

## 3. BENNETT'S FRACTURE OF THE BASE OF THE METACARPAL BONE OF THE THUMB

By ALEXANDER MILES, F.R.C.S. Edin., Assistant Surgeon, Royal Infirmary, Edinburgh, Surgeon to Leith Hospital, and J. W. STRUTHERS, F.R.C.S. Edin., Assistant Surgeon, Leith Hospital.

IN 1881 Prof. E. H. Bennett, of Dublin, first directed attention to the fact that fracture through the base of the metacarpal bone of the thumb is a common injury. He maintained that the fracture is the most common simple fracture of the metacarpus, that it may be readily recognised clinically, but is constantly overlooked, greatly to the disfigurement and damage of those who sustain it. In support of his contentions he exhibited six specimens of united fracture of the bone from the Museum of Trinity College, Dublin, and referred to several clinical cases of the injury he had himself observed. In 1900 Beatson reported a case of this injury which he had observed clinically, and Prichard recorded the occurrence of the accident to himself.

No other cases, so far as we can find, have been put on record, and although Bennett's cases have been quoted by others, his claims as to the frequency and importance of the fracture are not generally admitted. Ricard and Demoulin in Duplay and Reclus' "Traité de Chirurgie," in estimating the relative frequency of fracture of the metacarpal bones, quote the statistics of Malgaigne and Polaillon, and conclude from them: (1) that fractures of the metacarpal bones form 1 per cent. of all fractures; and (2) that of the five metacarpal bones, the first and fifth are least frequently, and the third and fourth most frequently broken. They refer briefly to Bennett's record but ignore his statements as to the relative frequency of the injury and seem rather to regard his cases as exceptional. Stimson treats the subject in a similar manner. Hoffa describes the injury as "*besonders typisch*" and reproduces Bennett's illustration of a typical specimen, but does not apparently regard the injury as a common one. In the last edition of the "Handbuch der Praktischen Chirurgie" the writers mention Bennett's fracture merely to say that it cannot be numbered among common injuries. In the article on "Fractures" in the *Encyclopædia Medica*, Bennett's illustration is reproduced as a "fracture of the stave of the thumb," and

the injury is incorrectly said to be caused by a fall on the palm of the hand. Scudder in his "Treatment of Fractures" gives a tracing of a radiogram of a "fracture of the upper end of the metacarpal bone of the thumb," but makes no reference to this injury in the text. We have not been able to find any reference to Bennett's work in English text books on surgery.

The observation of a number of cases of the injury has convinced us that Bennett's claims are well founded, and we put our experience on record in the hope that it may help to draw attention to this injury and to gain for it a more general recognition than it has hitherto received.

In his first and subsequent communications, Bennett described six museum specimens of the fracture and referred to eight clinical cases which he had observed.

With the two cases reported respectively by Beatson and Prichard, the total number of recorded cases, as far as we are aware, amounts to sixteen.

Since 1900 we have seen fifteen clinical cases of Bennett's fracture, notes of which we subjoin, and have been able to find two specimens of undoubted old standing cases of the injury, and two specimens showing changes probably due to Bennett's fracture followed by osteo-arthritis in the affected joint.

Our cases are as follows:—

CASE I.—Robert B., æt. thirty-eight, policeman. Four weeks before applying for treatment the patient struck the tip of his right thumb violently against a wall while struggling with a prisoner. The blow caused severe pain in the thumb, and after the injury, marked swelling appeared at the base posteriorly. The patient was unable to use the thumb after the accident owing to the severe pain which any attempt at movement caused. At first he regarded the injury as a trivial one, but as he found that pain and weakness persisted so that he was unable to use his right hand, he consulted Dr Wm. Paterson, who kindly referred him to us. On examination, it was seen that there was still considerable swelling over the base of the metacarpal bone of the thumb posteriorly. The range and strength of the movements at the carpo-metacarpal joint were much impaired. The patient could not abduct the thumb fully. He could oppose the thumb to the index finger, but the strength of the movement was very feeble, and he was unable to oppose the thumb to the little finger. The power of his grasp in the right hand was consequently very weak, and the attempt to grasp firmly caused pain at the carpo-metacarpal joint of the thumb. On palpation, the

swelling was found to be largely due to abnormal prominence of the base of the first metacarpal bone, which was found to be displaced upwards and backwards, being thus partially dislocated on to the dorsal aspect of the trapezium. This displacement could be partially reduced by extending and abducting the thumb while pressing the base of the metacarpal towards the palm, and the reduction was accompanied by marked crepitus. When the extension and pressure were relaxed the displacement was reproduced. The small palmar fragment of the metacarpal bone could not be distinctly felt among the muscles of the ball of the thumb.

A *diagnosis* was made of fracture through the base of the metacarpal bone of the thumb, with partial luxation of the main part of the bone upwards and backwards.

*Treatment.*—The displacement was reduced and the thumb fixed in the reduced position by a splint applied so as to keep up extension and abduction. At the end of a week the splint was removed and massage and passive movement were carried out till the patient was able to move the thumb freely. Five weeks after treatment was begun the patient had regained the use of his thumb almost completely and was able to resume work. On November 28th, 1903, two years and a half after the accident, he again reported himself. Slight abnormal prominence of the base of the metacarpal still remained but the movements of the thumb were of good range and strength, and the patient stated that he felt no practical inconvenience from his injury. The grasp of the right hand, however, was slightly weaker than that of the left, and the stretch of the hand not quite so wide.

In its history, clinical features and progress the above case is a typical one. The succeeding cases will be more briefly described, any particular in which they differed from the usual type of the injury being specially noted.

CASE 2.—Patrick Q., æt. forty-two, sailor. Four weeks before applying for treatment the patient in falling from a height of six feet on to the deck of a ship put out his hand to save himself and struck his right thumb violently against the deck. On examination, all the characteristic signs of Bennett's fracture were present. The displacement was very marked. Complete reduction of the displacement was impossible but crepitus was marked when the metacarpal was moved on the trapezium. A radiogram was taken and the diagnosis confirmed. The patient was in this case recommended to practise moving the thumb regularly and to massage the region of the carpo-metacarpal joint, from the first. Fixation was considered unnecessary as very little reduction of the displacement could be

effected. The patient gradually regained the power of the thumb. Two and a half months after he was first seen he reported himself, saying that he had been able for his work as a seaman for some weeks and felt no inconvenience from the injury. The displacement was as marked as before. Crepitus was no longer present. A second radiogram showed slight callus formation on the palmar aspect of the base of the metacarpal, uniting the fragments. The grasp of the right hand seemed slightly weaker than that of the left.

CASE 3.—Richard S., æt. sixty, engine fitter. Twenty days before applying for treatment the patient was knocked over while walking along the street. He put out his hands to save himself and "staved" his left thumb against the ground. He came for treatment on account of continued pain and weakness in the thumb. On examination, all the characteristic signs of Bennett's fracture were present. A radiogram confirmed the diagnosis. The treatment consisted of fixation of the thumb for two weeks, followed by massage and movement. The patient returned to work a few days after the splint was removed. He reported himself four months after the accident, saying that he felt an occasional twinge of pain when he grasped firmly with the thumb fully abducted, but that otherwise he felt no inconvenience from the injury. Some displacement of the metacarpal was still present, but the function of the thumb was fully restored. Some grating could be felt on moving the metacarpal on the trapezium. A second radiogram showed distinct callus formation uniting the fragments.

CASE 4.—George C., æt. fifty-four, labourer. Three weeks before applying for treatment the patient fell and "staved" his left thumb against the ground. On examination, all the signs of Bennett's fracture were present except crepitus. A radiogram was taken, which confirmed the diagnosis. Treatment was carried out as in Case 3, and the patient was able to resume work a week after the splint was removed. He reported himself four months later, saying that he had no inconvenience except a feeling of soreness in the thumb after a long day's work with a shovel. Some displacement was still present, and slight grating could be felt on moving the injured joint. A second radiogram showed marked callus formation uniting the fragments at the base of the thumb.

CASE 5.—Peter H., æt. forty-eight, labourer. The day before applying for treatment the patient fell to the ground from a height of eight feet. He put out his hand to save himself, struck the tip of his thumb on the ground, and hurt his thumb severely. On examination, there were found swelling and ecchymosis along the shaft of the metacarpal bone of the right thumb posteriorly. The patient could only move the metacarpal on the trapezium very slightly, and attempts at

movement caused pain. The base of the metacarpal projected backwards, but not so markedly as in most cases of Bennett's fracture. In reducing the displacement, crepitus was not felt, but on moving the metacarpal about freely occasional grating could be recognised. The case was regarded as one of Bennett's fracture with unusually little displacement. A radiogram showed, however, that the fracture was an atypical one, inasmuch as the palmar fragment had carried a long splinter from the front of the shaft of the bone with it, and the main or dorsal portion of the shaft had also given way just beyond the base of the bone. The thumb was fixed in the fully abducted position for three weeks, and the patient was instructed to practise movement regularly thereafter. When last seen he had regained the power of his thumb almost completely.

CASE 6.—Mrs M., æt. fifty-three. Eight days before applying for treatment the patient fell going downstairs and struck her left thumb against the edge of a step. She thought she had "staved" her thumb. Continued pain and weakness caused her to apply for treatment. On examination, pain, swelling, deformity and crepitus, were present as usual. The power of abduction was specially weak. The thumb was fixed in the reduced position for two weeks, and massage and movement employed afterwards.

CASE 7.—William P., æt. twenty-two, dock-porter. The patient was struck on the point of the left thumb by a falling sack of sugar, which he tried to hold up. A few days later he applied for treatment on account of pain and weakness in the thumb. On examination, pain and limitation of movement at the carpo-metacarpal joint of the thumb were present. The characteristic deformity was also present, but was less marked than usual. The deformity was reducible, and the reduction was accompanied by crepitus. Treatment was carried out as in the preceding case.

CASE 8.—James C., æt. forty-eight, sailor. Three days before applying for treatment, the patient struck a man violently on the head with his closed fist, and hurt his right thumb. Pain and weakness in the thumb remained, and caused him to seek advice. On examination, pain, limitation of movement, and characteristic deformity were present. The deformity was reducible, with crepitus. Treatment as in preceding cases.

CASE 9.—John L., æt. nineteen, labourer. Two days before applying for treatment the patient struck a man with his closed fist and hurt his right thumb. Pain and weakness in the thumb caused him to apply for advice. On examination, pain, limitation of movement and characteristic deformity were present. On reducing the displacement marked crepitus was felt. Treatment as in preceding cases.

CASE 10.—Agnes L., æt. nineteen. Eight weeks before apply-

ing for treatment the patient was thrown out of a cart and struck the point of the left thumb against the ground in her fall. The thumb was painful, swollen and stiff after the accident. The swelling and pain subsided in a fortnight, but the stiffness and weakness in the thumb remained till she came to hospital. On examination, marked limitation of the range and strength of the thumb movements were present, along with characteristic deformity. The deformity was irreducible and no crepitus could be felt. The hand was examined by the fluorescent screen and the diagnosis of Bennett's fracture was confirmed.

CASE 11.—Andrew D., æt. forty-six, carpenter. A few days before applying for treatment the patient was walking along in the dark, and in putting out his hand to grasp a door-handle struck the point of the left thumb violently against the door. On examination, all the characteristic signs and symptoms of Bennett's fracture were present. Treatment was carried out as before. The result was satisfactory.

CASE 12.—A. S., æt. thirty-eight, dock-porter. Twelve days before applying for treatment the patient while helping to carry a beam of wood, fell and struck his thumb against the beam in his fall. The thumb remained painful and stiff, and caused him to seek advice. On examination all the signs of Bennett's fracture were present.

CASE 13.—J. S., æt. forty-two, labourer. The patient applied for treatment on account of weakness of the thumb due to an old standing injury, the result of a fall some months before he came for treatment. On examination, characteristic prominence of the base of the first right metacarpal was present, there was also marked weakness of grasping power in the hand. A radiogram showed a united fracture through the base of the metacarpal bone, with marked callus formation on the palmar aspect of the shaft towards the base, and partial luxation of the metacarpal upwards and backwards.

CASE 14.—The notes of this case are incomplete. The patient was an adult male who came for advice on account of persisting deformity and slight disability of the thumb, some weeks after a fall, in which he had injured his thumb. His thumb showed the deformity characteristic of Bennett's fracture and a radiogram confirmed the diagnosis.

CASE 15.—R. D., labourer, æt. sixty. The patient was under treatment in a medical ward for advanced cardiac disease. His left thumb was noticed to present the deformity characteristic of an old standing Bennett's fracture in a very marked degree. He stated that many years before, he had "staved" his thumb, and that the deformity had persisted ever since. He suffered no practical inconvenience from the injury. On post-mortem examination it was found that the condition was one of ununited Bennett's fracture. The base of the main portion of

the metacarpal was lying on the dorsal aspect of the trapezium to which it had become adherent by strong fibrous adhesions, while the short palmar fragment was lying embedded in fibrous tissue and adherent to the trapezium where the articular surface for the metacarpal joins the dorsal aspect of the bone. The case was one, therefore, in which the displacement was unusually marked and in which the two fragments had been so far separated that union did not take place.

*Morbid Anatomy and Mechanism of the Fracture.*—Bennett originally defined the fracture as one "passing obliquely through the base of the bone, detaching the greater part of the articular facette with that piece of the bone supporting it, which projects into the palm."

The fracture might be more fully described as a chipping off, of the palmar projection of the base of the metacarpal bone of the thumb, with a varying amount of upward and backward displacement of the rest of the bone, the short palmar fragment retaining its normal relation to the trapezium. In a normal metacarpal bone this projection is well seen. It will be noticed that it carries a large part of the articular surface for the trapezium, and that the articular surface is concave from before backwards. This concavity fits on to the convexity of the trapezium. When a force is applied in the long axis of the metacarpal bone it tends to drive the main body of the bone off the trapezium, on to its dorsal aspect, and the bone is only maintained in position by the basal palmar projection. When the force is sufficient to fracture the bone, this projection is chipped off, and the remainder of the bone is driven more or less on to the dorsal aspect of the trapezium.

The line of fracture will vary according as the metacarpal is flexed or extended on the trapezium. In full flexion the summit of the convexity of the trapezium rests more towards the dorsal margin of the articular surface of the metacarpal than in full extension, when it rests more towards the palmar margin. It would be expected, therefore, that the line of fracture would be nearer the dorsal aspect of the bone when the accident happens with the metacarpal flexed, and nearer the palmar aspect when the accident happens with the metacarpal extended. In other words, the more the metacarpal is extended when the force is applied, the smaller will be the fragment chipped off from its base.

In Bennett's figure of a specimen of the united fracture, the line of fracture passes through the middle of the articular surface, and emerges on the palmar aspect of the shaft, about one-third of the length of the bone from its base. In case 5 of our series the line of fracture passes out on the palmar aspect of the bone, near its distal end. In four radiograms of other cases in our series, as also in Beatson's and Prichard's cases, the palmar fragment is seen to be much smaller, the line of fracture passing out on the palmar aspect of the bone, well within a third of its length from the base.

This variation in the line of fracture is easily accounted for on the view put forward above.

When, as frequently happens, a patient who has sustained the injury does not come for treatment till several weeks after the accident, the palmar fragment may unite with the shaft in the unreduced position, that is, more towards the distal end of the metacarpal than it should. In consequence of this, the direction of the articular surface for the trapezium is changed, and it comes to look more towards the palm than in a normal bone. In addition, a well marked transverse groove often remains on the articular surface indicating the old line of fracture. This is well seen in Bennett's original drawing. The occurrence of osteo-arthritis in the carpo-metacarpal joint after injury, is mentioned by Bennett, who says that certain of his specimens of united fracture of the metacarpal show few changes except those due to osteo-arthritis following the injury.

*Etiology.*—As is clearly brought out in the histories of the cases recorded above, the fracture is caused by indirect violence being the result of a blow on the tip of the outstretched thumb or on the end of the first phalanx when the terminal phalanx is flexed. In the majority of the previously recorded cases as in most of our own series, the usual history has been that the patient fell, and that in putting out a hand to save himself he struck his thumb violently against the ground. Many of the patients were unable to describe exactly how the thumb was held at the time of the fall and exactly how it was struck, but five of our patients stated definitely that they struck the tip of the thumb. In the other cases it was not possible to make out clearly how the thumb had been struck. In two of our cases and in one case recorded by Bennett, the fracture was caused by

the patient striking a violent blow, and in these cases the impact was probably against the end of the first phalanx, the fist being closed and the terminal phalanx of the thumb flexed.

The accidents which cause the fracture are of every day occurrence, a fact which our own and the other recorded cases clearly show. Many of our patients when asked how they had been injured, said that they had fallen and "staved" the thumb. The word "stave" is often applied in Scotland to a contusion or sprain of a joint, but it is important to note that a stave of the thumb frequently causes a fracture through the base of the metacarpal. All so-called staves therefore should be carefully examined to exclude the possibility of fracture.

*Clinical Features.*— In his first communication, Bennett laid stress on the fact that all the specimens and cases of the fracture he had met with were of the right thumb. Subsequent experience showed him, however, that the fracture occurred on the left side as well as on the right. In our own series seven of the cases were on the left side, so that although the right thumb seems to be rather more frequently affected than the left, the fracture may occur on either side. The ages of our patients varied from nineteen to sixty, the average being about forty. Two of them were women, the rest men.

In many cases the patients at first regarded the injury as a trivial one, and did not apply for treatment till the continued pain and weakness in the injured thumb made it clear to them that they were not merely suffering from a sprain.

It is interesting to note that even in cases which do not come under observation till two, three, or four weeks after being injured, crepitus may still be present. We have only once been unable to detect crepitus in cases seen within four weeks of being injured. In this case the radiogram confirmed the diagnosis of Bennett's fracture. The signs and symptoms are very constant and not difficult to recognise. The limitation of the range of movement is very marked, the patient being usually unable to oppose the thumb and little finger, and being able to oppose the thumb and index only very feebly. Abduction of the injured thumb is also very limited. In recent cases any attempts at movement cause pain, and in untreated old-standing cases, attempts to abduct strongly and to grasp firmly may also be attended with some pain.

The displacement of the main portion of the metacarpal

bone towards the dorsal aspect of the trapezium produces a marked abnormal prominence which partly fills up the hollow between the long and short extensor tendons of the thumb. This prominence is very easily felt and in many cases remains as permanent evidence of the fracture.

There is usually no difficulty in distinguishing the injury from a dislocation of the metacarpal backwards, the only injury with which it is liable to be confused. The facts that the deformity can be reduced, that the reduction is accompanied by crepitus, and that the displacement returns when the reducing force is removed all serve to distinguish the fracture from a dislocation. Many authors have described a partial dislocation backwards of the base of the metacarpal bone. Polaillon tabulated eleven recorded cases of the injury, and Hamilton figures a hand showing the deformity resulting from a supposed partial dislocation of the metacarpal, the displacement having remained permanent. As Bennett says, "When we bear in mind the form of the articulation in question, it is difficult to conceive the idea of a partial dislocation occurring in it and remaining as a permanent deformity." Such cases may well have been cases of Bennett's fracture, the true nature of which escaped detection. A reference to Polaillon's cases shows that a tendency to the return of the displacement was present in many of them after reduction, a fact which is strong evidence that they were not merely cases of partial dislocation, for when the form of the carpo-metacarpal joint of the thumb is taken into consideration, it seems clear that a dislocation once reduced would show no tendency to return.

We are inclined, with Bennett, to doubt the possibility of a partial backward dislocation of the base of the first metacarpal remaining as a permanent injury, till more positive evidence of its occurrence has been produced.

*Treatment.*—In recent cases, as has already been indicated, the displacement can easily be corrected by making traction on the thumb in the abducted and fully extended position, and at the same time making pressure over the dorsal aspect of the metacarpal. The main difficulty consists in maintaining the fragments in apposition. Immediately the extending force is relaxed the long fragment again slips upward and backward on to the dorsal aspect of the trapezium. In recent cases, therefore, after the displacement has been corrected, the thumb

should be fixed in the reduced position for three weeks to allow the palmar fragment to unite to the main body of the bone in good position. The best splint is a palmar one, as originally suggested by Bennett, extending from the tip of the thumb across the base of the hand and projecting beyond the ulnar side of the wrist. The lower end of the splint is first fixed firmly to the end of the thumb by a few turns of adhesive plaster or of a bandage. The thumb is then fully abducted and extended and the long dorsal fragment of the metacarpal made to resume its normal relation to the trapezium and the short palmar fragment, by pushing the splint downwards. The abduction and extension are kept up by applying a bandage round the wrist and hand so as to catch in the end of the splint which projects beyond the ulnar margin of the wrist, and push it downwards and to the radial side. An alternative method is to mould a poroplastic splint to the wrist and thumb after reducing the displacement, the splint being moulded to the fully abducted thumb and bandaged firmly in position. When the splint is removed gentle movement and massage should be practised for a week or ten days. A fortnight after removing the splint, that is, five weeks after the injury, the patient may be allowed free use of the hand.

In cases where the displacement cannot be reduced, nothing is to be gained by fixing the thumb, and the patient should be encouraged from the first to persevere with passive and active movement of the thumb at the carpo-metacarpal joint.

*Prognosis.*—In four cases which we have been able to follow up, the ultimate result as regards the function of the thumb has been good. In two of them the patients did not come for treatment till four weeks, in the other two till three weeks, after the injury. One of those patients was a policeman, the other three were manual workers, and although in all there is some permanent displacement of the metacarpal, none suffered practical inconvenience from the injury when seen some months after treatment had been discontinued. One man admitted that he had an occasional twinge of pain when he made a strong effort with the thumb fully abducted, and another that his thumb felt tired after a long day's work shovelling coal, but in none of these cases was the patient's efficiency as a worker or his wage-earning capacity diminished. The range of movement in all the cases was good.

In his original communication Bennett described the case of a girl who, two years after having fractured her metacarpal, failed to grasp or lift with certainty any object requiring a wide gape of the thumb. He stated that, in general, the injury renders the thumb for many months lame and useless. Beatson in describing his case notes that two and a half weeks after treatment had been begun (five weeks after the accident) a decided improvement had taken place in the usefulness of the hand and that "later all disablement quite passed away." Prichard records that in his case, which he says was practically untreated, the power of opposition did not return for more than three months.

From our experience of the four cases in which the ultimate result was observed, and our observation of other cases during the time they remained under treatment, we should be inclined to put the period of serious disablement of the injured thumb at about six weeks, although in many cases, especially those which have not been treated, the full power of the thumb may not be restored for some time longer.

We believe that complete recovery is to be ultimately expected in the great majority of cases, the case referred to by Bennett in which permanent weakness remained, being the only recorded one of its kind, and probably therefore exceptional.

*Relative Frequency of the Injury.*—Including our own series, the recorded cases of Bennett's fracture number twenty-five, the specimens ten, giving a total number of thirty-five.

Bennett is of opinion that the fracture is the most common simple fracture of the metacarpus. Our own experience entirely confirms this view, as during the period in which we have observed the fifteen cases recorded above, we have not seen more than ten simple fractures of other metacarpal bones.

The slight violence required to produce the fracture and the frequency of the accidents which may cause it, would alone suggest that the injury must be a common one.

The general failure to recognise this injury may be due to several causes. Firstly, as many of the patients under our care at first regarded the injury as a trivial one, and only applied for treatment some weeks after they had been hurt, it seems highly probable that many people who meet with the injury may never apply for treatment at all.

Secondly, it is probable that many who have seen cases of Bennett's fracture have not thought it worth while to record their experience, the injury being relatively an unimportant one. Thirdly, owing to the scant notice which it has received in text-books on surgery, many are probably not aware that such an injury occurs and may have allowed examples of it to pass unnoticed.

The total number of recorded cases is so small that positive statements as to the relative frequency of Bennett's fracture are perhaps premature, but we are decidedly of opinion that the injury is a common one, and we are inclined to believe that Bennett's opinion that it is the most frequent simple fracture of the metacarpus, is correct.

#### LITERATURE.

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#### V. DEMONSTRATION

(With Plates)

*Dr Chalmers Watson* gave a demonstration on the comparative pathology of gout. The tissues shown were taken from a young adult fowl which had succumbed, after a short illness, to naturally acquired gout. Such cases were very rare in the records of the disease and, so far as the author was aware, none had been submitted to a complete histological examination as in the present case. The naked eye appearances seen at the post-mortem were—alterations of the synovia to a cream-like fluid which gave the murexide reaction, deposit of uric acid in combination in some extra articular tissues round