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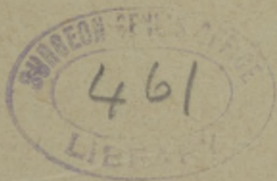
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THE TREATMENT OF  
CERTAIN FORMS OF FRACTURE.\*

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THE treatment of osseous fracture from rude beginnings has been eminently progressive and has gradually attained a perfection of methods and results remarkable even in the growth of modern surgery. In the management of many fractures it would seem that the possibilities of surgical art had been well-nigh exhausted, and this result has been so largely due to the contributive work of a great number of individuals, widely scattered in time and place and of varied degrees of professional prominence; that an unusual number of persons have come to rightfully regard themselves as identified with this particular phase of surgical progress.

This fact has rendered the subject one of exceptional universality of interest, and, together with its great practical importance to every general practitioner, has been sufficient to give it standing in the deliberations of any medi-

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cal association not exclusively devoted to the advancement of special subjects. It is an application of the surgical art which, in the exigencies of our profession, even the physician most averse to surgical practice is occasionally compelled to make, and in which the results, when unfortunate, are patent, and become the subject of always severe, sometimes judicious, and occasionally judicial, comment.

It is therefore pardonable, where professional pride and personal responsibility are both so deeply concerned, to traverse well-worn paths, for something always remains to the gleaner. It would be both useless and fatiguing to sketch, even in the most desultory manner, the treatment of fractures, either in general or in classes. Recent authors, Stephen Smith and others, have given it entirely adequate attention. There are, however, certain details and general considerations which, if scarcely demanding extended individual comment, may yet be naturally aggregated as a personal contribution to the subject. In this view some facts and observations here collated are worthy of notice either because of their importance or of their failure of general recognition. They touch the matter at somewhat distant points, but are related by laws of general acceptance and application.

The simplest form of fracture is that of a long bone at some distance from a joint. Its treatment in accordance with the careful methods in vogue during recent years usually affords almost perfect results. Angular deformity under ordinary circumstances, and when the accepted appliances for coaptation, extension, and counter extension are employed, is hardly to be feared; and since the advent of the aseptic era, when the resection and wiring of obdurate fragments became practicable, any considerable distortion is scarcely to be tolerated. Such, in this country at least, where mechanical skill is a common gift of Nature,

has long been the happy outlook for those who are still unfortunate enough to suffer this simplest of simple fractures. Up to a much later period abroad, however, eccentric results were still sufficiently common. I well remember, when thirty years ago I first saw foreign museums of pathology, I marveled much at their richness in strange osseous deformities and distortions, but the wonder lessened when I subsequently saw and noted in the service of Velpeau the indifference, carelessness, and neglect in treatment, and the distorted limbs which seemed to quite content even the master in surgery. I doubt not bones in France have since come to unite in more æsthetic form, but I question whether even now results in this particular are comparable with what we are accustomed to see at home.

There is another point of view from which the result of treatment has been less uniformly fortunate, and from which failure is quite too frequent. I refer to the occurrence of non-union and of ligamentous union of the fragments. I shall not attempt to present a statistical account of what may be termed this accident of treatment. I have encountered a considerable number of such cases during the past few years, though it has chanced that none of them were originally in my care. They have involved the humerus, radius, ulna, femur, fibula, and tibia, and the last mentioned has been most frequently in fault. The ætiology which is directly connected with treatment is well known, and the constitutional causes I have found to be more generally operative in the larger bones. Thus in six instances involving the femur two were of syphilitic origin, one was from malnutrition, and the fourth apparently resulted from too frequent disturbance of the fragments at an early period, and to a subsequent cachectic general condition. In a very interesting case, however, in the practice of Dr. S.

G. Cook, of New York, it was one of the metacarpal bones which suffered from constitutional cause. Union failed for ten weeks. The patient, who admitted former syphilitic infection, but presented no symptoms, was then subjected to specific treatment, and union began in two weeks' time and was rapidly perfected. It is evident that when the cause is wholly or in part of constitutional origin a corresponding general treatment is of primary importance, but local fixation and the correction of local errors should follow hard upon it. If the fault be essentially local the primary treatment must of course be local, but must often be supplemented by assiduous attention to the improvement of the general health.

I believe it can not be insisted upon too strenuously that possibility of imperfect union always exists. In a large proportion of such cases as have come under my observation the danger could have been averted by sufficiently early recognition and adequately careful treatment. There are instances like that in Dr. Cook's experience in which the clew is lost by absence of specific symptoms, and others in which constitutional depravity is irremediable. There are also instances of local default in which prevision is of no avail. Compound fractures sometimes, and intracapsular fractures of the cervix femoris always, fail of union. I speak advisedly of the latter lesion and am mindful of the earnest controversy which it incited some years ago, and which was so vigorously maintained by Dr. James R. Wood and Dr. Willard Parker. No one maintained that union seemed even possible *a priori*, but Dr. Parker presented a single specimen in which he believed it had actually taken place. Dr. John G. Johnson, of Brooklyn, demonstrated its fallacious character in a discussion of the whole subject, and no similar contention has since been made. The same anatomical conditions obtain in intracapsular

fractures of the cervix humeri and the same result must follow. If full allowance be made for these exceptional instances it still remains that the major part of cases of non-union depend upon remediable causes and defects of treatment. I think it is further true that the error is usually local. If firm, accurate, undeviating, and persistent coaptation be made, osseous union will seldom fail in uncomplicated simple fractures. The present means at our disposal for securing and maintaining coaptation are so varied and so perfect and so readily permit relief from unduly prolonged and exhausting confinement, that the surgeon can rarely escape full responsibility for perfect restoration of the parts. If in fractures of the shaft of the humerus the elbows were always properly supported, if in fractures of the shaft of the femur the fragments were always properly reduced, if in all fractures after the application of proper retentive apparatus it were left without unnecessary disturbance, the opportunities for study in the field of ununited fractures would be seriously curtailed. I dissent strongly from the opinion that it is ever safe to intrust any fracture which is within reach of retentive apparatus to the sole protection afforded by surrounding parts. It is not very long since I saw a case in which an unsuspected fracture of the upper fourth of the fibula had remained ununited for some months, and had led to a subacute arthritis of the knee. It united readily in the usual time after the application of a silicate-of-soda bandage. No fracture could be better supported by thick muscular environment and no result could more distinctly illustrate the efficacy and necessity of surgical aid.

I had not intended to discuss the causes of ununited and improperly united fracture, or measures for its avoidance, but rather to consider one or two of the operative methods for its repair. It is always well to regard any

case of this nature as simply one of delayed union till after the lapse of a considerable time and the thorough test of absolute immobility, with systematic hygienic and nutritive regimen. Where union is entirely wanting, attrition of the fragments may also be of service.

If operation is demanded, the choice lies between numerous procedures, two of which I have found to be efficient and deem to be simpler and safer than the others. These are (1) drilling, and (2) wiring and resection of the ends of the fragments, and of these the former seems to me, in suitable cases, the one to be preferred. It is certainly the easier of performance, can be indefinitely repeated, and in case of ultimate failure will not prejudice the resort to more serious operative measures. The femur, of all bones, is perhaps least suited to its employment. In case by any chance purulent inflammation follows, it is liable to be diffused along the muscular planes and to involve loss of limb or even life itself. I have met with one such accident after drilling the femoral fragments, and though the patient escaped dire disaster and eventually obtained proper union without further operative interference, I fully realized the danger to which he had been subjected. I saw in my service as *interne*, before aseptic surgery was practiced, a case in which death did result from diffuse suppurative inflammation of the deeper structures of the thigh after one of the other operations for the establishment of osseous union. The control of deep femoral suppuration is sufficiently difficult under favorable circumstances, but when the constitutional condition of the patient is impaired by long confinement, and perhaps by specific poison besides, and when it is induced by subcutaneous lesion, the difficulty may well become insuperable. I therefore favor an open operation in the thigh which permits early and thorough antisepsis and drainage should they be demanded.

Again, in very many, and probably in the majority, of cases there is an overlapping of the femoral fragments, which not only increases the difficulty of firm union, but causes deformity and weakness of the limb. An operation is requisite in which more perfect coaptation and a higher grade of ossific inflammation is obtainable, and in which, at the same time, the strength of the limb can be increased by the relief of deformity. I depend upon the wiring process to fulfill these indications. The seat of fracture is, of necessity, freely exposed, and every opportunity afforded for asepsis and drainage. Coaptation can be accurately effected and reduction of the fragments, or resection, if required, be made with proper care.

I am unprepared to demonstrate statistically its comparative safety or efficiency. Since the aseptic era, with which such comparison must begin, the whole number of recorded cases which have failed of osseous union and have been subjected to operation of any kind can not be large, and I am sure have not been tabulated. I have done this operation in two cases; in one, after resection of two inches and a half of bone, union became firm in thirty-three days and without the formation of pus; in the other, after a resection of one inch, union became firm in forty-five days after prolonged suppuration. In both the fracture had occurred in the middle third, six months previously in the first, and four months in the second. In the first case the subject was a girl of sixteen, suffering from the effects of syphilitic infection and dissipation; the second case was that of a man of twenty-nine, whose history was not clear. The method of operation presented nothing of special interest, and none of the delays and difficulties suggested by Treves were encountered. The question of safety is the general one of a simple wound originally uncontaminated and should hardly occasion anxiety. The

certainty of cure, comparative and absolute, must be a matter of estimate in the absence of any large number of cases in modern practice. If the patient's general condition warrants surgical interference of any kind, and always presupposing due skill and care on the part of the surgeon, success as well as safety should be reasonably assured. No other method has been devised in which the fragments can be so accurately secured, and under conditions so favorable to osseous production. If it results in failure, there is no reason to believe that the osteogenic process can be compelled by any other form of direct stimulation.

The consideration of ununited fractures of the humerus follows the same lines and leads to the same conclusions. The anatomical situation is similar and suggests the same views of treatment and of probable results. If there is much angular deformity or overriding of the fragments, or if a false joint has been formed, resection and wiring are likely to be indispensable. If there is simple non-union from want of support to the elbow or from too frequent manipulation during the progress of the case, drilling may possibly be successful, but is still injudicious for the same reason that obtains in case of the femur. In the present very general survey of the subject of mal-unions, it suffices to indicate the points of relation in this regard between the two bones.

In defective union of the smaller long bones of the extremities, notably the radius, ulna, and tibia, the question of treatment presents itself under somewhat different conditions. The fracture is likely to have occurred in a much more accessible position, usually subcutaneously, and even when nearer the head of the bone it has less formidable muscular surroundings. There is consequently diminished danger from the diffusion of pus from an accidental suppuration. The radius and ulna, if not the tibia, are much

smaller bones than the femur or humerus, and their osteogenic property is proportionately easier to excite. It is also practicable to maintain absolute immobility without necessitating an irksome confinement of the patient, which is always detrimental to the general health, and indirectly prejudicial to the process of repair. It might therefore be expected that the simpler method of drilling would suffice in case of these bones, and in my experience the result has justified the expectation. I have several times resorted to it for one or both bones of the forearm, and always with success. I have used it in a much larger number of cases for the tibia, and, with the exception of those in which the patient has abandoned treatment, they have all been eventually cured. The exact number I am unable to state, but I think from fifteen to twenty would be a conservative estimate. The fractures of the forearm have all been simple; those of the tibia, in three or four instances, were originally compound. In the latter a loss of substance, suppuration in the wound, or caries and necrosis of the fragments sufficiently account for lack of proper union. In all the radial and ulnar cases I have thought failure to result from original fault of apparatus or its too frequent disturbance in the course of treatment which has prevented absolute immobility, and I have no doubt the same error has been contributive in many of the tibial cases. I have had no reason to suppose that constitutional causes were operative in any of them or that the interposition of the softer tissues had played a part. The essential and determining cause of tibial default I believe to be found in deficient posterior support. I have certainly very generally observed it to be accompanied by a dropping backward of the lower fragment, which, as I infer, stands in relation of cause rather than of result, from the fact that when its prevention has been the subject of special care union has always been firm.

It is not sufficient to apply a plaster or silicate-of-soda apparatus, or to rely solely upon lateral coaptation. In either case, with or without the immovable appliance, a posterior supporting splint of some sort is requisite to safety.

If operation has been finally determined, and drilling selected as the means, nothing can be easier than its execution. It is well to use an anæsthetic, especially in primary operations, but it may be dispensed with on occasion. In private practice, where it is usually available, nitrous oxide is the preferable agent. I have not observed Brainard's advice to use the drill sparingly, but am accustomed to perforate each fragment in every direction, upward and downward, without its withdrawal, and to insert it again, or even a third time if necessary, to reach every part of the bone within an inch or more of the line of fracture. I have not hesitated, with due caution, to wound the soft parts contiguous to the bone. If there is considerable hæmorrhage, it is none the worse for the prospect of cure. The bone is often soft, but in cases of long standing it is more probably eburnated and its medullary cavity empty. It is scarcely necessary to say that every aseptic precaution should be employed with the same thoroughness as in a capital operation. The limb should be dressed aseptically, and, after superficial inflammation has subsided, should be put in plaster for four weeks. At the end of that period, if union is not satisfactorily firm, the drilling should be repeated and the limb again incased in plaster. I know no limit to repetition of operation but success. When union has become reasonably firm, it may be intrusted to plaster for a longer period and the use of the limb permitted. The general health of the patient should receive the same attention as should be accorded in the treatment of recent fracture. If I have been more fortu-

nate in my results than have other surgeons who have less confidence in this method, I attribute it entirely to my greater perseverance, or possibly in part and in some lesser degree to my habit of earlier interference. I know it has been thought wise to defer operation till after the lapse of many months. I am disposed to resort to the drill earlier—in two months even. I can not forget that the greater part of surgery is done in the service of the poor. It is their bones that are oftenest broken and that oftenest fail of solid union. If, then, time, which has to them an extraordinary value, can be saved by operation devoid of danger and fruitful of result, I am quite sure it should not be withheld in view of an otherwise possible recovery in the indefinite future. It is a luxury of dalliance beyond their means. If osseous union is delayed beyond two months it becomes improbable, and with the lapse of time the bone suffers changes which render the operative cure more difficult and more tedious. For a double reason, therefore, I advocate comparatively early interference.

I propose to very briefly abstract the history of three illustrative cases :

CASE I.—A young lady, thrown from her horse, fractured the right radius at the junction of the middle and lower thirds. At the end of two months, when I saw her first, union was still soft. She attributed the defective result, with apparent reason, to frequent removal of the dressings for purpose of examination. I drilled the fragments, and repeated the operation twice at intervals of thirty days before union was satisfactorily firm. The bone was in some way refractured at the same point shortly afterward, and I again used the drill for the fourth time, and without delay. The result was perfect at the end of the usual period, and now, after five years, is without reproach. No anæsthetic was employed.

CASE II.—A young man of twenty-five years was entangled in a rapidly-running rope, and his right leg nearly severed in

the lower third. Both bones were comminuted, and the limb held only by the integument and fascia of its posterior aspect. A fragment of the tibia was removed at the first dressing, and others after the necrotic process. The accident occurred on March 19, 1889, and the patient was originally in care of Dr. F. S. Dennis. The wound was not entirely healed till August. Union on the 2d of November was still fibrous, and resort was had to drilling, which was repeated on December 1st and February following, with the application of the plaster apparatus. Union became progressively firmer, and three weeks after the last operation he was allowed to walk with a brace fastened to the shoe. I have seen him within the present month, and his leg is absolutely solid, with an inch shortening and some limitation in extension of the ankle.

CASE III.—A locomotive engineer received injuries in a collision which necessitated amputation of the left leg below the knee, and occasioned a compound fracture of the right leg at the junction of the middle and lower thirds, resulting in fibrous union. He stated that his fractured leg was treated with various forms of apparatus, and that he was allowed to sit up at the end of six months, and three months later to walk with a crutch. The wound at the point of fracture was unimportant and readily healed. The tibia was drilled after fourteen months, at the time he came under my care, and plaster applied. Union became somewhat firmer, and the bone was again drilled at the end of thirty-eight days. In six weeks union was so firm that, after the reapplication of plaster and another drilling, he was allowed to go home into the country and to bear weight upon the leg in walking. The plaster soon broke away at the ankle, and he continued to walk upon the leg without any considerable support. Two months later union was found to be much weakened, and he was again drilled and put in plaster. In another two months union had again become firmer, and he was drilled for the fifth time and sent home in plaster, to return at the end of the summer, three months afterward. I have not seen him since, and have been unable to obtain any information as to his condition.

The second case I regard as the most extraordinary instance I have ever seen of recovery without mutilation from a compound fracture, and the subsequent establishment of osseous union as scarcely less remarkable.

These instances of fracture in which osseous union originally failed for different reasons all teach the necessity of patience on the part of both surgeon and patient. The first and second were ultimately successful because the patients realized the gravity of their condition, and were possessed of sufficient intelligence and resolution to be guided by advice and to persevere to the end of treatment. In the third, a man of equal intelligence ignominiously deserted when the prospect of cure was entirely hopeful, and left the surgeon not only helpless, but ignorant even whether or not his object had been accomplished. It is this infirmity of purpose which makes not only such cases, but primary fractures as well, often discouraging and always of uncertain issue. Any patient in hospital, or in private practice for that matter, is at any time quite likely to demand his discharge, in order to put himself in the care of an incompetent and irresponsible medical person, and to afford, perhaps, still another example of badly united fracture. The reference to causation in this accident would be most incomplete if attention were not emphatically directed to the patient's own frequent negligence, disobedience, and abrupt severance of professional relations.

Fractures through the extremities of the shaft of long bones constitute a clinical class by themselves. The danger here is less a question of angular deformity or of imperfect union than of fibrous ankylosis. It is true that I have quoted a case of non-union of the fibula near the knee joint, and that the adduction of the lower fragment in fracture of the surgical neck of the humerus is only too constant and too mischievous to escape attention; but the ever-present

menace—the one never to be avoided without early recognition and unremitting care—is the limitation of articular movement. The propinquity of the joint is a source of trouble and danger which I may assume to need no explanation. The necessity of judiciously early, patient, and prolonged passive motion is too thoroughly taught and understood to require even cursory mention. The use of massage, however, as practiced by the skilled masseur or masseuse, is an adjuvant in treatment of comparatively recent introduction and is worthy of at least passing consideration. It is not new to the profession, but as a definite means of accomplishing a specific object in surgical practice it is even yet imperfectly appreciated. In connection with the passive movements exercised by the surgeon, well-directed massaging and manipulation of the parts may be made of the greatest importance. It renders passive movements less painful, curtails the period of secondary treatment, and gives increased assurance of ultimate freedom of motion; but to obtain its full advantage it should be intrusted only to those who possess the requisite technical skill.

There is a special fracture in the vicinage of a joint which I propose to consider with some particularity, because it is in general so badly treated. This occurs at the lower end of the radius. In its more common form, known by the name of Colles, no fracture is more frequent; and, from the long-continued weakness of the hand and wrist which it usually entails, none is more important. It is because this secondary condition is unnecessary that I characterize the treatment of which it is the direct result as pre-eminently bad. My criticism applies solely to the splints habitually employed. The reduction of the fragments by extension, counter-extension, and manipulation, the subsequent lateral flexion of the hand to the ulnar side,

and the use of anterior and posterior splints with the ulna and radius in parallel position, can not be questioned. It is the prolongation of these splints which is the source of evil. I believe long splints are generally recommended in the standard text-books of surgery, and I know from my observation of hospital *internes* that their use is taught in the medical schools of New York with perhaps a single exception. It is insisted that immobilization of the wrist is essential to the stable fixation of the radial fragments. Actual experience shows this to be untrue, so that the prolonged and even permanent disability which it causes is gratuitous. The splints should be made of thin deal, a little wider than the forearm, should extend from the elbow to the wrist, leaving both joints free, and should be secured by broad bands of adhesive plaster and, if necessary, by a roller bandage. At the elbow they should allow absolute freedom of motion at the convenience of the patient. At the wrist they should accurately compress the extremities of the radius and ulna, just reaching to the margin of the joint without encroaching upon it. Although the wrist will be unimpeded in action and the hand mechanically unrestrained, the constraint of the forearm and the dependent position of the hand will maintain their absolute quiescence. The freedom of the joint from pressure or interference by apparatus insures its future integrity of action.

If the retentive bands of adhesive plaster are applied in the manner recommended by Dr. J. W. S. Gouley, who first in this country used the short splints for radial fracture, no readjustment will be required except as the subsidence of swelling may demand. In this method the lower band is attached to the inner border of the ulna, carried over the dorsal aspect of the wrist, and then over the anterior splint. The upper band is attached to the anterior surface of the

forearm below the elbow and carried over the posterior splint. Each band is made long enough to more than surround the limb. If the bands are simply wrapped around both splints, almost daily readjustment will be required for a week or more on account of the slipping of the apparatus downward. In this event great care should be exercised to avoid disturbance of the fragments.

Any splints which extend below and fix the wrist joint should be denominated *long* and the term *short* restricted to those which leave the joint free. Some confusion in nomenclature exists from failure to make this distinction upon an anatomical basis. Long splints have been made to extend to the metacarpo-phalangeal articulations, or even to the finger tips. They have also been fashioned in pistol shape as a means of maintaining lateral flexion of the hand, and this point has been much exploited. The smallest experience with straight splints, long or short, demonstrates that the hand once made to assume the proper position will retain it without special care.

The effect of long splints upon the future usefulness of the hand and wrist is so constantly observed as to scarcely admit of question even by the advocates of their use. Months or years often elapse before they are sufficiently restored to easily subserve the ordinary functions of life, and their finer movements, indispensable in certain occupations, are often permanently impaired. It is objected that the short splints do not sufficiently hold the fragments after reduction to obviate the danger of deformity. Experience and observation must be the sole arbiters in this point of dispute. I have never once treated this fracture in any other way, and I have never failed to keep the fragments in as good position as I was able to obtain in reduction. No splint can do more. This result has been confirmed in the practice of other surgeons who hold similar views. I

believe deformity will be really less with this method of treatment, since the bone is more open to inspection, and trifling derangements can be more readily corrected and with less disturbance of the apparatus. There is equal advantage to be gained in the treatment of other fractures of the forearm by not extending the splints below the wrist.

Fractures of the extremities of long bones implicating the joints are always unfortunate in result. The operative procedures which they demand are of great interest, and I regret that the limits of this paper do not permit their consideration. The conditions and methods of interference are of too great importance to justify the merely casual mention to which I should be restricted.

The treatment of compound fractures is another subdivision of the general subject which is too extended for our present limitations of time and purpose. I am less reluctant to turn aside from its discussion since it is already prominent in the literature of aseptic surgery. It may be said to epitomize the methods and possibilities of asepsis as it is practiced at the present time. I can not refrain from contrasting the results in compound fractures of thirty-five years ago and of to-day. Then few escaped without loss of life or limb; now few lives or limbs are sacrificed. The occasional recoveries of unamputated patients which I saw at that epoch were in Bellevue and were mainly attributable to the genius of Dr. James R. Wood, in whose service at the hospital I had the honor to be and whose friendship I shared with all young men in the profession with whom he came in personal relation. His professional sagacity was phenomenal, and, by the maintenance of open wounds, thorough drainage, and the most systematic attention to cleanliness which available means then permitted, he unconsciously anticipated without antiseptic agents the most important part of modern aseptic treatment. It may be of

passing interest to mention that impure carbolic acid was in use in that hospital at that time, but as a stimulant, not as an aseptic, and upon ulcers and old granulating surfaces, and not upon recent wounds.

The extraordinary collection of cases published a few years ago by Dr. F. S. Dennis admirably illustrates what is accomplished in the present aseptic care of this class of fractures. They probably underestimate than otherwise the chances of recovery. If those cases are excluded in which complications exist, as well as those in which some crushing violence has primarily destroyed or fatally impaired the vitality of all the structures of the part, failure to preserve the integrity of the limb may be fairly termed exceptional. A possible danger to life, born of aseptic faith, exists in overconfidence of the surgeon and a consequent attempt to avoid mutilation where there is no rational ground for hope. As safety lies in primary amputation, rash conservatism incurs a mortal responsibility. There is no conceivable contingency in which a surgical decision requires a more delicate appreciation of all the features of a case, studied in the reflected light of past experience, nor in which it should follow a more critical survey of all the elements of the situation. It may even then ultimately depend in great degree upon a professional instinct, not ignorantly innate, but founded upon the unconscious impressions derived from a multitude of previous observations, which upon occasion takes precedence of all formulated rules. If under such circumstances it proves that life has been endangered in the vain effort to save a limb, the intelligent and conscientious discretion which has been exercised and the acknowledged fallibility of human judgment will afford full absolution from responsibility. There can be no similar condonation of the error which comes from technical ignorance and inexperience when wiser

counsel can be had. Consultation costs nothing to the surgeon, and may profit much to the patient.

It may happen in a primary amputation, and usually does occur in secondary cases when the condition has become so depreciated as to be unfitted to withstand the effects of shock, that rapidity of operation is literally of vital importance. It can be facilitated by perfection of preparation; the assistants can be so familiarized with the operator's requirements, and his every possible want can be so exactly anticipated, that losses of time can be counted in seconds. I am accustomed to go further than this. The preservation of life is of paramount importance and the severance of the part which imperils it is the only pressing operative necessity. I therefore content myself with doing just this and no more. In such urgent cases I waste no time in forming flaps and have no hesitancy in cutting straight through the limb. If the patient lives, flaps may be fashioned or reamputation made at some more convenient season. I never employ an Esmarch bandage, and consequently have no occasion for a multitude of ligatures. There is no need for sutures or refinements of dressing. Three or four ligatures and a dash of hot water, a compress in the wound, some combination dressing, and a roller bandage over all, are matters of but a moment or two of time if preparation has been adequate. If the arterial trunk has been accurately compressed, if the anæsthetic employed has been nitrous oxide, or if ether or chloroform has not been carried beyond the necessary very moderate effect, shock will be reduced to its minimum. Cardiac and general stimulants can be hypodermically exhibited, hot-water bottles applied to the surface, and even hot-water enemata administered during the progress of an operation. It is the minutest attention to such details as these that makes the difference between life and death, and that has

sometimes enabled me to save cases which seemed practically hopeless. I should perhaps apologize for passing by the many serious questions connected with the treatment of compound fractures to linger over the steps of an amputation. I have often observed, however, that things which are quite simple and obvious are most neglected and consequently least understood. I am not sure whether this provisional amputation has been heretofore recommended as a formal operation.

There are two fractures—one of the vault of the cranium, the other of the patella—which, when simple, I usually make compound. This I do in the first for purpose of examination as well as of treatment, and in the second for treatment solely. I am compelled to assume, perhaps erroneously, that my views in regard to these fractures are known, for they have already appeared in print.

In a recent paper upon injuries of the head I referred briefly to fractures of the vault. I recur to them now in order to emphasize some points in treatment which I consider of sufficient importance to admit of iteration. These, in form at least, may be axiomatically expressed. A suspected simple fracture should be exposed by an incision of the scalp for purpose of examination. If a simple linear fracture be discovered, and there be no symptoms pointing to a complication, the wound may be closed. If with a linear fracture there be indications of meningeal hæmorrhage, or of lesion of the brain substance, or if there be an open fissure, trephination should be made for further exploration. If the fracture be depressed, the bone should be elevated, even in the absence of complicating symptoms. The further incision of the dura, or invasion of the brain itself, concerns the management of complications and not the fracture *per se*, and is consequently foreign to our purpose. This series of rules, which I regard as aphorisms,

are founded upon a belief in the necessity for the elevation of depressed bone under all circumstances—a necessity so urgent as to demand that the depression should be determined or disproved by any requisite operative means. It has fortunately become possible to institute these explorative measures without danger to the patient. The validity of the proposition that depressed bone should always be at once discovered and elevated or removed would seem to have been made convincingly clear in the history of numberless cases in which it has been neglected. It is not an occasional but a frequent instance in which, after the lapse of years, epilepsy, abscess, or mania has followed a cranial fracture, and in which a simple depression unrelieved, a cyst, or a spiculum of bone penetrating the brain, has been found to be the cause of an irremediable disease. If the occurrence of immediate danger is to limit responsibility, the surgeon may well allow his patient to drift, while he watches from day to day for the manifestation of primary symptoms, and in their absence for some brief time regard the cure complete. It is not even possible in a majority of cases to repair the evil consequences of such neglect by later operation; the remedy lies in prevention, not in cure. The epileptic habit, or the maniacal condition, once firmly established, the final removal of its cause is too often but an ineffectual resort. I have within the year removed an extensive area of depressed bone and a subjacent cyst in an adult, the result of an injury in childhood, without as yet any marked improvement in an epileptic condition. I offer no suggestion as to the method of primary operation. The employment of the elevator, rongeur, drill, chisel, or trephine is simply a matter of preference or convenience. The fact that a different view of practice is still maintained is simply an additional illustration of the vagaries of surgical opinion.

In the paper to which I have already referred I expressed an opinion that trephination is devoid of danger. I have feared lest I might have been understood in a broader sense than I intended. I am quite aware that this operation, in cases of chronic organic disease of the brain, is sometimes followed by a fatal result. I have recently trephined in a case of paresis in which I am convinced that death was hastened by interference. I am equally certain that an explorative trephination in a late stage of cerebral traumatism has in two instances been similarly unfortunate, and it is scarcely more than a month ago that, in a New York hospital, death followed trephination for epilepsy. It would not be difficult to multiply examples. In cases of recent fracture or of suspected meningeal hæmorrhage, to which I intended to confine my expression of opinion, I have no doubt of its entire safety. I have never seen any case in which there was the slightest reason to suspect that it had hastened or produced an untoward result. I do not hold the operation responsible for the effects of prolonged etherization, excessive hæmorrhage, or septic poison. It is true that shock from ether and hæmorrhage has proved fatal. If the brain has been crushed, the great venous sinuses wounded, or the larger meningeal arteries torn, much blood may be lost and considerable time occupied in the treatment of the wound; but it is these conditions, and not the operation which they necessitate, which involve danger. In the simpler and doubtful cases—the ones in which exploration or operation has been deprecated—there can be no great difficulty in safely limiting anæsthesia, controlling hæmorrhage, or counteracting the effects of shock. The further possibility of the occurrence of sepsis is not more a factor here than it is in operative wounds in general. If anything may be assumed absolutely, it is the certainty with which surgical cleanliness may be assured where

the making of the wound, as well as its cure, is under the control of the surgeon. I have seen cases of compound fracture, originally contaminated or foul from neglect, in which the suppurative process had invaded the brain or its membranes, but I have seen none in which an operation made to convert a simple into a compound fracture, or to open the cranial cavity, has given entrance to the pyogenic germs.

If we consider, then, the serious morbid conditions which often follow a neglect to relieve the brain from bone pressure, and the absence of probable danger which it involves, there seems to be no good reason why fractures of the vault should not be subjected to as critical examination as other accessible injuries, or why practicable measures should not be taken to avert future complications.

The second of the simple fractures which I habitually make compound is that of the patella. Three years ago, at the annual meeting of the Bellevue Hospital Alumni Association, I advocated wiring this fracture as the treatment to be almost invariably adopted, excepting scarcely more than those cases in which organic visceral disease rendered any operative interference inadmissible. My later experience has been for recent fractures entirely corroborative of the statements made at that time. The essential contentions which I then made were: That the obstacle to union is usually the intervention of the anterior capsular fibers, which fall between the fragments and prevent osseous contact, even though close approximation be effected; that this obstacle can not often be removed by any measure short of opening the joint; that this method is without danger; that its result is invariably osseous within less than half the time required for ligamentous union by other means; that restoration of the function of the joint can be made perfect by sufficient care in after-treatment; and that,

when the surgeon possesses ordinary operative skill, it is an operation not of choice but of obligation. I had at that time operated in forty-two recorded cases. I had never lost a life or limb, had never had a drop of pus in the joint, had never failed of osseous union, and had never but once had any ultimately serious limitation of joint movement. Since then I have continued to treat this fracture in the same way with the same results, and have had no occasion to change my views. At that time, only three years ago, the operation was regarded very much as was ovariectomy thirty years previously. No one quite ventured to call it unjustifiable, but almost every one looked at it askance, congratulated himself that he did not do it, and cheerfully awaited disaster to the occasional man who did. As a gentleman expressed it at a meeting of the Surgical Section of the Academy of Medicine, he treated fractures of the patella without operation, and could sleep undisturbed at night. In this brief interval I have noted with pleasure that an increasing number of surgeons are able to so treat this fracture as to gain the best results without the loss of rest which an uneasy conscience or lack of self-confidence seems to entail.

It will be unnecessary to recapitulate the steps of operation, which I have since modified in only one or two particulars. I have discarded the use of strong antiseptic solutions. I began with a bichloride-of-mercury irrigation of 1 to 5,000. I afterward reduced its strength to 1 to 10,000, with some misgivings as to its safety. I now use a solution of 1 to 20,000 in boiled water. I have no reason to doubt that boiled water by itself would be as sufficient here as in the larger serous cavity of the peritonæum. I add the modicum of antiseptic salt as a perhaps unnecessary precaution lest the joint cavity should suffer some casual contamination during operation. I find that by this

avoidance of strong antiseptics the subsequent restoration of movement in the joint is much more easily accomplished.

I continue the use of a single articular drainage-tube merely to afford an exit for post-operative hæmorrhage. I have long since ceased to fear the occurrence of purulent synovitis. I regard superficial suppuration, however, as quite possible whenever there has been much laceration of the soft parts; but if the deep sutures have been carefully placed and superficial drainage provided, there is not the slightest danger that pus will enter the joint.

In the second stage of treatment, after union has become sufficiently firm to render manipulation safe, the same advantage is to be derived from systematic massage that has been noted in fracture near the extremity of a long bone. There is the same necessity also, if it is to afford the greatest possible advantage, that it should be applied by a professional person who possesses technical skill and experience. Since I have discarded antiseptics of more than nominal strength, and have employed a masseur in cases where the joint is of more than usual rigidity or where it readily inflames by the use of passive motion, I have had much less trouble in restoring natural function.

The proper treatment of recent fracture of the patella is, in my mind, quite clear and well determined, but what to do with the fracture which has existed for a longer time is often difficult to decide. It is such cases which are most likely to come from a distance for relief, and they are certain to include all those most unfit for operation. The conditions which militate against success are mainly three—the contraction of the quadriceps extensor muscle, the atrophy of the lower fragment, and the shortening of the ligamentum patellæ. The muscular contraction can be overcome by massage, and is consequently unimportant;

the atrophy of the lower fragment is irremediable; but it is the shortening of the patellar ligament which renders many cases hopeless. Unless the fragments can be brought into at least partial contact, operation will be worse than useless. The length of time which has elapsed is important, but not absolutely determinate. At the end of two years I have obtained entire contact without difficulty or preliminary treatment. At the end of a few months even partial contact has been impracticable. In all cases the length of the quadriceps extensor should be restored, and the ligamentum patellæ, if possible, elongated by preliminary manipulation. Contact may be deceptive from portions of ruptured ligament which remain attached to the bony fragments. Operation, therefore, should not be ventured unless the fragments can be so readily brought together as to enable some allowance to be made for this source of error. There may be a single exception made to the rule. If there be absolute non-union, so that the whole joint cavity be subcutaneously exposed, flexion as well as extension impaired, and the limb so weakened as to justly occasion fear of fracture of the opposite patella, it may be well to operate even if doubt exist as to the nature of contact, and even at the risk of an ankylosed knee. If no contact at all be had, protection of the joint cavity will be lost and trouble probably arise from some form of synovitis. Old fractures of the patella at best are as troublesome and unsatisfactory after operation as recent cases are tractable and perfect in result.

There is an operation which has been recommended in place of wiring, and which has for its object approximation of the fragments by means of a subcutaneous suture. It is radically defective because it fails to secure osseous union. It does not provide for the removal of intervening capsular fibers, and has consequently no advantage over a

plaster apparatus except in making approximation closer. It is quite as difficult to do as the radical open operation, and would seem to be quite as likely to be followed by superficial suppuration.

The consideration which I have been able to give to the several fractures mentioned has been of necessity hasty and imperfect. I have already disclaimed any intent to make either a systematic or an exhaustive study of the general field in which they occur, and have sought only to emphasize some facts and observations which have impressed me with special force. I have spoken with some positiveness and insistence because my personal observation has led to positive convictions, and because I know that exact truth always loses by indirectness of expression.

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