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The most important step in the treatment of fractures is that the surgeon shall have made a diagnosis of the condition which he is about to treat. To undertake the treatment without an adequate picture in one's mind of the bony lesion present detracts materially from the satisfaction in one's work and conduces sometimes to poor results, on the one hand, or to unnecessary confinement of the patient, on the other. So important is this that when the surgeon is not able to satisfy himself as to the full character of the injury by means of the ordinary methods of examination, the two artificial diagnostic aids should be called on, and either general anesthesia or the *x*-ray employed.

Still, the old and simple methods of diagnosis are of the greatest value. In many of our hospitals young men are subjecting all their fractures to the *x*-ray for diagnosis. This is most valuable for corroborating the diagnosis; for bringing out the details, or for clearing up difficulties; but to employ the *x*-ray *de novo* as a routine, results in a blunting of their diagnostic sensibilities and places them at a disadvantage when required to treat fractures when they have not access to the *x*-ray.

Let us not fall into the error of thinking that, because this subject of fractures is one of the oldest branches of surgery and deals with the commonest of surgical lesions, it has attained to anything like its ultimate perfection. It is still in the hazy stage of development. I have no hesitancy in stating that some of

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the newer and more dramatic branches of abdominal surgery are more nearly perfected than is the surgery of fractures, which has occupied therapeutic ingenuity from a time antedating recorded history.

The surgeon does wisely to think of a fracture as a wound—a wound of bone—which in its treatment and healing is amenable to the same rules that govern the healing of wounds in other parts of the body. The more widely the wound surfaces are separated the greater is the damage to the blood and lymph channels and to the nerves. The more mobility there is the greater will be exudate and swelling. Conversely the sooner and more accurately the wound surfaces are brought together and retained in apposition the less will be the swelling and the more perfect the healing.

We have not only to think of the wounded bone, but of the structures which lie in relation to it. The muscles play an important rôle, but muscular resistance is often regarded as the obstacle to reduction when the trouble is due really to the interposition between the bone ends of fascia, of a bundle of muscle, of a clot, or of periosteal tissue, which the *x*-ray does not reveal. When manipulation does not force such fractures from their entanglements, a satisfactory result is best secured by operation. Unless operated on these fractures are the ones which give delayed union or non-union.

There is much misconception of this question of non-union. Students are taught much about constitutional weakness, old age, and lack of earthy salts in the blood; but these, in my judgment, are insignificant. The vast majority of cases of non-union are due to the conditions just narrated. Given broken bone surfaces held in close apposition, bone to bone, and they will grow together, just as they do in fractures of the skull; but let soft tissues be interposed and the patient is a candidate for the so-called non-union—and a diet of oyster shells and parlor matches will not alter the case.

Swelling is another important consideration. It is due to exudation, 1, from the wounded bone surfaces and, 2, from the surrounding soft tissues which are injured by bone fragments or by loss of support. We may put it down as a pretty general rule that this swelling is in direct proportion to the amount of mobility. The exudate from the bone itself amounts to but little. Most

of it is from the damaged blood channels of the neighboring soft tissues. The swelling in fractures of the skull is inconsiderable, notwithstanding that the total area of bone surface involved is commonly more than in fractures in the leg or arm, and the vascularity greater. The reason for this is the natural immobility of fractures of the skull. For these reasons the best

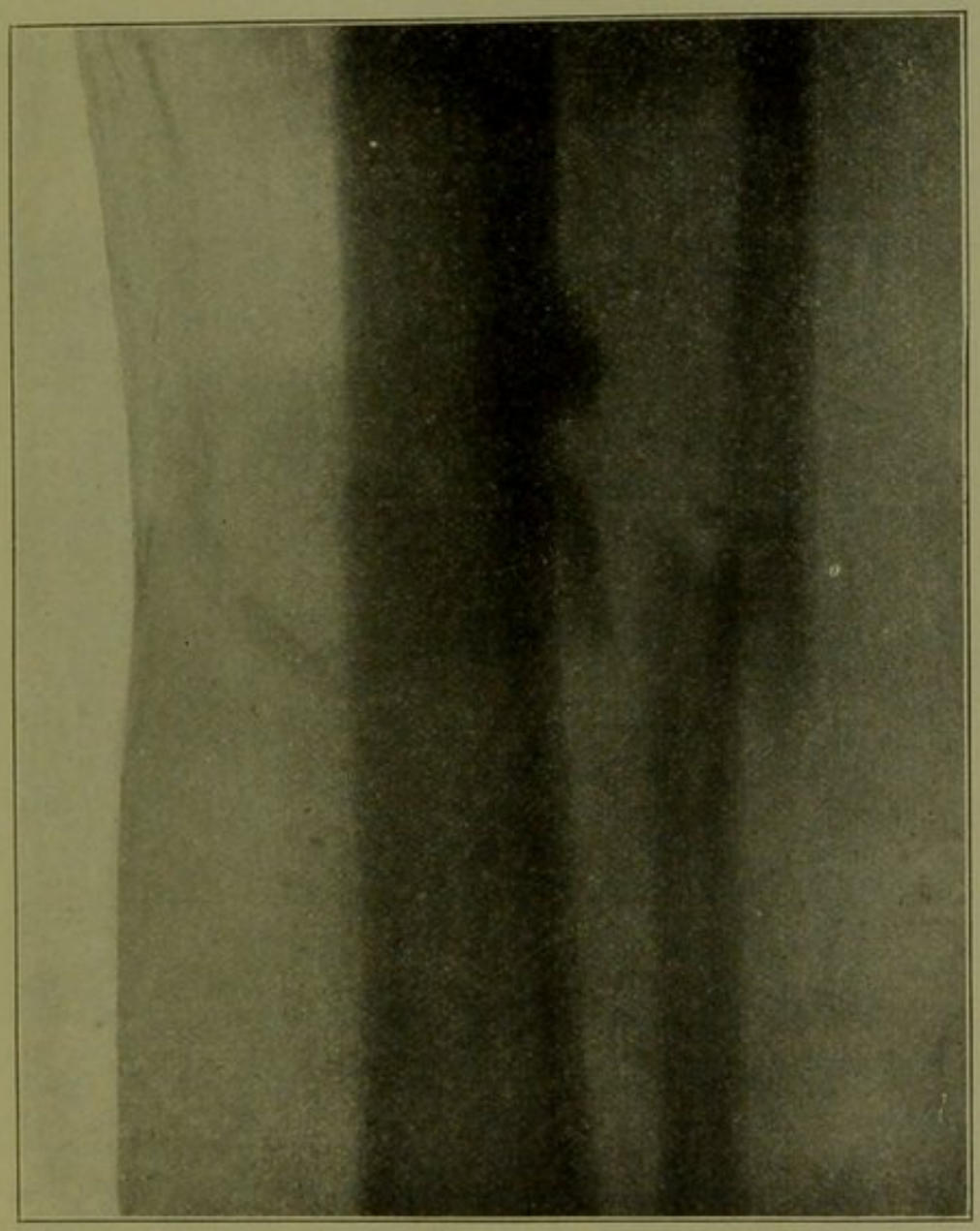

Fig. 1.—Fracture of tibia and fibula in plaster case. Position corrected with the aid of the *x*-ray. Best possible correction. Observe lateral displacement of fibula and loose fragments of bone.

results in the treatment of fractures will be secured by early immobilization. The sooner a fracture is reduced, its bony surfaces brought into apposition and held immovably, the less will be the swelling and the more satisfactory the result.

There is a prevalent notion of waiting until "the traumatic reaction has subsided." This ancient phrase rolls off the tongue sonorously and sounds important—we have heard our teachers and the men we venerate use it. But there is traumatic reaction going on all the time as long as the bones are out of place or so long as they are movable. There is also an ancient practice of deferring serious treatment until "the swelling has gone down" (another legacy from the dead past). If we can effect immobilization soon enough, the swelling will not come up. Lead and opium and other embrocations have no place in the modern treatment of fractures.

Fig. 2.—Fracture of lower end of tibia in plaster case. Presumably in good position. Observe lateral displacement and overriding.

In most hospitals, however, when a fresh fracture of the tibia and fibula is brought in, it is put up temporarily in a vast amount of cotton and basswood splints in such a way that the bones are not immobilized. Swelling is expected, and the expectation is fulfilled. After the muscles, tendon sheaths and nerves have been infiltrated with exudate for a week or so the serum is sufficiently absorbed for the leg to be properly immobilized.

Can anything better than this be done? I think there can. For many years it has been my teaching and practice to correct deformity and permanently immo-

bilize such fractures as soon as possible. When the fracture is seen within two to twelve hours after the accident there is usually no swelling present. I am in the habit of drawing a long white cotton stocking over the leg and applying plaster of Paris immediately over this. It does not require a heavy covering with the plaster bandage to immobilize the fracture. It need not be more than one-eighth of an inch thick. It is important that the bandage next to the stocking be applied without folds and with the most perfect possible evenness. No reverses should be made. The bandage should be

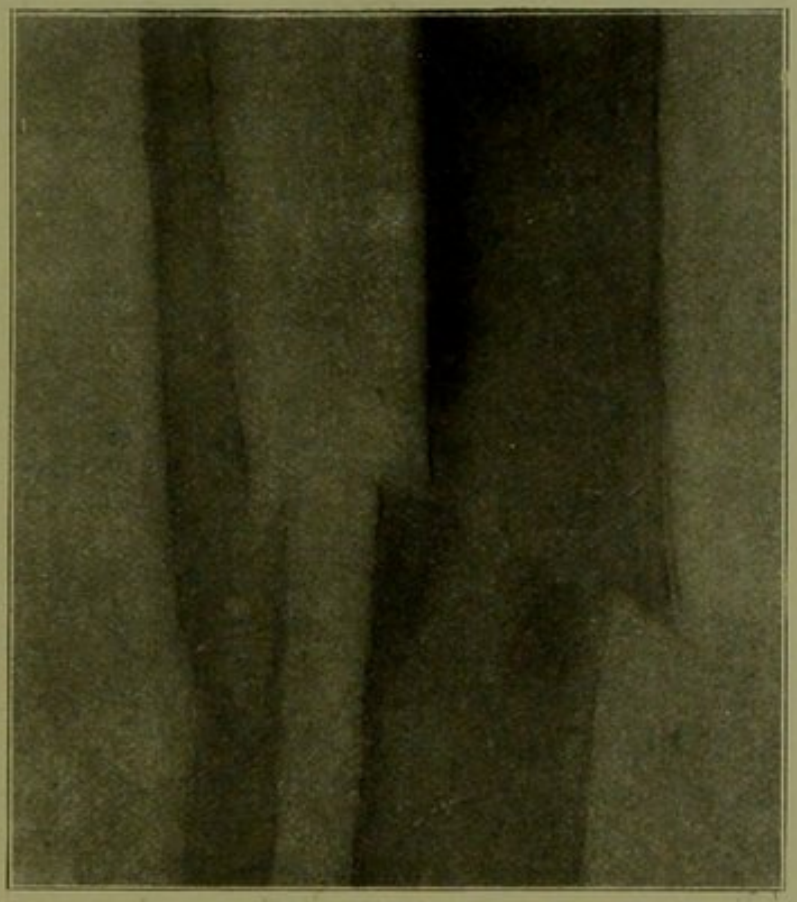

Fig. 3.—Fracture of tibia and fibula in plaster case. Presumably good position. Observe lateral displacement, angular displacement and shortening.

allowed to run out flatly, and when it is wished to change its course it should be cut and started in the direction desired. If you want an idea of the difficulty of doing this properly examine the ridges and unevennesses to be seen on the inside of the ordinary hardened plaster cast after it is removed.

A thin cast applied over the stocking conforms to the shape of the leg and allows of an estimate of the lines and contour which can be compared with the other limb.

A good plan is to cut through this cast on either side so as to divide it into an anterior and posterior half. This can be done before the last banadage is applied, and while the plaster is still soft, by using a sharp scalpel or bandage scissors. Then the final bandage is put on. Later when the cast is hard, if it is desired to inspect the leg, it is an easy matter to cut through the

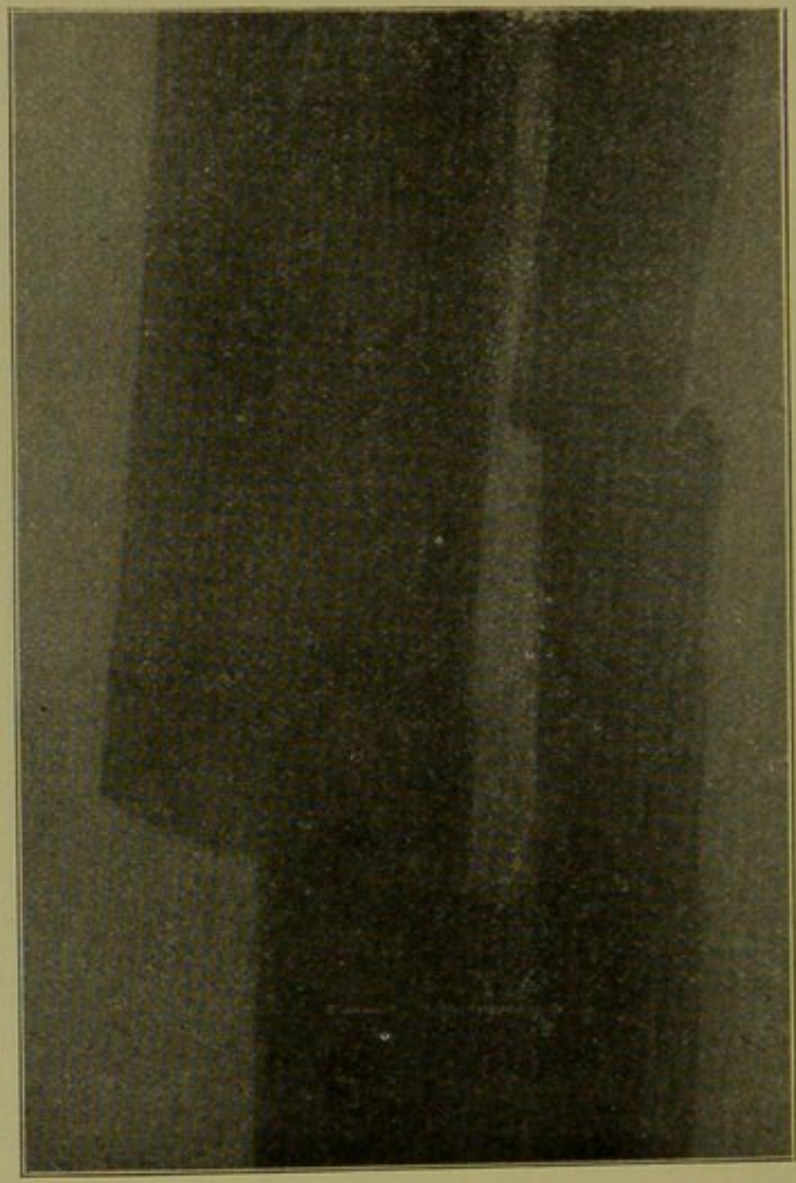

Fig. 4.—Fracture of tibia and fibula in a very fat leg in plaster case. Presumably good position. Observe lateral displacement of tibia.

outer bandage, following the underlying crack, and lift off the front half of the splint. This operation is facilitated by employing two stockings instead of one, and, at the first cast-cutting operation, dividing the outer stocking, which is adherent to the cast, and leaving the under stocking intact.

Putting up a fracture immediately after its occurrence is not usually regarded as good surgery. It is not good surgery if the cast is not put on well. But if it is smoothly applied and the apposition is good there will be no further swelling, provided there is no extraor-

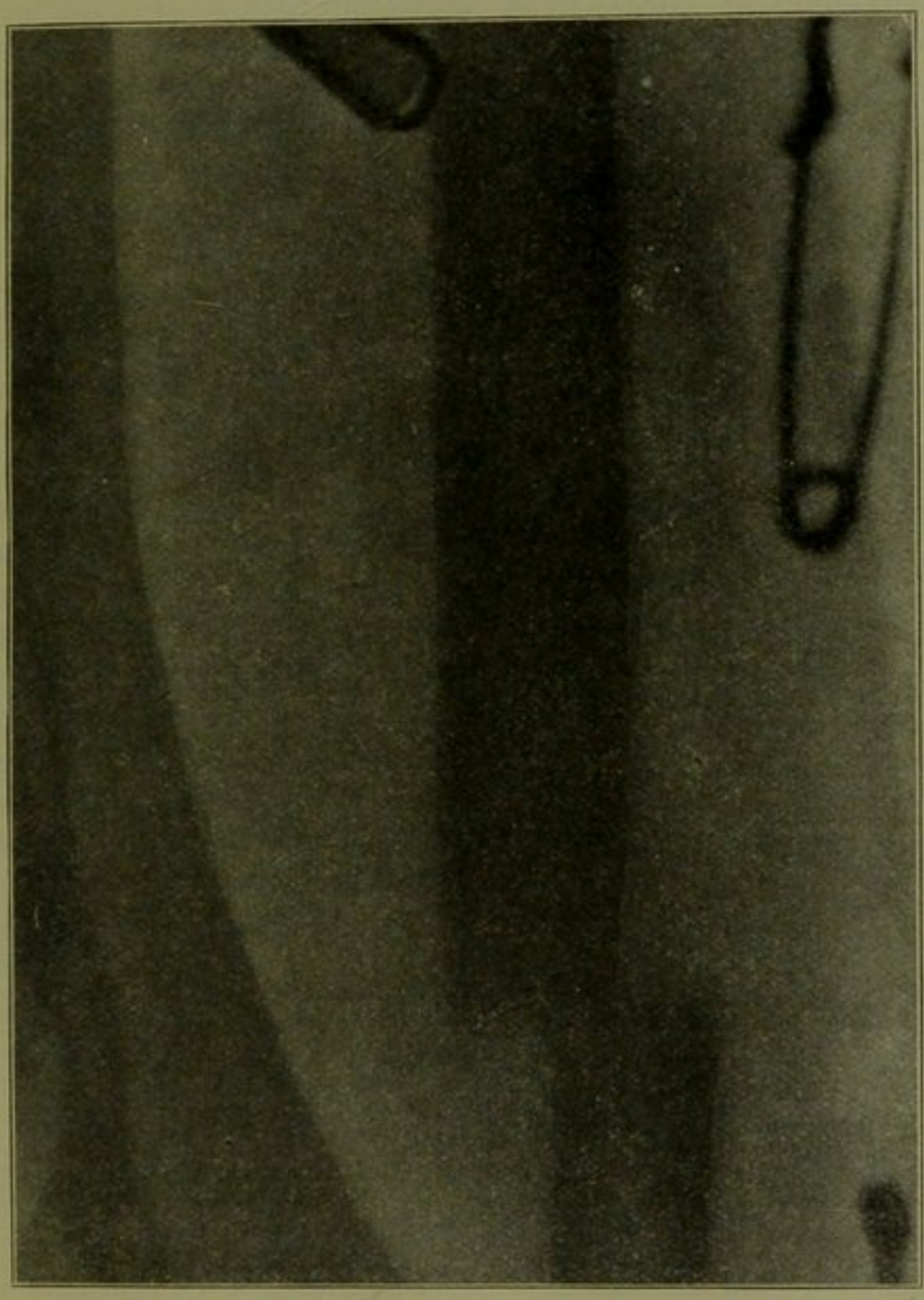

Fig. 5.—Fracture of shaft of humerus after reduction and immobilization. In apparently good position, but actually with lateral displacement equal to half the diameter of the bone.

dinary condition present, such as imperfect reduction, rupture of large vessels, or venous obstruction. After such immobilization the leg should be free from pain. There should be no throbbing or discomfort; if there is.

the chances are that the reduction is not good. Such a splint should never be left on in the presence of pain. It is very rarely that pain is present after this treatment.

Now, I do not promulgate this as the best routine treatment of fractures of the lower extremities. To do so would be as wrong as to say that every fractured patella should be sutured or that every inflamed appendix should be operated on. That would be a dangerous teaching. What I do say is that in experienced and skilled hands this is the best treatment.

Another matter to which attention may be called is the manner of extension in fractures of the thigh. In the ordinary fractures about the middle third of the femur, the overriding of the fragments is considerable, but there seems to be little appreciation of the great amount of force required to overcome the muscular contraction and bring down the fragments into place. Under the best conditions there is rarely a complete correction of the overriding. Fortunately, most fractures of the shaft of the femur are oblique and the broken bone surfaces slide over one another, longitudinal shortening causing but little lateral displacement. When the fracture is transverse the overriding produces lateral displacement equal to the diameter of the bone, often interposes more or less soft tissue and becomes a more serious thing. In order to overcome these longitudinal displacements in a man an extension which is more than the patient can tolerate is necessary. If the fracture is oblique, twenty to forty pounds will nearly correct the overriding; if it is transverse, that amount will not bring the bone ends into apposition either with or without the use of a general anesthetic.

What I desire to call attention to particularly is that the time to apply this extension to accomplish results is immediately after the accident. Every hour adds to the infiltration, with serum, blood and leucocytes, of the connective tissue, fascia and muscle about the fracture, and diminishes the elasticity of these tissues. What can be done by twenty pounds of traction in the first twelve hours can not be done by forty pounds after the third or fourth day. Dr. Stimpson's proposition to tire out the muscles by traction does not work here. Instead of relaxing, the tissues become more resistant.

Still, I have seen surgeons begin with a moderate amount of extension, then after a few days measure the legs and find shortening and add five pounds, continuing to repeat this until by the end of a week or so they get up to an amount of extension which if applied on the first day would have done much good, but which on the seventh day is ineffective. The time to put on the maximum extension is at the very first—from twenty-five to forty pounds in a man—then at the end of a week, ten days or two weeks, this extension can be reduced, or even sooner if necessary.

The *x*-ray has revolutionized our conception of fractures. A broken bone was once thought of as a simple mechanical matter to be considered in the same light as a broken stick or other broken object, the treatment consisting naturally of putting it back into position and keeping it there until it could grow together. Then came the callus, like a plumber's "wiped" joint, and sealed it together. There is still in the public mind an unfortunate practice of thinking of a fracture as a matter of the bone alone, when in truth so many other structures are involved that the bone is but a single part of a pathologic complex.

The *x*-ray has shown that an accurate replacing of fragments is rare. It is unfortunate that the public expects a perfect piece of joining from the surgeon, who works on an unseen structure covered by muscles, vessels and nerves, which often make it even impalpable. When we secure a perfect functional result we permit the idea to prevail that we have done a perfect piece of joining. Let us not forget that a perfect functional result is compatible with an imperfect piece of joining. In most of the complete fractures of long bones of the leg the apposition is far from correct. Open operation is the only method by which they can be made correct. A restoration of function is the thing we aim at. But we should disabuse the public mind of the idea that that requires accurate apposition.

Many times I have put up fractures of the tibia with the greatest care and been confident that the apposition must be perfect, only to find on *x*-ray examination glaring failures of apposition. Still, good functional results were produced in these cases, but had the patients seen the *x*-ray plates we may be sure that they would have been fearful lest they never again be able to

use their limbs. This is one of the values and dangers of the *x*-ray—valuable to the surgeon and patient for the help it affords in permitting the surgeon to know the condition of the bones, dangerous to the surgeon and the patient for its misleading effect on the mind of the latter.

I show here a number of pictures illustrating the importance of the *x*-ray and also the difficulties in securing perfect apposition even when guided by this important aid. Good functional results were produced in all of these cases. It is true that I could present a larger number of pictures showing more perfect apposition, but the points which I desire to impress are the following:

1. The perfect reduction of fractures of long bones is difficult and often impossible without operation.
2. Without the *x*-ray we are always in the dark as to the actual conditions present.
3. Reduction with mathematical precision is not absolutely essential for a good functional result.
4. If surgeons would display as much zeal in discussing their imperfect results as they do in presenting their triumphs, our literature would be richer, more practical and of vastly more value, and the public would be less prone to expect impossible things in the treatment of fractures.

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