular tissue like scar tissue. Where it has been in apposition with the bone the tumor tissue becomes softer and reddish in color. The denuded bone surface is somewhat irregular, but presents no necrosis nor evident invasion by the neoplasm. At the lower extremity of the growth and just outside of the periosteum is a sharply outlined nodule about 7 mm. in greatest diameter and composed partly of a dark red and partly of a grayish translucent tissue.

The shaft of the bone contains normal marrow.

Microscopical examination of sections of the growth, hardened in Zenker's fluid, shows the neoplasm to consist of cells and a relatively large amount of connective tissue. The cells vary considerably in size and shape and very atypical in appearance. In places the cells are very numerous and form more or less well defined islands in the midst of the connective tissue. In other places the cells are scattered throughout the connective tissue. The connective tissue itself, in

places, forms the most prominent feature of the growth and is very dense and coarse.

Sections of two small lymphatic glands, presumably from the axilla, show in one of them a small secondary tumor, identical, in structure, with that of the growth on the bone.

*End Result.*—About three months after the operation she died. The wound appeared healed and normal. There were evidences of trouble with the lungs and stomach, suggesting very strongly that metastases had occurred in these situations.

**CASE XIV.** A boy. Tumor of the shoulder region; malignant. Amputation at the left shoulder joint; died.

A. L., fifteen years old. Service of Dr. C. B. Porter. A tumor of the shoulder was first noticed two years ago. This has grown slowly and painlessly.

Examination finds a poorly-nourished, anemic boy; he has lost flesh and strength during the past two years. The region of the left shoulder is occupied by a large, round, smooth mass which completely obliterates all the outlines of the shoulder joint. The overlying skin is white and the superficial veins are enlarged. The mass involves not only the shoulder and the scapula but also the tissues below and above the clavicle. The circulation of the left arm is poor; there is slight numbness of the left upper arm and forearm.

*Operation.*—Amputation at the left shoulder.

*Pathological Report* by Dr. W. F. Whitney:

*Diagnosis.*—Osteo-sarcoma (round celled).

A lobulated dense new growth, which had entirely replaced the scapula and upper part of the humerus. On section, a portion of it was soft, rather myxomatous looking, while the rest was made up of an osteoid tissue with little islands of cartilage here and there. The mass measured 18 by 21 by 24 cm. and weighed 7,000 gm.

The autopsy, by Dr. J. H. Wright, showed a small metastasis in each lung.

**CASE XV.** Woman. Tumor of lower end of the radius and ulna. Amputation of the forearm. Recurrence one year and a half later in the stump. Amputation at the shoulder joint. Recovery. Lived six years after the first operation. Died of acute pneumonia.

T. A. P., sixty-seven years old. Service of Dr. J. W. Elliot. Two years and a half ago there was pain in the thumb. Two months later the wrist began to swell and throb. To-day there is a tumor involving the ends of the radius and ulna. The pathologist, Dr. Mallory, pronounces it to be osteo-sarcoma.

*Operation No. I.*—Amputation above the elbow joint.

A year and a half after the first pain the arm began to swell again and has slightly increased in size.

Examination finds a well-preserved old woman. The stump of the amputated arm is the size of a large cocoon. The skin over the stump is tense, tender, and the surface temperature is increased. The skin is ulcerated in two places; there are no glands in the axilla or above the clavicle.

*Operation No. II.*—Amputation at the shoulder joint, two years after the first operation.

*Pathological Report.*—There is unfortunately no complete descriptive pathological report. Dr. F. B. Mallory reported, after an examination of the first specimen only, that the tumor was an undoubted osteo-sarcoma.

*End Result.*—The patient lived six years after the first operation. She then died of acute pneumonia.

SARCOMA OF THE LONG BONES. MASSACHUSETTS GENERAL HOSPITAL CASES.

CASE.	AGE.	OPERATING SURGEON.	SEX.	REGION.	KNOWN DURATION OF GROWTH.	PATHOLOGICAL REPORT.	OPERATION DONE.	IMMEDIATE RESULT.	REMOTE RESULT.
1 R. B.	59	S. J. Mixer	F.	Humerus, upper third	4 mos.	Myelogenous round-celled sarcoma	Amp't at shoulder joint	Recovery	3 yrs. 4 mos., rheumatism, otherwise fair health.
2 L. T.	16	W. M. Conant	F.	Tibia	2 mos.	Giant-celled sarcoma	Resection	Recovery	3 yrs. 2 mos., good health, no recurrence.
3 M. C.	24	R. B. Greenough	F.	Ulna, lower end	3 mos.	Giant-celled sarcoma	Resection	Recovery	3 yrs. 2 mos., no recurrence.
4 R. O.	24	S. J. Mixer	M.	Tibia	13 mos.	Giant-celled sarcoma	Amp't thigh	Recovery	6 yrs. 3 mos., good health.
5 C. D. S.	33	C. B. Porter	M.	Radius Forearm	1 mos.	Giant-celled sarcoma	Partial operation, amp't above elbow	Recovery	15 yrs., perfect health.
6 J. C.	19	J. C. Warren	M.	Femur, lower end	3 mos.	Round-celled sarcoma	Amp't at the hip joint	Recovery	Died about 13 mos. Lung metastases.
7 R. L. T.	15	John Homans	M.	Tibia	3 mos.	Round-celled sarcoma	Amp't thigh	Recovery	2 yrs. 5 mos., good health. Drowned.
8 J. D.	33	F. B. Harrington	M.	Tibia	36 mos.	Spindle-celled sarcoma	Amp't thigh	Recovery	1 yr. 3 mos., died, metastases.
9 K. M.	26	A. T. Cabot	F.	Tibia	6 mos.	Round-celled sarcoma	Amp't thigh	Recovery	3 yrs. 6 mos., good health.
10 M. B.	50	J. W. Elliot	M.	Tibia	18 mos.	Osteoid sarcoma	Partial operation	Recovery	After 5 yrs. 3 mos., health poor; local trouble at operation site.
11 L. S.	16	J. C. Warren	M.	Middle Humerus	12 mos.	Large, round celled sarcoma	Amp't at shoulder joint	Recovery	No reply.
12 J. I. C.	33	H. H. A. Beach	M.	Humerus	3 mos.	Sarcoma	Amp't at shoulder joint	Recovery	Recurrence axillary in 10 mos.
13 C. O.	38	F. B. Harrington	F.	Humerus, upper third	16 mos.	Fibro-sarcoma	Amp't at shoulder joint	Recovery	2 yrs. 4 mos., died, metastases in lungs.
14 A. L.	15	C. B. Porter	M.	Humerus, upper third	24 mos.	Round-celled sarcoma	Amp't at shoulder joint	Died	Autopsy; metastases in lungs.
15 T. A. P.	67	J. W. Elliot	F.	Forearm	6 mos.	Osteo-sarcoma	Amp't upper arm amp't shoulder joint	Recovery	4 yrs. after last operation died of acute pneumonia.

DISINFECTION OF THE CLINICAL THERMOMETER.

By FRANCIS P. DENNY, M.D., BROOKLINE, MASS.

In a letter to the *Philadelphia Medical Journal*, Dec. 15, 1903, Dr. W. H. Dyer called attention to a method of disinfecting the clinical thermometer by putting a few drops of formalin in the thermometer case. As this convenient method has not received the recognition that it deserves it has seemed well to again call attention to it, and report the results of some tests of its efficiency.

If two or three drops of formalin (40% solution of formaldehyde) are put in the thermometer case, they are taken up by the absorbent cotton usually kept at the end of the case, which will remain moist for a number of days. Formaldehyde gas is freely given off from the formalin, but is confined in the air-tight chamber of the case. If the formalin has been freshly added the surface of the thermometer when taken out of the case is often covered with minute sweat-like drops of fluid, showing the high humidity. The small size of the chamber, the high humidity, and the high temperature if the thermometer is carried in the vest pocket, furnish conditions very favorable for the disinfectant action of formaldehyde.

The tests which are here reported show that the disinfectant action of the formalin remains active for several weeks or as long as the pungent, irritating odor of the gas is marked. In practice it is well to add the formalin about every two weeks or oftener if the odor seems at all weak, and the cap should be kept on the case when the thermometer is being used in order to pre-

vent evaporation. The thermometer should be washed in water both before and after using. If by mistake the thermometer is put directly into the patient's mouth, the taste is somewhat unpleasant but no serious effects result.

Where the thermometer has been used for a patient known to have a contagious disease it is best to disinfect it outside the case, or at least fresh formalin should be added and the thermometer exposed to the gas a longer time than usual (several hours) before being used again. This method should not be employed when it is desired to use the same thermometer within a few minutes for another patient; for example, in hospitals and dispensaries, or when a physician is attending two patients in the same family. Under such circumstances disinfectant solutions should be used.

*Tests.*—The organisms used and the number of tests made with each were as follows: *Staphylococcus pyogenes aureus* 4, *P. typhosus* 3, *B. subtilis* (spores) 3, *B. diphtheriæ* (pure) 4, mixed cultures from throats of diphtheria patients 8; and in 3 tests the thermometer was infected by putting it for a moment in the mouth of a healthy person.

When cultures were used a few drops of an emulsion of the growth were put on a sterile glass slide and a clinical thermometer, or a glass rod of similar size, was rubbed in this. When partially dried the thermometer was put into the case with the infected end uppermost—that is, away from the moist cotton—so that the disinfection would have to be gaseous rather than from the direct action of the solution. For a control a second thermometer was similarly infected and