

Plummer (S. C.)

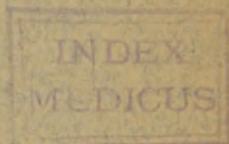
PUNCTURED WOUNDS OF THE FEET.

A REPORT OF TWO HUNDRED AND THREE CASES TREATED AT THE
MEDICAL BUREAU, WORLD'S COLUMBIAN EXPOSITION, DUR-
ING THE "CONSTRUCTION PERIOD," JUNE 1ST,
1891, TO MAY 1ST, 1893.

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S. C. PLUMMER, A. M., M. D.,

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Of 3,356 surgical cases, of all grades of severity, treated at the Medical Bureau of the World's Columbian Exposition, from its organization for the treatment of patients, June 1st, 1891, to the opening of the Exposition, May 1st, 1893, 203 come under the head of "punctured wounds of the feet," the implement inflicting the injury being, almost invariably, a nail, and in a vast majority of cases, a rusty nail, an injury which, to the lay mind, calls up at once visions of lockjaw and other dire results, a dread not without foundation when viewed in the light of scientific knowledge; for we now know that the bacillus of tetanus is found in the dust of the street and is thus likely to be introduced into a wound of the foot, and that, moreover, the bacillus being anaerobic, punctured wounds are of all kinds the most favorable to its growth. Perhaps, then, the greatest value of this report will be its lesson as to the value of the prophylactic treatment of tetanus by the thorough disinfection of all suspicious wounds; for in no case, so far as known, has tetanus followed.

The cases from which this report is made include all the cases of punctured wounds of the feet which came to the Medical Bureau during the Construction Period of the Exposition, and were treated by Drs. Allport, Yeager, Plummer, Marquis, Edgerly, Gentles and Hillmantel, of the medical staff. By the order of Dr. John E. Owens, the medical director, as complete records as possible have been kept of all cases treated at the Medical Bureau, but as the hospital keeps no patient over night, being essentially an emergency hospital, many cases have passed from under our notice after the first treatment. Of the cases included in this report 86 were kept under observation during the entire period of disability, that is, until the patient was able to return to work; 15 other cases were seen for the last time at from 1 to 12 days after

the injury. Many of the latter doubtless returned to work a day or two after last coming under observation, but being more interested in the practical than in the scientific aspect of their cases, did not report again at the hospital. The remaining 102 cases were not seen after the first treatment.

The occupations of the patients were as follows: Laborers 64, carpenters 40, Columbian Guards 13, bridgemen 11, foremen 5, painters 7, carpenters' helpers 5, electric wiremen 5, tanners 5, plasterers 4, staffworkers 4, janitors 4, moulders 3, roofers 3, iron-workers, steam fitters, plumbers, superintendents, cornice makers, inspectors and glaziers, each 2; and clerks, machinists, machinists' helpers, upholsterers, tallymen, engineers, draughtsmen, waiters, gasfitters, boilermakers, sculptors, teamsters, gardeners, and "not stated," each 1. You will thus see that 35 occupations are represented, including all classes of society, and consequently all grades of cleanliness, or the contrary.

In 202 cases, where the date of injury and date of first treatment are given, 173 are found to have been treated on the same day that the injury occurred, and 29 from 1 to 6 days after the injury; one case being treated 6 days after; one 4 days; one 3; seven 2, and nineteen 1 day after the injury.

The cause of the injury was, in every case but one, a nail. In the one exceptional case the cause was a piece of metal which fell upon the foot. In 39 cases, where the kind of nail is specified, 24 were the ordinary blunt pointed steel nails, while 15 were the sharp pointed round wire nails. In 16 cases the nails were new and clean; in 23 cases rusty.

In 5 cases the puncture extended clear through the foot; in 1 case the punctured wound was complicated by a contusion, and in 1 case there were two punctured wounds. In 4 cases, where the patients tried domestic treatment before coming to the hospital, the foot was found swollen and painful. In 1 case the domestic treatment consisted of a mixture of sugar and soap; in another of a cow manure poultice.

In 9 cases foreign bodies were found in the wound, this number representing over 4 per cent of all the cases. In 3 cases pieces of rubber boot were found; in 2, pieces of leather; in 2, pieces of sock; in 1, a piece of a nail; and in 1, sand.

In 119 cases in which the injured foot was designated, the right foot was found to be injured 70 times, the left 49 times. In 79 cases in which the portion of the foot injured was designated, the location was as follows: Sole 46, dorsum 5, sides 6, toes 7,

web of toes 3, and heel 2. The wounds of the dorsum were, in most instances, caused by pieces of falling timber having nails projecting from them. In wounds in other localities the nail was often driven into the foot with great force owing to the fact that the man was weighted down with a burden at the time of receiving the injury.

The treatment of punctured wounds of the feet may be summed up in one word, thoroughness, which implies primarily in the surgical treatment of any wound, the obtaining and maintaining of asepsis. In most cases the wound is apparently trivial; and the surgeon may share with the patient a feeling that active interference is unnecessary; he will trust to good fortune for a favorable result, and if complications arise, treat them when they appear. This can be done only at great risk to the patient. When it is called to mind that, in over four per cent of cases, foreign bodies are present in the wound; and that there is a probability in every case that pyogenic microbes have been introduced, and a possibility that those of tetanus may also be present, and that under the very condition favorable to their growth, namely, an anaerobic condition, it will be seen how irrational this "let well enough alone" treatment is. One case in this series will illustrate the danger of this course. The injury was so trivial that no treatment was thought necessary; cellulitis followed and the man was disabled from duty for twenty days, a longer period than that of any other case where the duration of disability is recorded.

The domestic treatment by various kinds of poultices in the four cases coming under our observation was followed by cellulitis.

Although our treatment varied much in different cases, the routine treatment finally agreed upon as being applicable to most cases and followed by the best results, was as follows:

1. Thorough cleansing of the foot with solution of bichloride of mercury 1-1,000.
2. Trimming the edges of the wound.
3. Swabbing out the wound with a probe lightly covered with cotton and dipped in 95 per cent solution of carbolic acid.
4. Drainage.
5. Antiseptic dressing.
6. Rest.

In the sole of the foot, where the epidermis is very thick, the edges of the wound frequently came together with valve-like accuracy, effectually preventing the escape of anything from the wound, so that, in some cases, it was only after trimming away the

edges that the presence of a foreign body was discovered. This procedure also favors drainage.

The use of the probe in cleansing these wounds is preferable to syringing, for two reasons: First, it is easy to reach the bottom of the wound with a probe, while it is doubtful in many cases whether this could be done with a solution applied by a syringe; secondly, a small particle of foreign material will often adhere to the cotton and thus be removed.

In some cases the use of peroxide of hydrogen by injection was substituted for the probe with carbolic acid. This would suggest itself as being a particularly appropriate agent as far as the bacillus of tetanus is concerned, on account of the anaerobic qualities of the bacillus and the oxidizing property of the agent.

For drainage a strand of silk-worm gut doubled upon itself was most frequently used. This has the advantage of being easy to introduce, and by its elasticity tending to keep the edges of the wound apart. In some of the larger wounds a gauze tampon was substituted for the silkworm gut.

The antiseptic dressing most frequently used consisted of powdered boric acid next to the wound and a covering of dry bichloride gauze, held in place by a muslin roller. At first iodoform was extensively used instead of the boric acid, but comparative tests showed it to be in no way superior.

Rest was directed to be as nearly absolute as possible for at least two days, at which time the patient was directed to return for redressing; with elevation of the foot. In thirty-eight cases the wound was so slight that the patient was allowed to return to work at once; but in the other 165 cases rest was uniformly enjoined.

Suppuration was as a rule prevented. In many cases the wound was found perfectly dry on the second day after the injury; but in the majority there was a slight discharge without, however, any evidence of inflammatory reaction around the wound. Drainage was usually removed the second day after the injury. The dressing was reapplied and the patient prohibited from walking on the injured foot until the wound was entirely healed.

Of ninety-eight cases which were under observation at least two days after the injury; eighty-six recovered without appreciable suppuration or any other sequelae. Of the twelve cases in which there were sequelae, in five there was suppuration; in five, cellulitis, in one abscess, and in one, synovitis of one of the metatarsophalangeal joints, which was probably punctured. In one case of suppuration the patient had removed the antiseptic dressing and

applied a piece of meat in its stead; in another a foreign body had remained in the wound and was expelled during the suppurative process. In one of the cases of cellulitis rest had been prescribed, but patient returned to work at once, and, after four days' work was disabled for seven days.

In cases where inflammation of any kind followed the injury, the wound was thoroughly cleansed, usually with peroxide of hydrogen, and the wound dressed, in most cases, with a wet boric acid dressing.

I wish again to call attention to the fact that tetanus was not a sequel in any of the cases, showing that its occurrence does not depend upon any particular kind of nail causing the injury, or upon its being clean or rusty; nor does it depend upon the portion of the foot injured.

In eight-six cases the entire duration of disability is recorded. In thirty-eight of these cases the men return to work at once. In the remaining forty-eight the disability extended over periods varying from one to twenty days. The average for the eighty-six cases four days. As this, however, includes all the cases in which the disability was nothing and only part of those in which one or more days were lost, it is manifestly too low for a general average. In the forty-eight cases in which the patient did not return at once to work, and in which he was kept under observation until able to return to work, the duration of disability is seven days. Taking this as the average for the 165 men who did not immediately return to work, the estimated total number of days lost on account of punctured wounds of the feet is 1,155, an average of a little less than six days for each of the 203 cases. This represents almost a loss of four years' work for a single man.

DISCUSSION.

Dr. L. L. McARTHUR: I wish to congratulate the Doctor on the opportunity of a lifetime to present so valuable a paper to the society. Certainly no surgeon has before had an opportunity to see and care for so many cases of punctured wounds of the feet under modern aseptic methods. Dr. Plummer is to be congratulated on the methodical and scientific manner in which he has approached the subject and presented it. He is to be congratulated on the excellent results which have followed the application of our present scientific knowledge of the causation of inflammation, especially of tetanus, for it is well known and proven, that the microorganism of tetanus is always to be found in rich loam, and hence, in the dust

which will be likely to adhere to the soles of the feet in Jackson Park. Our knowledge of tetanus teaches us, too, that symptoms rarely make their appearance before the ninth day, so that a wound which may appear to be healed on the third or fourth day and no attention paid to it, when suddenly the spinal and nervous phenomena, are apt to become apparent. Some years ago I looked up the subject of tetanus, and in looking over the literature of the war of rebellion as to cases of tetanus reported, if I recollect correctly there were 12,000 injuries of the hands and feet, and among these fifty-two cases of tetanus occurred in the feet, and some eight or ten in the hands. I believe the free drainage used in the doctor's cases has done much to prevent tetanus in them. I have no doubt that the specific organisms of tetanus were introduced into many of these wounds. Its poison or ptomaine has a definite chemical composition; has been extracted and undergoes chemical reactions as do the alkaloids; with the different precipitants it can be recognized, and moreover has a definite physiological effect upon the lower animals. If free provision is made for its escape from the wound no constitutional symptoms are manifested. This organism is not one which lives readily in the human body; if its ptomaine be allowed to escape the blood soon inhibits its growth.

Dr. A. BELCHAM KEYES: It seems to me that Dr. Plummer's estimate of the number of lacerations and contusions in punctured wounds is small. It is difficult to conceive that a nail would not lacerate and contuse to a certain extent. Foreign bodies are, of course, various and probably minute foreign bodies are carried into every wound, the chances of suppuration depending on the number present, and power to produce sapremia or septicemia of the particular microorganisms introduced.

We understand that the bacillus of tetanus has its natural habitat in moist earth. Most of the cases I have seen, some seven or eight have been from wounds of the hands, perhaps because in this climate the feet are all protected by shoes. One interesting case was of a man who was shot in the groin by a thirty-eight caliber revolver, and two weeks later when the wound was granulating nicely, developed tetanus. The granulating surface was excised but the man died, it being impossible to control the convulsions. The thyroid gland of this man was removed and inserted in the abdominal wall of two dogs; it was absorbed, but the dogs remained perfectly well. Dogs, according to Kitasato, are not as easily inoculated as other animals; tetanus does not seem to develop until the wound is granulating or perfectly healed,

i. e., until the oxygen is cut off on account of the anærobic disposition of Rosenbach's bacillus. It should not be forgotten that wounds are too small sometimes to be seen; we know how a severe cellulitis may occur from a minute puncture that clears up by a wet antiseptic dressing. Microorganism requiring a very high power microscope to see can enter a very small puncture.

In the County Hospital I found foot injuries showing a great deal of dirt and other foreign bodies, if carefully cleaned, heal rapidly. The foot is a long distance from the circulation centers; we know how hard it is in old people to heal wounds of the feet compared to the scalp; also the feet are prone to infection even in the most cleanly person; and lastly, elevation of the limb plays an important part. While in this age, perhaps the proper surgical treatment would be to excise where practicable the parts exposed to infection at the primary dressing.

DR. BAYARD HOLMES: We can only hope that Dr. Plummer will be at the World's Fair when they are tearing it down. The nails will then be dirty and have the bacilli from all over the world upon them, and after those dirty nails are thrust into the feet it will be interesting to know whether he will have such luck as he exhibits in this report.

DR. S. C. PLUMMER, in closing the discussion, said: I wish to thank the gentlemen of the society for the kind manner in which the paper has been received. In regard to Dr. Keyes' suggestion as to classification of these punctures, I would state that a great many of these wounds were made by sharp-pointed wire nails which could not produce very much laceration. Where the wound was made by the larger square-ended nails, of course, we could call it strictly speaking a contused punctured wound. But as the essential feature of the cases was that the wounds were punctured, that is, the edges were closed so as to shut off the deeper portion of the wounds from the air; they had all the essential characteristics of a punctured wound, and I classified them accordingly. The fact that these wounds are as a rule followed in a certain percentage of cases by tetanus, and that in all this large series of cases there was no case of tetanus is very suggestive. Of course the absence of tetanus might have been a coincidence, but it looks as though there was some relation between the prompt drainage and attention to the wound, and the fact that tetanus did not follow.

As to the existence of the tetanus bacillus in the ground at the World's Fair we cannot say positively, it was not looked for. It seems to me the soil there is favorable for the development of the

bacillus; it has been in use for two years and the surface soil of the roads has been mixed with soil brought from the city upon the wheels of vehicles. Consequently it seems to me the tetanus bacilli must certainly have been present in the park sometime during the construction period. And, moreover, if the association with horses has anything to do with the causation of tetanus, as Dr. Shakespeare, of Philadelphia, has suggested, there certainly was a good opportunity for the introduction of the bacillus through that medium, because horses were used there from the beginning, the first work done having been grading, in which horses and mules were largely employed.

