

Original Articles.

CAUSES OF DISABILITY AFTER FRACTURES OF THE LOWER LEG AND ANKLE.*

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THE thing we know least about in surgery, and particularly in minor surgery, is end results. This is particularly true in regard to fractures. The great experience gained in hospitals is after all a rather loose experience, and under present conditions of hospital practice (and abuse) in the large cities, no one man has a large series of fractures in private practice, and hospital cases are hard to follow. So we tend in prognosis to fall back on tradition and authority rather than to tabulate our actual experience.

I have never yet looked into the results of any single class of fractures without finding sharp discrepancies between the traditions and the facts as they stand. Many such discrepancies bear on prognosis and not particularly on treatment. I believe the facts that I shall here try to bring out call for some modification in treatment as well as prognosis. We were all taught, I think, that deformity was the thing we were to avoid in leg fractures — and taught little else. In fact, it seems to make little difference whether there is a little shortening, whether or no the much-talked-of "riding fragment" is present. Once solidly healed, the shaft is perfectly competent to bear weight whether smooth and regular or not — the important disabilities that follow these fractures are not of the leg but of the foot and ankle. Deformity as such is to be avoided, of course, but it is not of the greatest importance. I am firmly convinced that the avoidable disabilities are nearly all due to one or more of three causes, as follows:

(a) Failure to maintain or restore the general long axis of the leg, whether local deformity is much or little.

(b) Mechanical damage to the ankle-joint or change in its plane, and

(c) Loss of joint motion from rigidity of muscles and tendons.

It is some years since we learned the lesson in regard to Colles' fracture that disability and deformity had no very close connection, and that over-long fixation was almost the only cause of functionally poor results. This does not apply directly in case of fractures of the leg and foot, because the leg has a function in weight-bearing as well as propulsion; hence the mechanical conditions of shaft and joint are more important, but when one comes to look at end results the frequency with which disability is due mainly or entirely to stiffness is surprising.

I have been watching these cases for several years with a view to getting at the reasons for disability in individual cases, and about four years ago, with Dr. Bottomley, attempted a systematic study of end results of leg fractures by sending out cards to old patients. It did not work very well, owing largely to the fact that

many leg fractures occur in young workmen of the drifting class. We got relatively few cases, and a recent search I have made found but few more. In the main the cases on which I have to base my conclusions are cases followed through the out-patient till they were walking, and more especially those who came to the City Hospital long after injury to seek relief from disability. In all I have notes of forty-seven cases followed to something like end results. They are in the main the *least favorable* of our results. Good results do not appear again in hospital. What the percentages are I do not know. My impression is that any considerable degree of disability is rather unusual. Most cases recover very well, though it takes a good while.

This is given as a preliminary paper, not because I expect to change conclusions but because a study of this sort, to give considerable numbers of each type of fracture and each form of disability, should number hundreds of cases. Perhaps in time we may get such data. Only from careful detailed observation of large numbers, however, can we learn much; letters from patients as to results are almost worthless.

In the series studied the following conditions were found as causes of disability of greater or less grade:

(a) Displacement of the bone ends, *per se*.

(b) Change of axis of the leg.

(c) Damage to joints, interfering with their bony mechanism.

(d) Arthritis — "traumatic."

(e) Static flatfoot, not from deformity but following over-use of atrophic muscles.

(f) Contractures.

Shortening as a cause of disability I could never be certain of. Rarely is there over half an inch shortening, and unless it is considerably more than that I cannot see that any disability results, though there may be a slight limp.

Rotation out or in of the lower fragment I did not meet in more than a trifling degree. *Outward* rotation, unless slight, must be a favoring factor in producing "flatfoot."

Poor circulation and persistent swelling often delay use, and so do damage. I have one case where the swelling itself, persisting for many months, seemed a *direct* cause of disability.

To take these matters up in detail:

As to the displacement of bone ends in fractures of the tibial and fibular shaft. Displacement is a factor in delay of union. I have watched very long course of union from this, and have twice operated merely to quicken intolerably slow union by getting better apposition, but so far as direct result of *moderate* inaccuracy in replacing bone ends goes, I believe it is *nil*. If the deformity is *great* there seems to be enough bone strain to give some persistence of *local* pain and soreness on use. This was present in two cases of our series.

Displacement is, however, of importance in another way. The foot, to fulfill its function, should be under the weight-bearing (vertical) line of the leg; a relatively slight bowing or

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overlap may throw it out enough to make trouble by increase of strain on ankle and foot. It is a question then not of bone outlines, but of preservation of the general axis of the leg.

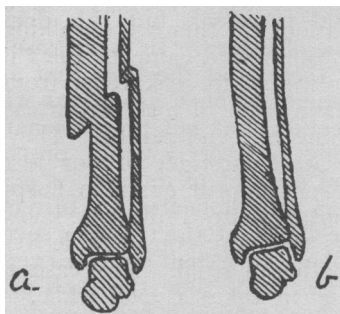


Fig. 1.

(a) Which shows obvious deformity, is no worse so far as preservation of the axis of the leg is concerned than (b) which looks much more nearly normal.

The most common deformity seems to be in the direction of valgus. This throws the weight-bearing line to the inner side of the foot. It may often act as does a rachitic knock-knee, and, for the same reason, producing an ordinary "static" flatfoot deformity.

Deformity in the contrary direction if marked gives a defective tread and trouble in balance, and not infrequently some disability from the strain on the tendons outside the ankle. This deformity is a rare result in fracture of the leg, common as a result of fractures about the ankle. Deviation in this direction if of slight degree is a help rather than a damage, for it lessens the chance of a flatfoot strain, being in fact equivalent to the Trendelenberg operation for flatfoot.

Forward deviation is rare, except for the very mild deformity often associated with inward bowing where this is due to overlapping. Presumably the result of marked forward bowing would be like that resulting from like bowing after rickets, namely, a shambling gait without real disability. I have not seen it as a cause of disability after fracture.

Backward bowing, on the other hand, is common. This is because of the tendency of the limb to sag downward in its plaster or splints as the original swelling subsides, and because our inspection is apt to be limited to a front view of the leg, which does not show this deformity.

Deviation in this direction if more than slight is rather serious. Study of cases shows two factors that bear on this.

First, such deformity gives what is practically a shortening of the tendo Achillis, and moreover somewhat impedes the action of this tendon mechanically.

Second, the forward displacement of the foot results in (a) what amounts to an extreme hyperextension of the knee, (b) in a practical lengthening of the lever length of the foot, involving extra lift on the part of the soleus and gastrocnemius, already handicapped by the distortion of their tendon. The practical result is a con-

siderable loss of working power and a good deal of clumsiness of gait. Not infrequently the disability is enough to warrant secondary operation. I have notes of two such cases operated and of one other that should have considered operation.

The distortions occurring from fractures involving the ankle-joint bring in new elements. Here we have to deal not only with the change of axis but often with a widening of the joint or a dislocation of the astragalus.

Backward dislocation at the ankle complicating Pott's fracture is familiar to all of us. It results in partial loss of motion, in loss of any firm column of support, and sometimes gives almost total disability. Fortunately it is rare and probably always avoidable by proper treatment.

Forward dislocation at the ankle is less frequent. I have seen it but twice in the cases of this series, and in both cases associated not only with fracture of the malleoli but also with a chipping off of the front of the tibia at the ankle. Both were very lame, but one case had fibrous ankylosis, the other much rigidity. There are no data to show how much trouble the displacement alone will cause.



The backward bowing shown is equivalent so far as leg mechanism is concerned to a hyperextension of the knee to an extent indicated by the dotted line.

Displacement inward has in this series been very common — this I take not to be the rule. Such displacement results from fracture across the tibia into the joint or from "inverted Pott's" fracture — in a mild degree and rarely from excessive correction of a Pott's fracture. The disability is from the malapposition of joint surfaces, from the twisted tread of the foot, and from associated stiffness. The disability is usually severe except where the distortion is from over-correction in Pott's fracture, which does no harm.

Outward displacement is common, resulting in the rule from insufficient care in treating Pott's fractures, i. e., from neglecting the often needful extreme inversion of the foot. The symptoms are essentially those of static flatfoot plus muscle

rigidity. Even slight deviation in this direction is apt to cause trouble. Where there is added a widening of the mortise as well as an outward distortion, we have an added factor of disturbance when static troubles begin.

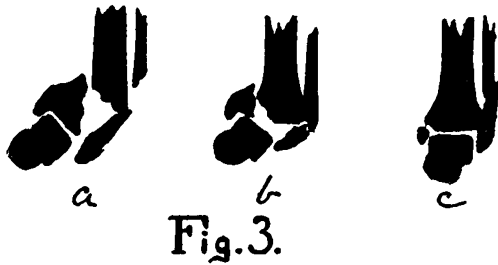


Fig. 3.

The mechanism of inward displacement of the foot with (a) Tibial fracture involving the joint, (b) Inverted Pott's fracture, (c) Over-correction of typical Pott's fracture.

The symptoms due to static trouble from ankle fracture vary, as do those of ordinary static flat-foot, according to individual equation; but I have notes of but one case with *marked* outward displacement due to fracture in the shaft where symptoms did not develop, and *no* such case where like deformity involving the ankle joint failed to give symptoms.

Sometimes with, sometimes without, trouble with the arch we have a true arthritis. It is clinically characterized by swelling in some degree, by pain, sensitiveness and loss of motion, and inasmuch as these may all be due to other causes it is hard to be sure whether arthritis is present. In two of the cases of this series I know it was present because I operated on them — one showed fibrous ankylosis, the other marked loss of articular cartilage.

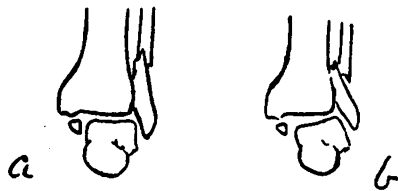


Fig. 4.

Outward displacement in Pott's fracture. (a) Simple outward displacement. (b) Outward displacement with widening of the mortise, permitting rocking of the foot outward.

A comparatively large class are those in which with beginning use relative overloading has overtaxed the muscles that should support the arch, but are unable to do their work, owing to the simple atrophy of disuse. These cases result in simple static flatfoot in all ways comparable to the ordinary orthopedic flatfoot with little or no tendency to the development of contractures.

By contractures I mean all loss of joint motion due to actual or practical shortening of muscle and tendon in the limb. Just what the essence of this change is no one knows; it seems to be the late stage corresponding to the early loss of motion common to all fractures, entirely recovered from in time in most instances, in others resulting

in permanent change. It is not a pure disuse phenomenon, though averted by persistent early use. It has long been known that fixation, even long continued, has little and transient effect on normal limbs or on those affected with certain pathological processes, but this does not hold true in case of injury. In every case of fracture of the leg there is at the time that apparatus is removed some stiffness, associated with swelling and infiltration, but not proportionate to them. It is roughly, but very roughly, proportionate to the general amount of damage, *e. g.*, it is much less with an uncomplicated fracture of the fibula at or near the joint than with a severe fracture of both bones. Its extent increases very definitely with the length of time the limb is held fixed. In cases where motion is begun early it subsides; in cases where motion is long postponed it often persists without change, or with little change, even after use. The site of the change is various, according to the site of injury — this is the most definite and most significant fact about it and I think helps to explain what it is we are dealing with. In cases of ankle fracture, or fracture below the middle of the leg, it is ankle stiffness with which we have to deal, while the knee is unaffected. If the break, on the other hand, is in the upper third of the shaft, the stiffness at the ankle is far less, but there is a limitation of knee motion, often of considerable amount and tending to be permanent.

Throughout the cases I have looked into this has held true — it is a fact with which I was previously unacquainted and I think it helps our understanding of the character of the process. Where knee-stiffness follows fractures below the knee we can be sure that it has nothing to do with direct muscle damage or with alleged tendon adhesions. I am inclined to be skeptical about tendon adhesions. So far as the real evidence goes, they seem to be very rare. It must depend on reflex action or fixation, or both. Fixation alone should act equally on knee and ankle, for both are always fixed whether the fracture be low or high up, but this is not the case. On the other hand, the cases studied show that those in which motion is long delayed give most stiffness. We must, I think, be forced to consider this stiffness due first to some reflex action (similar to spasm from joint damage) aggravated by long disuse and tending to pass over to a permanent shortening of the muscle. I believe this to be the only logical explanation.

Now as to the clinical side: if we are dealing with knee stiffness from high fracture we find limitation of motion definite but not extreme, and not greatly interfering with ordinary function. The limitation is of flexion only, for all fractures are put up in extension. At the ankle the problem is different. There is apt to be limitation in all directions — least in direction of plantar flexion, usually most obvious in limitation of pro and supination. If the foot has been put up without due care in securing a right angle loss of dorsal flexion is considerable; if the right

angle has been preserved, as it always should be, this loss is much less. In a general way short tendo Achillis is common to all fractures below the middle of the shaft; lateral limitation seems more in ankle fractures. Loss of dorsal flexion entails according to its grade a difficulty in the normal stride. There is an attempt to compensate by medio-tarsal motion, and the patient suffers from what the orthopedists call medio-tarsal strain (familiar in other conditions involving short tendo Achillis).

Loss of lateral motion does not interfere with the straight step, but renders all accommodation to varying surfaces a strain on the shortened structures. These are the patients who "can walk all right in the house but not on the street," familiar to all of you. Every attempt to accommodate is a strain on the shortened tendon of the inner or outer side; every sharp strain brings its reaction of lameness, and often fresh access of stiffness — part of which remains permanently, so that they get worse instead of better. Slight wrenches of these joints are serious in their results. This I have seen repeatedly when, after months of tolerable use, light fresh strains have resulted in considerable and permanent stiffness.

This stiffness differs from that of simple static irritation in that it is not relieved by rest, as are like types of foot of the usual flatfoot origin whether they show only pain or pain with spasm — nor are the cases we are considering greatly relieved by the wearing of carefully fitted supports — nor does the stretching of the Schaffer shoe limber them up to any serviceable extent. It is not well to be too dogmatic, but it seems that the pain and stiffness of these cases, with stiffness from trauma and disuse, are entirely different from the like symptoms in the cases above noted, where mechanical disadvantage and weak muscles following fractures give a breaking down or laming of the arch later.

Dr. E. G. Brackett was kind enough to give some of these cases the benefit of his skill in treatment — and even in his skillful hands these really rigid ankles proved far more intractable than any rigid flatfoot; in fact they failed to improve to any degree under any treatment devised, while the static cases following fracture yielded excellent results. Tenotomies we did not try, nor have I seen them tried in such cases save for the tendo Achillis; tenotomy of all the lateral tendons is a severe measure, though it would be amply justified by some of these cases if results could be promised.

Since I began to formulate this matter of contractures I have treated a number of leg fractures in house and out-patient departments at the hospital, by allowing very early a brief daily removal of apparatus and gentle active motion of the ankle joint. Passive motion I have avoided as more liable to do harm. In cases so treated I have had no trouble with position or with progress of union, and have had far more rapid return of mobility. Part of them only have been followed up, so I cannot speak of statistics,

either with the routine or with this method, but I believe this to be a step in the right direction. I am not ready to advocate the "massage" treatment of our French *confrères*, but I do think they have proved that we insist too absolutely on fixation in many cases, and that we fix fractures for a needlessly long time. Absolute fixation is necessary not for a given number of weeks or until union is firm but only in so far and so long as there is danger of displacement, — which is usually not long, — after this, protection with intervals of motion and perhaps massage to maintain flexibility and nutrition can do no harm. As said above, we have learnt the lesson as it applies to Colles' fracture, — the time has come when we must extend its use. Twenty years ago Sands' paper on the harmlessness of fixation was the beginning of the end of the old vicious practice of forced passive motion; we have gone to the other extreme now and have enforced absolute fixation beyond all reason.

To recapitulate, the chief causes of disability in leg and ankle fractures as they appeared in this series studied are:

Failure to preserve the line of the limb — and consequent static trouble.

Mechanical damage to the ankle joint.

Static trouble from over-load on atrophied muscles — apart from any malposition.

Contractures.

In the first place, the tendency to mal-position must be guarded against, first, by careful study of lesions and by careful reduction; secondly, by careful review (checked if may be by x-rays) of the result of reduction and of the present condition — a review to be made after not over two or three weeks, when swelling and spasm are gone, yet while correction of mistakes is still easy. Later, operations are the only resort; — undesirable, yet they are often of great service. The purely static troubles independent of malposition are usually readily relieved by careful plate-support.

The contractures are I believe avoidable in all cases unless there is long-continued tendency to recurrence of deformity or delayed union or extreme trauma affecting soft parts as well as bone. I believe they call for treatment directed toward preserving flexibility and nutrition of the muscles, instituted before fixation has rendered the early spastic changes permanent. This means that rigid plaster bandages must be made removable at two to four weeks, not at three months, and that exercises without weight bearing must be done persistently under proper supervision. If this is not done we must expect stiffness of ankles and less often of knees, as one of the great factors of disability. In five or ten years from to-day I believe any disability from stiffness due to contractures following ordinary leg fractures will be considered as great a reproach as obvious malposition is to-day, as great reflection on treatment as are the stiff hands and wrists after Colles' fractures — once so common — in the practice of to-day.