

under the first phalanx of its corresponding toe. The swelling which immediately followed the receipt of the injury had concealed its nature, and now, several months having elapsed, reduction could not be effected. The only relief which could be afforded him, therefore, was in wearing a piece of hollow cork at the bottom of the inner part of the shoe, to prevent the pressure of the metatarsal bones upon the nerves and blood-vessels.<sup>1</sup>

## CHAPTER XXVI.

## COMPOUND DISLOCATIONS OF THE LONG BONES.

*Frequency of Compound as compared with Simple Dislocations.*—Compound dislocations, as compared with simple, are of rare occurrence. Of ninety-four dislocations reported by Norris as having been received into the Pennsylvania Hospital for the ten years ending in 1840, only two were compound;<sup>2</sup> and of one hundred and sixty-six dislocations in my record of personal observation made in 1855, only eight were compound.<sup>3</sup>

*Relative Frequency in the Different Joints.*—In my own recorded cases just referred to four were dislocations of the tibia inwards at the ankle-joint, one was a partial (pathological) dislocation forwards at the same joint, one a dislocation of the astragalus, one a dislocation of the head of the humerus into the axilla, and one a forward dislocation of the radius and ulna at the wrist-joint. I have also met with several examples of compound dislocations of the elbow and fingers. Both of the cases reported by Norris were dislocations of the thumb.

Sir Astley Cooper, speaking upon this point, says that the elbow, wrist, ankle, and finger-joints are most subject to these accidents; and that he has seen but two in the shoulder-joint, and one in the knee-joint. He had never seen a compound dislocation at the hip-joint, and he believed that it was "scarcely ever" so dislocated. Malgaigne says that a compound dislocation at the hip-joint has probably never occurred. Mr. Bransby Cooper has, however, reported in detail a very interesting case of this accident, communicated to him by Dr. Walker, of Charlestown, Mass., in which reduction was accomplished by *manipulation* alone, by Dr. Ingalls on the second day. The patient died at the end of about three weeks.<sup>4</sup> I have already, when considering dislocations of the femur downwards and backwards, referred to the case reported by Dr. W. Taylor, in which reduction having been effected recovery took place.

Among the cases of compound dislocation recorded by Sir Astley and

<sup>1</sup> Sir Astley Cooper, *op. cit.*, p. 385.

<sup>2</sup> Norris, *Amer. Journ. Med. Sci.*, April, 1841, p. 335.

<sup>3</sup> For most of these cases, see Transactions of the New York State Med. Soc. for 1855, article entitled "Report on Dislocations, with especial reference to their Results," by F. H. Hamilton.

<sup>4</sup> A. Cooper, on Dislocations, etc., by B. Cooper, p. 59.

Bransby Cooper, most of which were communicated to these gentlemen by other surgeons, forty-five were dislocations of the ankle, ten of the astragalus, four of the ulna at the wrist-joint, four of the thumb, two of the knee, one of the shoulder, one of the elbow, one of the radius and ulna at the wrist, one of the scaphoid bone, and one of the metatarsal bone of the great toe. Other writers have occasionally described compound dislocations of the clavicle, but I know of no record of a compound dislocation of the lower jaw.

*Prognosis, as determined by the Mode of Treatment adopted by most of the Ancient and many of the Modern Surgeons.*—By most of the early writers these accidents, whenever they occurred in the larger joints, were regarded as nearly beyond the reach of art. Says Hippocrates: "In cases of complete dislocation at the ankle-joint, complicated with an external wound, whether the displacement be inwards or outwards, you are not to reduce the parts, but let any other physician reduce them if he choose. For this you should know for certain, that the patient will die if the parts are allowed to remain reduced, and that he will not survive more than a few days, for few of them pass the seventh day, being cut off by convulsions, and sometimes the leg and foot are seized with gangrene." Hippocrates adds: "But if not reduced, nor any attempt at first made to reduce them, most of such cases recover."<sup>1</sup>

The same remarks are applied by Hippocrates to compound dislocations of the head of the tibia, of the lower end of the femur, of the wrist, elbow, and shoulder-joints; death occurring in all cases, as he believed, more or less speedily whenever the bones are reduced and retained in place a sufficient length of time, and "were it not that the physician would be exposed to censure," he would not reduce even the bones of the fingers, since it must be expected, he thinks, that their articular extremities will exfoliate even when the reduction is most successful.

I shall presently show, however, that even Hippocrates advised and probably practised resection in certain cases of these accidents.

Both Celsus and Galen adopt almost without qualification the line of practice laid down by Hippocrates, and affirm equally the danger and almost certain death consequent upon the reduction of compound dislocations in large joints.<sup>2</sup> Celsus recommends resection in some cases.

Paulus Ægineta, however, and after him Albucasis, Haly Abbas, and Rhazes, do not regard the rules established by Hippocrates, in relation to the non-reduction of the bones, as so imperative, nor the results of the opposite practice as so uniformly fatal.

"Hippocrates remarks," says Paulus Ægineta, "in the case of dislocations with a wound, the utmost discretion is required. For these, if reduced, occasion the most imminent danger, and sometimes death, the surrounding nerves and muscles being inflamed by the extension, so that strong pains, spasms, and acute fevers are produced, more particularly in the case of the elbows, knees, and joints above, for the nearer they are to the vital parts the greater is the danger they induce. Wherefore,

<sup>1</sup> Works of Hippocrates, Syd. ed., London, vol. ii. p. 634.

<sup>2</sup> Paulus Ægineta, Syd. ed., vol. ii. p. 510.



Hippocrates, by all means, forbids us to apply reduction and strong bandaging to them, and directs us to use only anti-inflammatory and soothing applications to them at the commencement, for that by this treatment life may sometimes be preserved. But what he recommends for the fingers alone, we would attempt to do for all the other joints; at first and while the parts remain free from inflammation, we would reduce the dislocated joint by moderate extension, and if we succeed in our object, we may persist in using the anti-inflammatory treatment only. But if inflammation, spasm, or any of the aforementioned symptoms come on, we must dislocate it again if it can be done without violence. If, however, we are apprehensive of this danger (for perhaps, if inflammation should come on, it will not yield), it will be better to defer the reduction of the greater joints at the commencement; and when the inflammation subsides, which happens about the seventh or ninth day, then, having foretold the danger from reduction, and explained how, if not reduced, they will be mutilated for life, we may try to make the attempt without violence, using also the lever to facilitate the process.<sup>1</sup>

In the following quotations from three of the most celebrated writers of the last two centuries, we find but little if any evidence that the opinions of the fathers upon this subject were not still held in general respect: "If the joint be dislocated, so that it is either uncovered, or a little thrust forth without the skin, the accident is mortal, and of more danger to be reduced than if it be not reduced. For if it be not reduced, inflammation will come upon it, convulsion, and sometimes death. 2. There will be a filthiness of the part itself. 3. An incurable ulcer, and if perhaps it be brought to cicatrize at all, it will easily be dissolved by reason of the softness of it; but if it be reduced, it brings extreme danger of convulsion, gangrene, and death."<sup>2</sup>

"Si vero in magnis articulis tam valida fuit facta luxatio, ut ligamentis ruptis os articuli multum sit protrusum per integumenta, hæc pars ossis vasis privata moritur, citius autem si reponatur, quam si non reponitur; quare sola amputatio restat ad conservationem vite."<sup>3</sup>

Heister, who makes no allusion to this subject in the first edition of his great work, published at Amsterdam in 1739, adds the following remarks in his last edition, translated and published in London in 1768: "Dislocations attended with a wound, especially of the shoulder or thigh-bone, are of very bad consequence, and often endanger the life of the patient; in Celsus's opinion (Book VIII., Chap. XXV.), whether the bones be replaced or not, there is generally great danger, and so much the more the nearer the wound is to the joint. Hippocrates has declared that no bones can be reduced with security, besides those of the hands and feet. (*Vectiar.* 19, 5.) See more on this subject in that passage of Celsus just now quoted, though I by no means recommend the following him implicitly."<sup>4</sup>

<sup>1</sup> Paulus Ægineta, Syd. ed., vol. ii. p. 509.

<sup>2</sup> *Chirurgion's Storehouse.* By Johannes Scultetus, of Ulme, in Suevia. London ed., 1674, p. 31.

<sup>3</sup> Johannes de Gorter. *Chirurgia repurgata.* Lugduni Batavorum, 1742, p. 86.

<sup>4</sup> *General System of Surgery,* by Dr. Laurence Heister. 8th ed. London, 1768, vol. i. p. 164.

See also, "De l'intervention Chir. dans les lux. compliquées du cou-de-pied," by G. Poincot, Paris, 1877.

Such were the extreme views as to the fatality of these accidents, and of the feebleness of our resources, entertained by the ancient, and even by the more modern writers almost down to our own day; with only rare exceptions these limbs were condemned either to great and inevitable deformity, or to amputation. Nor, if we speak only of their fatality, have surgeons ceased to regard these accidents as among the most grave with which they have to deal.

*Pathology and Appreciation of the Sources of Danger as compared especially with Compound Fractures.*—The danger, according to Sir Astley Cooper, consists in the rapid inflammation of the synovial membranes, which is speedily followed by suppuration and ulceration, whereby the ends of the bones become exposed; and for the repair of which lesions great general as well as local efforts are required, and a high degree of constitutional irritation results. In addition to which circumstances, "the violence inflicted on the neighboring parts, the injury of the muscles and tendons, and the laceration of bloodvessels, necessarily lead to more important and dangerous consequences than those which follow simple dislocations."

The sources of danger enumerated by Sir Astley Cooper have been regarded as sufficient to account for their extraordinary fatality by the majority of those modern surgical writers who have alluded to the subject; but I must confess that to me they do not appear so. In compound fractures the mortality is far less; yet one might naturally suppose that when the sharp and irregular fragments are pressing into the flesh, among nerves and bloodvessels, the irritation and inflammation would be equal, if not more than equal, to the irritation and consequent inflammation produced by exposing a joint surface to the air; indeed, modern experience has sufficiently shown that these surfaces are much more tolerant of atmospheric exposure, and of the action of many other irritants, than surgeons formerly supposed. A clean incision into a large joint, which exposes the synovial membranes to the air, and which permits the products of inflammation to escape freely, is attended with much less danger than a small puncture which does not at all permit the air to enter, nor the increased synovia and the pus to escape. Very grave results sometimes follow from large wounds into large joints, but under judicious treatment such results are the exception and not the rule.<sup>1</sup> But Sir Astley evidently attributes more of the bad consequences to the exhausting effects of the efforts at repair, than to the immediate inflammation resulting from the exposure of the joint. It is pretty certain, however, that a majority of these patients die at a period too early to render this cause in any considerable degree operative.

As to the bruising of the "muscles and tendons, and laceration of bloodvessels," it cannot be denied that it must usually be greater than in "simple dislocations;" and I will not say that it is not in a given number of instances greater than in the same number of instances of compound fractures. The tissues have often been thrust rudely through

<sup>1</sup> Upon this point, see the very able article, entitled "Amputations and Compound Fractures," by John O. Stone, in the *New Journal of Medicine*, vol. iii. of 2d series, p. 316, Nov. 1849; and also a paper entitled "De la conservation dans le traitement des fractures compliquées," by G. Poincot, Paris, 1873.



by a large and smooth bone, and the tendons have been stretched violently or torn completely asunder; while occasionally large arteries, which are prone to hug the bones about the joints, are lacerated and left to bleed. That the importance of these complications, however, may not be overestimated, I must state that Sir Astley Cooper himself has remarked how seldom, in compound dislocations of the ankle-joint, the large arteries are injured; that a tearing of the ligaments and of the tendons is almost as likely to occur in simple dislocations as in compound; and, indeed, that in neither case are the tendons usually ruptured, but only thrust aside. Moreover, the skin is often made to give way not so much from the pressure of the round head within, as from the equal pressure of some sharp angular body from without. In all these respects, there are many examples of compound fractures which possess not a whit of advantage; in which cases, nevertheless, the surgeon feels very little doubt as to the ultimate cure.

In short, the causes which, according to Sir Astley Cooper, determine the extraordinary fatality of these accidents, do not sufficiently differ from those which operate in compound fractures to occasion so great a difference in results, and the fatality of compound dislocations remains unexplained; or if surgical writers have here and there intimated the true cause they have failed to give it its proper place and value.

I think the cause of the greater fatality of compound dislocations over compound fractures is to be found in the simple fact that dislocations are generally reduced, and by splints or other apparatus successfully maintained in place, while compound fractures, as my statistical report of cases has proven, are not generally reduced completely, nor can they by any means yet devised, except in a few cases, be maintained in place if reduced. Broken limbs, whether simple or compound in their character, will in a great majority of cases shorten upon themselves in spite of the most assiduous and skilful attempts to prevent it.<sup>1</sup>

In adults most bones break obliquely, and cannot be made to support each other, and even in transverse fractures the broken ends are generally small compared with the articular ends of the same bones, and afford a very uncertain and inadequate support for themselves; not to speak of the difficulty of once bringing their ends into exact apposition where the muscles are powerful, or where they lie embedded in a large mass of flesh so that they cannot be felt. While, on the other hand, dislocated bones, whether simple or compound, are capable, when restored to place, of supporting themselves; or with only slight assistance, their reduction may be maintained; it is also ordinarily a work of no great difficulty to reduce them.

Herein, then, consists the most important difference between these two classes of accidents, which are in other respects so similar. In the one, the very nature of the injury prevents the complete reduction, and the consequent violent strain of the muscles, tendons, and other soft tissues; while in the other, the nature of the accident leaves it in the power of the surgeon to reduce the bones, and modern surgery has in a great measure

<sup>1</sup> "Report on Deformities after Fractures." Trans. Amer. Med. Assoc., vols. viii., ix., and x.

sanctioned the practice of maintaining them in place, in defiance of the efforts of the muscles, and sometimes, no doubt, at the imminent hazard of the life of the patient.

Is it not fair to presume that tissues which have been stretched and lacerated, require rest in order that they may recover from the effects of their injuries? And if the soft parts are really more injured in dislocations than in fractures, does not the indication for rest become for this very reason more imperative?

*General Inferences.*—I have come, then, to regard the shortening of limbs after fractures, within certain limits and in certain cases, as a conservative circumstance rather than as a circumstance which the surgeon should in all cases seek to prevent.

There is abundant evidence that the ancients had some knowledge of the value of rest to the muscles, tendons, etc., in the prevention of inflammation after compound dislocations, since they constantly urge the greater danger of reducing these dislocations, than of leaving them unreduced; and they do not hesitate to recommend that, in case violent inflammation supervenes upon the reduction, the bone shall immediately be again dislocated. Galen speaks very explicitly on this subject, and says that "the danger in reduction consists partly in the additional violence inflicted on the muscles, and partly in their being then put into a stretched state, whereby spasms or convulsions are brought on, and gangrene as the result of the intense inflammation which ensues;" and Paulus Ægineta remarks: "For these, if reduced, occasion the most imminent danger, and sometimes death; the surrounding nerves and muscles being inflamed by the extension," etc.

I have already quoted from Sir Astley Cooper the causes or reasons which he has assigned for the fatality of compound dislocations; and the same reasons have generally been assigned by those who have written since his day; but he has elsewhere, when speaking of excision, given place to the very idea for which I claim so much prominence, the danger arising from a stretching of the muscles. Mr. Liston, also, and Mr. Miller, when speaking especially of dislocations of the tibia at the ankle-joint, refer to the same source of danger.

*Treatment.*—Let us see now the alternatives which surgery presents for the treatment of these intractable accidents.

1. Reduction of the bone.
2. Non-reduction.
3. Amputation.
4. Tenotomy.
5. Resection and reduction.

The questions for us to consider are, first, by which of these several methods is the life of the patient rendered most secure? and, second, where, of two or more methods, all are equally safe, by which will he suffer the least maiming or mutilation?

*By Reduction.*—We have seen already how the old surgeons regarded the practice of reducing compound dislocations of the larger joints. It is not difficult, however, to find in the records of surgery numerous examples of successful terminations under this practice.

Dr. White, of Hudson, N. Y., has reported a case of this kind in



which the dislocation was at the ankle-joint.<sup>1</sup> Pott says he has seen this practice occasionally succeed,<sup>2</sup> and Mr. Scott communicated to the *Lancet*, in March, 1837, a case of compound dislocation of the humerus successfully treated by reduction. Sir Astley Cooper also records several cases of compound dislocations at the lower end of the tibia and fibula, successfully treated by reduction.

A careful examination, however, of those cases reported by Sir Astley as having been reduced without resection, and which resulted in cures, does not, in my opinion, leave much substantial evidence in favor of the practice; or perhaps I ought rather to say that it leaves only a qualified evidence of its propriety in certain cases. He has mentioned about sixteen of these examples, comprising dislocations of the lower end of the tibia, or of the tibia and fibula, outwards, also inwards and forwards, all of which, save one quoted from Mr. Liston, have been reported to him by other surgeons, and not one of which had he ever seen himself. Many of the cases are reported very loosely, evidently in reply to circular letters, and from memory, without recorded notes, and by unknown, and in some sense irresponsible, surgeons. It is not always said whether the wounds in the soft parts were made by the protrusion of the bones, or by some external violence; yet this is certainly a very material point in determining whether reduction is to be followed by inflammation or not. The results, sometimes only attained after exposure to great hazards, are, after all, often sufficiently unfavorable.

It will be noticed, also, that, in Cases 152 and 153, the astragalus was comminuted and removed, either at first or at a later day; and in Cases 154, 155, 156, and 160, the tibia, and also probably the fibula, were broken, and it does not appear but that in consequence of this complication the limb became shortened, and the muscles were thus put at rest, very much as if the bones had been resected; and in one of the cases enumerated under 161, the lower end of the tibia spontaneously exfoliated. That a comminution or that any fracture of the astragalus, or of the tibia and fibula, should be regarded in these cases as rendering the accident less grave, can only be comprehended by a full appreciation of the value of relaxation of the muscles.

The few cases which remain after this exclusion do indeed illustrate how nature and skill may triumph over great difficulties, but nothing more.

It is possible, also, that some of these examples of recovery after reduction may admit of an explanation entirely consistent with my own views of the true source of the danger in these accidents, if indeed they do not tend actually to confirm my doctrines. I have myself seen several examples of complete recovery after reduction of compound dislocations at the ankle-joint, although resection was not practised; in one of which, all the tissues, or nearly all which suffered any injury, were completely torn asunder, and therefore wholly removed from the danger of which I have spoken. The example referred to is the following: On the 30th of October, 1858, John Bourquard, æt. 30, was caught in the tow-line of a

<sup>1</sup> White, Amer. Journ. Med. Sci., Nov. 1828, p. 109.

<sup>2</sup> Pott, Chirurg. Works, vol. ii. p. 243.

canal-boat, causing a compound dislocation of the right ankle-joint. I found the foot, immediately after the accident, thrown completely back against the lower part of the leg, the integuments in front of the joint, as well as all of the tendons and ligaments on this side, being completely torn asunder, while the tendo Achillis, and the tendons behind both of the malleoli, with the corresponding integuments, were uninjured. This immunity of the tissues behind the malleoli was due to the direction in which the foot was drawn, namely, directly backwards. Everything which had suffered a strain being thoroughly severed, I did not hesitate to attempt to save the limb without resection. The reduction was accomplished very easily. The leg and foot were placed in a box filled with bran, and cool water dressings were applied to the portion which was exposed. On the 22d of November the limb was removed from the bran to a pillow, the union being sufficient not to demand so much lateral support. About the first of March he left the hospital, the wound having closed, but the ankle remaining swollen and stiff.

I have also seen two cases in which the foot has been nearly severed from the leg through the ankle-joint, by means of a "reaper." In each case the patient was standing with his back to the machine, and one of the blades cut horizontally from side to side, severing everything except about three inches of integuments in front, and the extensor tendons of the toes. In the first instance, having seen the patient, a gentleman nearly sixty years of age, within three or four hours after the receipt of the injury, I found him exceedingly exhausted by the hæmorrhage. Both malleoli were cut off smoothly, the knife having severed the limb so exactly through the joint, as to have incised the cartilage of incrustation at but one or two points. Having secured the bloodvessels, I replaced the foot, and after a few days of attendance I left him in the charge of an excellent young surgeon, Dr. Robertson, of Lancaster, N. Y., to whose diligence and skill the patient is no doubt mainly indebted for his recovery. After the lapse of nearly one year he was able, by the assistance of a shoe furnished with lateral supports, to walk very well. In the second case, which was only brought to my notice some months after the accident occurred, in consequence of a troublesome fistula near the ankle-joint, the recovery had been complete except that a small fragment of one of the malleoli was necrosed and required removal.

Dr. Eli Hurd, of Niagara Co., N. Y., was equally fortunate in a case of compound dislocation of the shoulder-joint. This was in the person of G. T., æt. 30, who was caught in the gearing of a threshing-machine on the 18th of February, 1852, which, having drawn him in with great force, dislocated the head of the left humerus downwards through the integuments into the axilla. Reduction was accomplished according to the method recommended by Nathan Smith, by pulling from each wrist at right angles with the body, while the operator himself seized the naked head of the humerus with his left hand, his right resting upon the top of the shoulder, and pushed it into place. The time occupied in the reduction was about thirty seconds. The forearm was then suspended in a sling, and the venous hæmorrhage, occasioned by a rupture of the subclavian vein, was arrested by compression. The tegumentary wound, between three and four inches in length, was subsequently closed by



sutures, and cool water dressings were applied. On the fourth day the wound had united by first intention, and the man was walking about his room. In less than a month he was dismissed cured, and in the following harvest he was able to cut his own hay and grain, and to use his arm as before the accident.<sup>1</sup>

Miller and Hoffman reduced successfully a compound dislocation of the knee,<sup>2</sup> and Galli has communicated a similar case to Malgaigne.<sup>3</sup>

Whether either of the last three mentioned examples admit of the same explanation as the preceding three, I am unable to say, but whether they do or do not, they are too exceptional in their character to prejudice materially the argument which I shall hereafter make in favor of resection.

It is not pretended that the few cases which I have mentioned in the preceding pages are all of the compound dislocations of the larger joints, successfully treated by reduction, which have been recorded; nor are they all which have come under my own observation; nevertheless, I repeat, success by this method has up to this moment, whatever plan of after-treatment has been adopted, been found to be the exception and not the rule. I speak now more especially of those dislocations of this class, which are rendered compound by the thrusting of the dislocated bone through the flesh, and which, in my experience, constitute by far the largest proportion of these examples.

*Non-reduction.*—While it is true that not many cases of compound dislocations, especially of the larger joints, can be found recorded as having terminated favorably after reduction, yet it will be very difficult to find an equal number of cases of compound dislocations, unreduced, which have terminated favorably. The fact is, no doubt, that at the present day very few surgeons would feel themselves justified in leaving a bone out of place unless they proceeded to amputate. In the *Transactions of the New York State Medical Society* for 1855, I have reported (Case 16 of Tibia and Fibula, p. 87) a compound dislocation at the ankle-joint, which, being unreduced, terminated fatally on the twenty-eighth day. This is the only example of a compound dislocation of a long bone, left unreduced, which has fallen under my observation; excepting, of course, those cases in which amputation was immediately practised.

The united testimony, however, of the old surgeons, who generally neither amputated nor adopted the method of resection, but who recommended and practised non-reduction, is, that it is much more safe to leave these bones unreduced, than to reduce them without resection; and I see no reason to doubt the correctness of their opinions in this matter. But whether it would be more safe to leave such limbs unreduced, or having practised resection to restore them, is another question, in which the advantage and comparative safety of the latter practice are too obvious to require explanation or defence.

*Amputation.*—Says Pott: "When this accident (dislocation of the ankle) is accompanied, as is sometimes is, with a wound of the integu-

<sup>1</sup> Hurd, Buffalo Med. Journ., vol. ix. p. 119.

<sup>2</sup> Miller and Hoffman, London Med. Repos., vol. xxiv. p. 346.

<sup>3</sup> Galli, Malgaigne, op. cit., tom. ii. p. 958.

ments of the inner ankle, and that made by the protrusion of the bone, it not unfrequently ends in a fatal gangrene, unless prevented by timely amputation, though I have several times seen it do very well without." And Sir Astley Cooper, speaking of compound dislocations of the ankle-joint, remarks: "Thirty years ago it was the practice to amputate limbs for this accident, and the operation was then thought absolutely necessary for the preservation of life, by some of our best surgeons." Nor is it difficult to see by what reasoning surgeons of "thirty years ago" had fallen back upon this desperate remedy. Both reduction and non-reduction having proven eminently hazardous, in the absence of perhaps both knowledge and experience in resection, they finally adopted the alternative of amputation, as that which after all must give to the patient the best chance for life; and were no other alternatives to be presented, this would be my choice in a large proportion of cases.

It must not be understood, however, that amputation is an expedient wholly free from danger; or, indeed, that the chances of the patient are in the average very greatly increased by this practice. Of thirteen amputations made for compound dislocations at the ankle-joint, in the Royal Infirmary at Edinburgh, only two resulted in the recovery of the patients.<sup>1</sup> Alluding to which, Mr. Fergusson remarks: "An amount of mortality which may well incline the surgeon to act upon the doctrine inculcated by Sir Astley Cooper" (to attempt to save the limb by reduction). But Mr. Fergusson has added a sentiment which accords very closely with my own experience and opinions. "I fear, however, that in the attempts which have been made to save the foot (by reduction), the results in all the cases have not met with the same publicity—that the instances where amputation has been afterwards necessary, or where death has been the consequence, have not always been recorded; and, from what I have myself seen, I would caution the inexperienced practitioner from being over-sanguine in anticipating a happy result in every example."

*By Tenotomy.*—As a means of overcoming the resistance of the muscles, and for the purpose especially of facilitating the reduction, tenotomy has been proposed. First by Dieffenbach in cases of ancient unreduced dislocations; but Wm. Hey, Jr., was the first to make a practical application of this suggestion in a case of compound dislocation. After cutting the tendo Achillis, the ankle being dislocated, the reduction was easily effected, but a strong tendency to displacement backwards remained, and he was obliged afterwards to cut the tendons of the tibialis posticus and flexor longus digitorum.<sup>2</sup>

This method, based in some degree upon a very correct notion of the principal sources of difficulty, I regard as in most cases totally impracticable, at least to any useful or adequate extent. In order to be efficient, usually, all the tendons passing the articulations must be cut, or nearly all of them; and I doubt whether the judgment of any discreet surgeon will ever sanction such an extreme measure. Nor do I think that in the point of view in which I am now considering this subject, having ref-

<sup>1</sup> Edinb. Med. Monthly, Aug. 1844.

<sup>2</sup> Hey, Trans. of Province. Med. and Surg. Assoc., vol. xii. p. 171, 1844.



erence only to the question of danger, if the cutting of the tendons was sufficiently extensive to have any real effect in facilitating the reduction, the practice would be found to have any advantage over other methods known to be eminently dangerous. Certainly in no case would the surgeon, in my opinion, be justified in cutting any other than the tendo Achillis.

*By Resection.*—Finally, resection presents itself for our consideration as the only remaining surgical expedient.

We have seen that most of the early writers understood the effects of a constant strain upon the muscles in increasing the danger of spasms, inflammation, and death; but in general they have suggested no remedy but non-reduction or amputation. Hippocrates, however, uses the following language, after speaking of resection of protruding bones in accidental amputations or in fractures of the fingers: "Complete resection of bones at the joints, whether the foot, the hand, the leg, the ankle, the forearm, the wrist, for the most part, are not attended with danger, unless one be cut off at once by deliquium animi, or if continued fever supervene on the fourth day." To which passage the translator adds the following note: "This paragraph on resection of the bones in compound dislocations and fractures contains almost all the information on the subject which is to be found in the works of ancient medicine." Celsus notices the practice of resection in compound dislocations very briefly, as follows: "Si nudum os eminent, impedimentum semper futurum est; ideo quod excedit, abscindendum est."

Mr. Hey, of Leeds, was the first of modern surgeons who called especial attention to the value of resection in compound dislocations.

Subsequently, Mr. Parks, of Liverpool, in an "Account of a New Method of treating Diseases of the Joints of the Knee and Elbow," advocated the practice of resection in certain cases of diseases of these joints, but especially in "affections of the joints produced by external violence."

M. Levéille, in France also, following, as he affirms, the guidance of Hippocrates, has advocated a similar practice.

Velpeau, Syme, Fergusson, Erichsen, Miller, Liston, Chelius, Lizars, Gibson, Norris, under certain circumstances, and especially where the bones cannot otherwise be reduced, and where the dislocations occur in certain joints, and especially the elbow and ankle-joints, recommend resection. To which names I may add that of Sir Astley Cooper, who has considered the subject, as applied to the ankle-joint, quite at length, and who says: "I have known no case of death when the extremities of the bone" (tibia, at the ankle) "have been sawed off, although I shall have occasion to mention some cases which terminated fatally when this was not done."

Why resection should diminish the danger to life, by placing at rest the injured muscles, has been already sufficiently considered; but it seems not improbable that, if the synovial membranes are actually more susceptible of violent and dangerous inflammation than the other tissues about the joints, then would this source of danger be removed just in proportion as the synovial membranes themselves are removed. Such,

indeed, was the argument used by Sir Astley; and Mr. South, in a note to Chelius, when referring to this fact, has made the following statement:

"In compound dislocations of the ankle-joint, with protrusion of the shin-bone through the wound, most English surgeons saw off the joint end, not merely to render reduction more easy, but also, according to Sir Astley Cooper's opinions, to lessen the suppurative process, by diminishing the synovial surface. This mode of practice is certainly not commonly followed in reference to other joints, and the younger Cline was always opposed to its being resorted to in dislocated ankle."

The following cases having occurred under my own eye, will serve to illustrate the value of the principle which I have been endeavoring to establish:

Samuel Adamson, of Buffalo, æt. 24, was caught by the cable of a vessel, June 17, 1855, dislocating the left tibia at its lower end inwards, and breaking the fibula two inches above the ankle. I was immediately called, and found the tibia protruding through the skin about three inches. The periosteum was torn up, and the cartilaginous surface of the end of the bone was roughened. His thigh was also severely bruised and lacerated, but the bone was not broken.

Dr. Boardman assisting me, we attempted to reduce the bones, but with our hands we found it impossible to do so. I proceeded immediately to remove about one inch and a half of the lower end of the tibia with the saw. The remaining portion was then brought easily into place, and the wound dressed with sutures, adhesive strips, bandages, and light splints. On the same day he became an inmate of the marine wards at the Hospital of the Sisters of Charity, and was placed under the care of Dr. Wilcox, through whose politeness I was permitted to see him frequently.

The wound in the leg healed kindly, with only a slight amount of inflammation and suppuration. Violent inflammation, however, occurred in the thigh, followed by extensive suppuration and sloughing. This, in fact, proved to be by far the most serious injury, and that which most endangered his life and delayed his recovery.

After about two months, the ankle was in such a condition as to require little or no further attention. The fragments of the fibula had shortened upon each other and were united, so that the tibia rested upon the astragalus. It was nearly two months, however, before he began to walk, owing to the condition of his thigh.

August 24, 1856, fourteen months after the accident, Adamson called at my office. He was then employed again as a sailor on board the schooner Sebastopol, and performed all the duties of an ordinary deck-hand. His leg is shortened one inch and a quarter; from which it seems that there has been some deposit upon the end of the bone, which has compensated for one quarter of an inch of that which I removed. The ankle is perfect in its form, being neither turned to the right nor to the left, and he treads square and firm upon the sole of his foot. There is considerable freedom of motion, especially in flexion and extension. Occasionally it becomes a little swollen and painful.

January 1, 1875, Rosanna Wilbur, æt. 45, was admitted to ward 13, Bellevue Hospital, having just been injured by a street-car. She was in



good health, but very fat, weighing 185 lbs. She was found to have a compound dislocation at the right ankle-joint—the tibia being thrust completely through the flesh—and also a fracture of the fibula. Dr. Lewis, the house surgeon, reduced the dislocation at once, and easily, and then sent for me. I advised an attempt to save the limb without resection, and by supporting the limb with the plaster-of-Paris dressing. This dressing was applied fourteen hours after the accident by Dr. Lewis, a window being made opposite the ankle. January 3, the window was enlarged. January 5, gangrene and phlebitis had occurred; fenestra again enlarged. January 7, entire splint laid open, and hot-water dressings applied. January 12, suspended limb. January 21, the condition of the limb very critical; and, in a consultation composed of the visiting surgeons, we were equally divided between amputation and resection. It was permitted, therefore, that I should choose my own course. I immediately resected two inches of the lower end of the tibia, and placed the limb again in a sling supported with compresses as means of lateral support, and warm-water dressings were continued. The subsequent progress of the case was very slow, and there were several smart attacks of erysipelas, so that her life was at times in danger; but finally all unfavorable symptoms disappeared, and on the first of May, the ankle was in perfect shape, admitting of some flexion and extension, and the wounds were almost completely closed. It is now apparent, that a resection on the first day would have been the most judicious practice, but that even at a later day it saved her life.

In a case of compound dislocation of the upper end of the humerus, occurring also under my own observation, and recorded in the *Transactions of the New York State Medical Society for 1855* (p. 27, Case 14), in which reduction was followed by death, I have now much reason to believe that if I had practised resection before the reduction, my patient's chances for recovery would have been greatly increased; perhaps also the case of compound dislocation of the wrist-joint recorded in the same volume (p. 68), in which, having reduced the bones, I was subsequently compelled to amputate, may equally illustrate the hazard to which the practice of reduction without resection must often expose the patient.

The same remarks I will venture to apply to the case of compound dislocation of the hip, of which I have already spoken as having occurred in the practice of Dr. Walker, of Charlestown, Mass. Had the head of the femur been resected before its reduction, I cannot doubt but that the unfortunate man's chance for recovery would have been very greatly improved.

Thus, if we consider the question of the life of the patient only, the argument and the testimony seem to favor resection, in a great majority of cases of compound dislocations occurring in large joints, and in a considerable number of cases of similar accidents in the smaller joints. It is certainly more safe than non-reduction or reduction without resection, and it is probably quite as safe as amputation.

Poinsot, who has collected 82 reported cases of immediate resection practised for compound dislocations of the ankle-joint, found 68 cures,

10 deaths, and 4 secondary amputations, of which latter one was cured, two died, and the result in the fourth was unknown.

But there is another question, which is, in my estimation, secondary to the one now considered, but which is often in the estimation of the patient himself of the first importance, namely, by which method will he suffer the least maiming or mutilation?

This question I do not find it difficult to answer. Certainly it is not by non-reduction or by amputation; and, putting tenotomy aside, it is now a question only between reduction without resection, and reduction with resection. These two methods, one of which experience has shown to be fraught with danger, and the other of which experience has shown to be relatively safe, are now to be compared in a point of view in which their antagonisms are perhaps less conspicuous, yet sufficiently marked.

First. In either case the inflammation consequent upon the injury may be violent, and the recovery slow and tedious. The same arguments, however, which I have applied to the question of the comparative danger of the two modes, must apply with nearly equal force to this question of maiming; since the amount of maiming must often be governed by the intensity and duration of the inflammation, and upon this point the testimony has been shown to be in favor of resection.

It will be observed that not only is the danger of maiming rendered more considerable by reduction without resection, because the inflammation is so much more likely to extend to the tendons and muscles, causing them to adhere to each other, and to become subsequently atrophied, a condition from which they often never completely recover; but also because the ligaments and capsules of the joints, with the synovial surfaces, are in consequence encroached upon, and the freedom of motion is ever afterwards greatly restricted, if not completely lost. This marked impairment of the functions of the joint does not always happen, but it cannot be denied that it does generally. Indeed, it is by no means uncommon for these accidents to be followed, after ulcerations of the cartilage, by copious bony deposits in and around the joints.

How is it, on the other hand, with these joints after resection? I have thus far heard of no cases in which complete ankylosis resulted; but in all considerable freedom of motion has returned, and in some the restoration in this respect has been nearly or quite as complete as before the accident.

Poinsot has also made a very careful *résumé* of the results of resection in regard to the usefulness of the limb. In 41 cases where the patients have been seen after complete recovery there is not a single failure; only it is observed that in the case of Ollier, there existed a slight deviation of the foot backwards, which was corrected by apparatus. In all of these cases the patients walked well, and were able to resume their previous occupations.

A similar analysis made by the same writer, of examples treated by reduction and without resection, gave the following results: In 19 of 23 cases, the patients could walk without artificial support; in one case the aid of a cane or of other support was required; three times the foot was ankylosed in a vicious position, and remained painful, and the patients were obliged to ask for surgical interference; in two of these latter cases



amputation was practised, and in one resection, the resection restoring to the patient a useful limb.<sup>1</sup>

Says Dr. Kerr, of Northampton: "Several cases of compound dislocation of the ankle have fallen under my care, and it has been uniformly my practice to take off the lower extremity of the tibia, and to lay the limb in a state of semiflexion upon splints; by this means a great degree of painful extension and the consequent high degree of inflammation are avoided. The splints I used are excavated wood, and much wider than those in common use, with thick movable pads stuffed with wool. I keep the parts constantly wetted with a solution of liquor ammoniac acetatis, without removing the bandage. In my very early life, upwards of sixty years ago, I saw many attempts to reduce compound dislocations without removing any part of the tibia; but, to the best of my recollection, they all ended unfavorably, or, at least, in amputation. By the method which I have pursued, as above mentioned, I have generally succeeded in saving the foot, and in preserving a tolerable articulation."

Sir Astley Cooper has made a valuable experiment to determine the condition of the new joint under these circumstances; and the vast number of examples in which resection has now been practised in cases of caries of the articulating surfaces, and their results, add still more substantial proofs as to the usefulness of the joints after such operations.

"I made an incision upon the lower extremity of the tibia, at the inner ankle of a dog, and, cutting the inner portion of the ligament of the ankle-joint, I produced a compound dislocation of the bone inwards. I then sawed off the whole cartilaginous extremity of the tibia, returned the bone upon the astragalus, closed the integuments by suture, and bandaged the limb to preserve the bone in this situation. Considerable inflammation and suppuration followed; and in a week the bandage was removed. When the wound had been for several weeks perfectly healed, I dissected the limb. The ligament of the joint was still defective at the part at which it had been cut. From the sawn surface of the tibia there grew a ligamento-cartilaginous substance, which proceeded to the surface of the cartilage of the astragalus to which it adhered. The cartilage of the astragalus appeared to be absorbed only in one small part; there was no cavity between the end of the tibia and the cartilaginous surface of the astragalus. A free motion existed between the tibia and astragalus, which was permitted by the length and flexibility of the ligamentous substance above described, so as to give the advantage of a joint where no synovial articulation or cavity was to be found. This experiment not only shows the manner in which the parts are restored, but also the advantage of passive motion; for, if the part be frequently moved, the intervening substance becomes entirely ligamentous; but, if it be left perfectly at rest for a length of time, ossific action proceeds from the extremity of the tibia into the ligamentous substance, and thus produces an ossific ankylosis."

Second. Is it not probable, moreover, since the limb can be retained

<sup>1</sup> Poinset, op. cit., p. 1238.

in place so much more easily after resection, that it will actually, in a majority of cases, be found to have been retained in place more perfectly? Even after simple dislocations, especially in those occurring at the ankle-joint, great deformity and much maiming are the not unfrequent results, and that, too, when all diligence and care have been employed. It has been impossible always to maintain a perfect apposition in the articulating surfaces. How much greater must be this difficulty in cases of compound dislocations.

Third. The only argument which remains in favor of reduction without resection is the necessary shortening of the limb after resection. But this need seldom perhaps exceed three-quarters of an inch, and often not more than half an inch; an amount of shortening which, as I have had occasion to prove when treating of fractures, does not necessarily produce a halt, and which indeed is often not known to exist by the patient himself. It is claimed that the experience of Heine, Langenbeck, Volkman, Hueter, and other German surgeons, has shown that in a considerable number of cases, when these resections have been made by the *subperiosteal* methods, no shortening whatever has resulted.<sup>1</sup>

Finally. It must not be inferred, that the author intends to recommend resection as a universal practice in cases of compound dislocations of the long bones. He has only sought to determine in a general manner its relative value as compared with other modes of procedure; and especially has it been his intention to bring more prominently into view the importance of rest and relaxation to the muscles, as an element in the treatment most essential to success. To declare its special application to cases would demand a treatise more elaborate than it was proposed to write. If, however, one were to speak of the individual bones only, there seems sufficient authority in the facts and arguments already presented, to conclude that resection is applicable to certain compound dislocations of the clavicle, humerus, radius, and ulna, fingers, femur, tibia, fibula, and toes; in short, to a certain proportion of all these accidents occurring in the long bones of the extremities.

If an attempt is made to save the limb without resection, it is scarcely necessary to say that the success will depend, in a great measure, upon the care, attention, and skill bestowed upon the treatment. The limb must be maintained in a position of rest, combined with moderate elevation; and warm water or other suitable dressings assiduously applied; including a judicious employment of antiseptic precautions and of drainage.

<sup>1</sup> On Subperiosteal Resection of the Tibio-tarsal Articulation. By Achilles Rose, M.D., New York. The Medical Record, July 3, 1875.