

## OPERATIVE FIXATION AS A CAUSE OF DELAY IN UNION OF FRACTURES.\*

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THE great activity, developed in recent years, in the operative treatment of closed fractures, makes it desirable to report any instances of operative fixation that have been followed by unsatisfying symptoms or disastrous results. Many of us have for years been opening recent, closed fractures for the discovery of complicating lesions, for operative reduction, or for satisfactory fixation. My own advocacy of such measures began about 1885. Hence I should not be considered an unduly prejudiced critic of the present furore for operative uncovering of the ordinarily severe closed fractures of the tubular or long bones.

It seems to me, however, that the earnest advocacy of such radical procedure by especially expert and experienced operators has a tendency to do harm to surgical science and to encourage the assumption of unnecessary risks by the public. The situation resembles that of the period when hundreds of women were unnecessarily rendered sterile by oöphorectomy for the so-called sclerotic ovary, others subjected to needless nephrorrhaphy for loose kidneys, and both sexes deprived of useful thyroid glands; because these operations were found to be comparatively free from fatal issue and because neither the docile patients nor the hasty surgeons knew the true physiological worth of the organs thus subjected to surgical insult. A similar illogical following of brilliant operative masters is now occurring in the domain of tonsillar pathology, and is fast approaching, one may fear, in the treatment of closed fractures of the bones of the extremities.

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Operative surgery has a brilliant career, but its activities must be controlled by a logical mind, not too much given to dwelling on the conservatism of the past or so flushed with victory that it encourages running amuck through hospital wards.

I recently reported<sup>1</sup> two deaths following fixation of closed fractures of the femoral shaft with plates and screws. Dr. Joseph Ransohoff,<sup>2</sup> of Cincinnati, says that Babler in a late report of the St. Louis City Hospital mentions two deaths occurring out of 13 cases of simple (closed) fractures of the femur treated by plating. He himself knows of two other deaths after operative treatment of this injury. I, myself, have heard of one death other than mine occurring in Philadelphia under similar circumstances. This shows that operative fixation of fractures of the femur at least is not as innocuous a proceeding as some medical men seem willing to assume.

My present purpose is to seek information on the comparative rapidity of bony consolidation of fractures under non-operative and operative treatment. It will be conceded at once that to obtain a mathematical determination of this question, it would be necessary to apply both methods to the same number of fractures of the same character and severity, occurring in the same part of the skeleton, and treated under the same circumstances by the same surgeon. These conditions are manifestly unobtainable. I must, therefore, be content to give the statements, which I have obtained from recent surgical literature, bearing on the length of time required for the union of broken bones under these dissimilar methods of treatment.

My attention was called to the possibility of plating being a cause of delay in union by having under my care a young man in whom this contingency seemed to take place.

Mr. D. S. B., aged twenty-nine years, sustained on April 13, 1912, a closed fracture of the right tibia, a little below the middle of its shaft, and a double fracture of the fibular shaft of the same

leg, which also was closed. The injuries were due to striking his leg against that of another player in a game of baseball. His general health was good. A surgeon endeavored to set the fractured leg without anæsthesia, but was not successful. Then 15 pounds extension, made with an anklet and a pulley, was employed for several days. Ten days after the receipt of injury, an X-ray picture was taken showing a fracture of the tibia, which was almost transverse, and two adjacent fractures of the fibula. At this time an attempt was made under chloroform anæsthesia to reduce the fragments. This was unsuccessful.

Fourteen days after the accident the tibia was exposed by a longitudinal incision under ether anæsthesia, and a Lane plate about four inches long was applied with screws to the fibular aspect of the tibia. The reduction of the fracture was perfect. No fixation apparatus was used for the fibular breaks. A gypsum encasement was put upon the leg for external support. It covered the ankle-joint. I do not know whether it went above the knee. The external wound healed by first intention and without pain. The gypsum splint was split two weeks after its application.

Ten weeks and two days after the receipt of the fracture (June 24, 1912) he came to me walking on crutches, and with the leg still protected with the gypsum splint. The fibula had apparently united, but there still was marked anteroposterior mobility at the seat of the fracture of the tibia. There was no swelling as of tibial callus on the subcutaneous surface of the shin bone; and the apposition of its fragments was perfect. I treated him with calcium carbonate, gr. v., and calcium lactophosphate, gr. v., internally three times daily before meals, used the rubber bandage around his thigh for congesting the seat of fracture, supported the broken bone with a gypsum encasement, and had him walk on crutches and stay a good deal in the open air. This line of treatment I continued for six weeks (until August 5, 1912) without producing any special effect on the ununited tibia. He was quite anxious about his useless leg, but seemed in good health except for this worry. He was a rather free user of tobacco.

As sixteen weeks and two days had by this time elapsed without union of the major bone occurring, I advised removal of the Lane plate and inspection of the site of fracture. I ex-

pected to find muscle or fascia between the ends of the fragments, or that the tibia was held apart at the break by the plate or by the already united companion bone. My suggestion to the patient was that I would remove the plate and then perhaps re-fracture the fibula to gain close contact of the tibial fragments or insert a bone graft cut from the crest of the same tibia in the gap between its fragments.

The tibia was exposed by an incision in the old scar, the plate was found hidden, under fibrous tissue and a small boss of callus, on the fibular aspect of the tibia. The subcutaneous or inner surface of the tibia was smooth, showing no deformity and no elevation of callus under the periosteum where the line of fracture was situated. The screws were imbedded in the bone, but were readily removed. There was no pus about the plate or screws. There was, however, a slight darkening of the tissues and some softening of the structures in a few places where they were in contact with the metal. The plate was removed, as were all the screws. A few drill punctures were made into the bone ends and into the tissue between them. The wound was closed without drainage, and it healed promptly.

The leg was dressed with a gypsum encasement and in a few days the man was allowed to be up on crutches. The rubber bandage for engorging the limb was used for longer periods of the day than before, lime salts and tonics were given, he was sent to the seashore, and much was done to encourage him. His tobacco was limited.

When seen on November 30, 1912, which was exactly 33 weeks after the fracture occurred, he still had a slight antero-posterior movement of the tibia at the seat of the fracture. At this point there is a slight mound of callus, and the bone is nearly solid. The gypsum splint has been discarded for three weeks and he has not used the rubber bandage for a short time past. He still takes small doses of calcium carbonate and calcium lactophosphate. He uses a cane for walking outside his home, but in the house uses the leg without any support. He has been attending to his scholastic duties for about two months. He was ordered to wear the rubber bandage for an hour a day and to take a small amount of lime salts. He evidently soon will have firm and satisfactory cure of the fracture without deformity.

In looking for a cause of delayed union in this patient I came to the conclusion that it was not unlikely that the opening of the tissues to apply the fixation plate had something to do with the delay in solidification of the fracture of the larger bone. Slow union or non-union of a fracture from interposition of muscle or fascia is not unusual, but here my exploratory observation at the time I removed the plate showed that this was not the cause of the trouble in this instance. It is true that the patient was very much worried over his condition and was away from his family at the time the accident took place. He also was very anxious to obtain a rapid cure because of the necessary resumption of his teaching in the fall. All these facts have seemed to me scarcely a sufficient reason for the want of callus formation at the seat of the fracture of the tibia in a man so young and apparently so healthy. It is true that there were three fractures, the two in the fibula and the one in the tibia, to be united, the existence of which threw a little more responsibility upon the bone-making powers of the blood.

Upon looking over recent surgical literature, I have been struck with the number of surgeons who believe that the opening of a closed fracture, for the purpose of establishing an anatomical correction of a deformity, has a tendency, not to shorten but to lengthen the time of consolidation of the broken bone.

Some of the advocates of the operative treatment of fractures, and particularly, I think, Mr. Arbuthnot Lane, believe that opening the tissues to gain access to the seat of fracture does not delay the union of the broken bone. Mr. Lane, I think, states that anatomical reposition in the manner advocated by him is almost never followed by delayed union or non-union.

Dr. Thomas W. Huntington, of San Francisco, says that it is interesting to note that in practically all cases where anatomical reposition has been attempted, three things have been accomplished: rapid bony union, absence of deformity, and absence of pain.<sup>3</sup>

Huntington in another article printed in 1908<sup>4</sup> in speaking of fractures of the femoral shaft states that approximate anatomical reposition is essential to quick repair and ideal result. He also believes that a very large percentage of all cases of delayed or non-union can be attributed to faulty adjustment. These two writers represent, I think, the opinion which most of us held when, within recent years, the unusual activity in operative treatment of these lesions began. That broken bones should unite by first intention when the fragments were properly adjusted seemed in accord with what happened in wounds of the soft parts and was, therefore, accepted. Perhaps due weight was not given to the possible physiological differences in the repair of tissue in which the deposition of inorganic salts is required to complete the restitution of physiological function. It is also possible that our reasoning was faulty, because the proper distinction was not made between bad open fractures which notoriously require a long period of time for proper cure, and uncomplicated closed fractures.

Dr. William Darrach, of Roosevelt Hospital, New York, has had a wide experience in the operative treatment of fractures, and is an earnest advocate of the method in a large range of cases. He says in his paper<sup>5</sup> read before the American Medical Association and published in August of this year that his experience has been that firm union comes a little more slowly in fractures that have been opened.

Another similar opinion is given by Dr. Astley P. C. Ashurst<sup>6</sup> in his article on the treatment of fractures of the forearm, in which he gives the notes of 52 cases treated without operation. He states that if in treating these fractures the surgeon will use "the eyes in the ends of his fingers, he will secure by conservative means quite as good, and in many cases a much better result than by operation, and in a shorter time." In another part of his paper he gives as his opinion that after operation the process of union often is slower than it would have been if no operation had been employed.

One of the advocates of the rather frequent necessity for direct fixation of fractures is Dr. Leonard Freeman, of Colorado. His statement is that it is certain that delayed union is more common after operation than when fractures are treated by ordinary means.<sup>7</sup>

In a later article published in 1911,<sup>8</sup> when discussing the operative procedure, Dr. Freeman makes this statement: "All this gives rise to two dangers—infection and delayed or non-union." In the same article, he continues: "The tibia is one of the most frequent sites of delayed or non-union, and particularly is this true of fractures that have been operated upon and perhaps united by wires or bone plates. Fritz Koenig asserts that this is due to the removal of blood clots and tissue fragments, which are supposed to stimulate bony union, while others place the blame upon the foreign bodies introduced by the surgeons; but whatever the explanation may be, the fact remains." In the earlier article Dr. Freeman says that this delay in union may occur when the periosteum has not been disturbed and when no wires are employed. This seems to indicate that he attributes the slowness of bony repair to the operative intervention itself without reference to foreign bodies being used or the periosteum being unduly disturbed. In another part of his earlier article he speaks of the delayed union after operative intervention being more frequent when fractures of the femur are so treated than those of the tibia, and attributes this more frequently delayed union to the necessary disturbance of the tissues in a deeper wound.

Probably this experience of Dr. Freeman has something to do with his advocacy of subcutaneous fixation with long screws and an external clamp.

In an article in the *Journal of the American Medical Association* of October 21, 1911, Dr. Edward Martin, of Philadelphia, asserts that: "It is noteworthy that union is usually delayed, that the time of treatment is not materially shortened, that the results are not uniformly good. But taken as a whole, they are infinitely better than could possibly have been secured by other than operative means." He thinks: "There

has seemed to be a relation between the size of the internal splint and the promptness of final union. In other words, we have felt that the less foreign matter we put into the wound the quicker it got well." The same writer in an article on the open treatment of transverse fracture of the femoral shaft printed last year<sup>9</sup> makes the statement that union is nearly always delayed, the delay being proportionate to the amount of stripping of the bone ends and trauma of the soft parts at the time of operation. He thinks that we have no evidence that the period of after-treatment, before complete, or what we call complete, restoration of function is accomplished, is materially shortened by plating.

These opinions of Dr. Martin are confirmed by his statement made in September of this year<sup>10</sup> that as a rule the presence of a plate (Lane plate), instead of stimulating osteogenesis between the broken bone ends, retards it.

This statement of Martin is quoted by Dr. F. H. Albee<sup>11</sup> in his paper on bone transplantation in the treatment of Pott's disease, club-feet and ununited fracture as a reason for advocating the use of bone grafts in non-union of fractures.

These writers are not alone in the belief that direct fixation may be a cause of delay in union. William Hesser<sup>12</sup> has written that it has been his experience to see union delayed weeks, even months, though he has never had a case of infection.

S. C. Plummer, of Chicago,<sup>13</sup> states that he has heard Dr. John B. Murphy express the opinion that union was slower when a Lane plate had been applied. Plummer says that this has also been his experience in some cases. Plummer, therefore, does not agree with the opinion of Mr. Lane, whom he quotes<sup>14</sup> as making the statement that operative treatment "shortens the duration of the period during which he (the patient) is incapacitated for work, since union is practically by first intention, and, consequently, very rapid and perfect."

I finally give the opinion of Joseph A. Blake,<sup>15</sup> of New York, on this subject, which is valuable, because Dr. Blake has been greatly interested in the operative treatment of fractures and



has written a good deal in its favor. In speaking of non-union after the operative treatment of broken bones, he says: "The occurrence of non-union is not so very rare, even when the fragments have been maintained in end-to-end position by ordinary external splints. I have seen such results notably in the femur. I have also seen non-union occur when the femur had been wired. In these cases non-union has usually been attributed to the presence of the wire. When, however, the wire was changed for a plate which kept the fragments rigidly fixed, union resulted in spite of the presence of much more foreign material."

Many surgeons have probably seen this occurrence. I, myself, a good many years ago was unable to get union of an ununited fracture of the humerus by wiring, which another surgeon subsequently cured, I understood, by the insertion of a plate.

Blake further says that he has had three cases of mild infection after operations upon the femur in which there was a rather excessive production of callus. In these instances "union did not seem to be delayed, but even seemed to be accentuated." He makes the assertion that "mild infections apparently do not interfere with union, but, on the other hand, seem to stimulate the formation of callus." He maintains, however, that: "Infections severe enough to cause necrosis of tissue manifestly will prevent union." He calls attention to the fact that he does not look upon infection of such operative wounds with satisfaction, for infection must be considered, he says, "the worst misfortune that can happen in operations for fractures."

Plummer, in commenting upon the fact that slight degrees of sepsis seem to hasten union of the broken bone, truly says that all agree that the one chief and overwhelming cause of failure in the operative fixation of broken bones is sepsis.

I have reported my own case of apparent interference with union by operative fixation with a plate to maintain coaptation of the fragments after a difficult reduction. I have also gone over the recently expressed opinions of surgeons doing

this kind of work. My intention has not been to discourage the election of direct fixation in fractures, which are difficult to reduce or hard to maintain in position after reduction. This contribution is rather a plea for caution against the enthusiastic adoption of this method of treatment as a routine means of dealing with closed fractures. The profession and the public should know that while it is a necessity in some cases and its adoption a question of judgment in other cases, there are many instances of subcutaneous or closed fracture in which it is not needed. Good results can often be obtained, both as to anatomical restoration of the parts, good function and rapid cure, by external dressings guided by a thoughtful, careful surgeon, who has a mechanical mind and anatomical knowledge. The operative treatment is particularly dangerous when adopted by novices in aseptic surgery, or in places where complete aseptic surroundings cannot be obtained.

## REFERENCES.

- <sup>1</sup> International Clinics (1912), vol. iii, 22d Series; also Trans. College of Physicians of Philadelphia, 1912.
- <sup>2</sup> Lancet Clinic, August 17, 1912.
- <sup>3</sup> International Clinics, 21st Series, vol. iii.
- <sup>4</sup> ANNALS OF SURGERY, September, 1908.
- <sup>5</sup> Journal American Medical Assoc., August 3, 1912.
- <sup>6</sup> Am. Journ. of Med. Sciences, June, 1912, p. 843.
- <sup>7</sup> Surgery, Gynæcology and Obstetrics, Feb., 1909, p. 120.
- <sup>8</sup> ANNALS OF SURGERY, September, 1911, p. 382.
- <sup>9</sup> Surgery, Gynæcology and Obstetrics, August, 1911.
- <sup>10</sup> Surgery, Gynæcology and Obstetrics, September, 1912.
- <sup>11</sup> The Post-Graduate, November, 1912.
- <sup>12</sup> Surgery, Gynæcology and Obstetrics, August, 1911.
- <sup>13</sup> Journal of Iowa State Medical Society, June, 1912.
- <sup>14</sup> Surgery, Gynæcology and Obstetrics, April, 1909, p. 344.
- <sup>15</sup> Surgery, Gynæcology and Obstetrics, April, 1912, p. 338.