



Clinical Orthopaedics



Clinical Orthopaedics

ANTHONY F. DePALMA

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Number Six

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Section I

ENDOPROSTHESIS

John Rhea Barton

FREDERICK R. THOMPSON, M.D.*

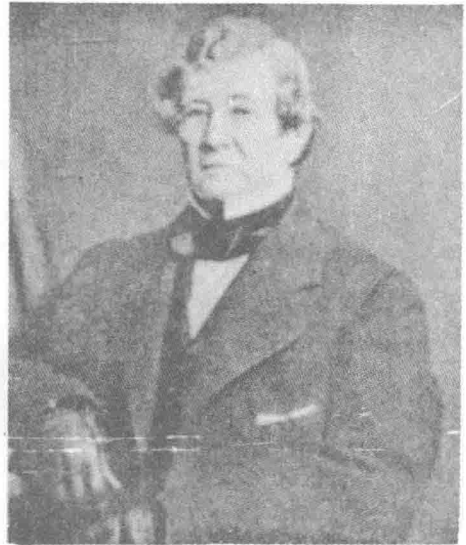
I beg leave to call the attention of my professional brethren to the following paper, believing that it contains some new views, in relation to a deformity and lameness, hitherto, I think, excluded from the surgeon's list of curable complaints, and one of the opprobria of our art; I allude to a firm, bony ankylosis of the human joints.

BARTON

In these days of general orthopaedic interest in hip arthroplasty in which various types of endoprostheses are utilized, it is interesting to review the work of Dr. John Rhea Barton, of Philadelphia, who, in 1827, first stimulated our interest in this subject. Many have not had the opportunity of reading Barton's original paper entitled *On the Treatment of Ankylosis by the Formation of Artificial Joints*. It had a far-reaching effect on the surgical concept of the treatment of stiff joints by his confreres representing the new American School of Surgery in post-Revolutionary times and was quoted widely in Europe.

Barton, then 32 years of age, was a young attending surgeon on the staff of the Pennsylvania Hospital in Philadelphia. He had seen in the hospital a sailor named John Coyle who had fallen from the ship's hatchway into the hold a year previously and sustained some type of fracture of the hip. The hip was ankylosed in an adducted position with about 50° of flexion. Due to the lack of roentgenograms in those days, opinion varied as to the real nature of the primary injury sustained. Some surgeons considered it to be due to a dislocation; others, to a

fracture. There was a history of prolonged inflammatory reaction in the hip following the injury, so that the patient had lain in bed for 5 months with his thigh drawn up to a right angle. Barton described his careful examination of the joint and ruled out dislocation because of the relative positions of the greater trochanter to the anterosuperior spine. He felt that there had been an extensive comminuted fracture with disorganization of the joint, followed by subsequent inflammation, and that later true bony ankylosis had taken place. The patient was placed in traction for several weeks to determine whether the ankylosis was fibrous or bony, but the joint failed to change its position. At about this time the patient fell under the



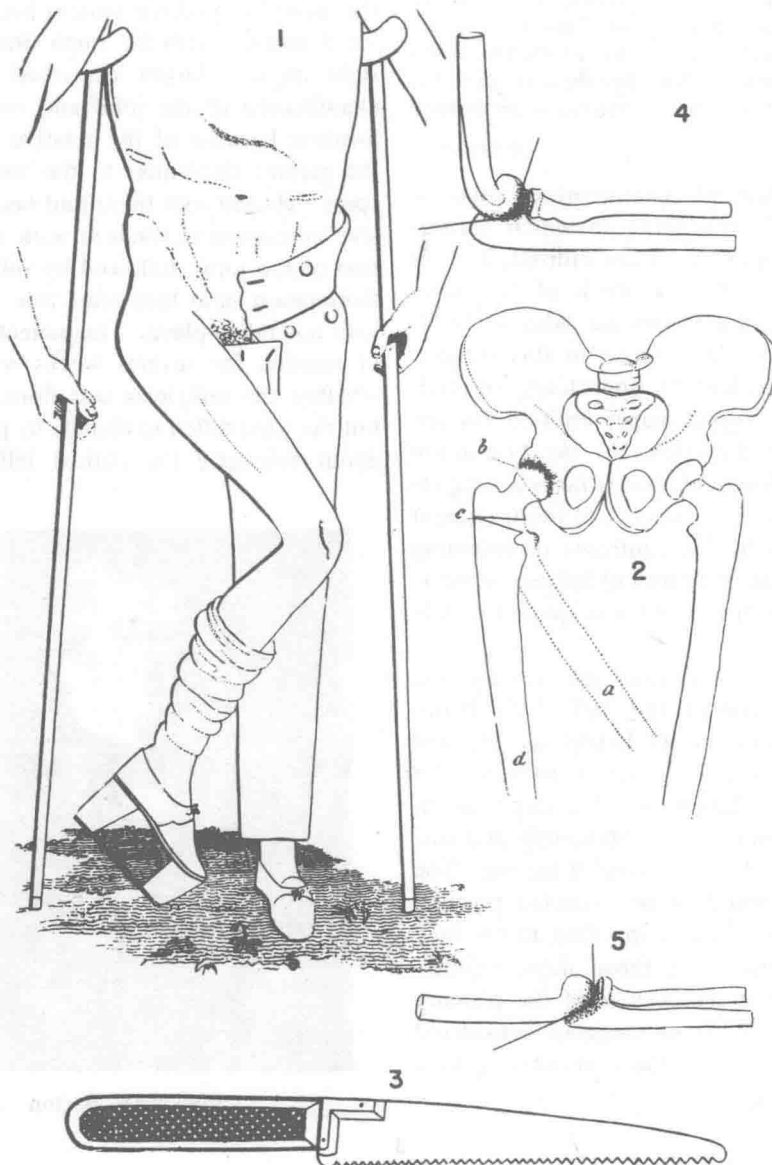
John Rhea Barton

* New York, N. Y.

care of other colleagues, and Barton did not see Coyle again until a year later, when, finding him still in the hospital, he began to think about an operation that would correct the patient's severe adduction-flexion-internal rotation deformity and also give him active motion of the joint. Essentially, he planned to perform a subtrochanteric osteotomy and, after the "irritation" had passed away, prevent the formation of bony union by gentle and daily movements of the limb.

Since his reasoning is interesting in view of our later knowledge of histology and surgery, I quote extensively from his article:

In this proposition, four material points presented themselves for consideration, viz., the practicability of the operation; the degree of risk to life, consequent thereto; the probability of being able to arrest ossific re-union; and the reasonable prospect of benefiting the patient thereby. The arguments I adduced in favour of such an operation were these: That the anatomy



of the part did not present any insurmountable obstacle to it. The fear of cutting into a joint was not to be entertained here, since, from previous disease, all the characteristics of a joint were gone; synovial membrane destroyed; cartilages absorbed; and an amalgamation of the head of the femur with the acetabulum, had taken place. That the shock to the vital system would not, probably, be greater than is frequently endured from accidental injuries, and other operations. That, if the opinion commonly assigned as the cause of the formation of false joints, after fractures, be true, such as frequent motion in the broken ends of the bone, a deficiency of tone in the system, etc., these agents could be resorted to with promising results.

In order to decide the important question, as to the benefit which the patient might reasonably be expected to derive from such an operation, it was necessary to consider how nearly a joint, thus artificially formed, would resemble, in its construction and functions, the natural articulation. What change the divided ends of the bone would undergo; whence would be derived its cartilaginous surfaces, its ligaments, its capsule, and its synovia; and, finally, what was to restrain its undue motions. My hopes of improving his condition, were founded upon the following facts and observations in relation to these points. That a bone, once divided, in a person otherwise healthy, must again unite, either by bone or by ligament; no case to my knowledge, being on record, where a broken bone remained always afterward destitute of attachment between the divided extremities; except in cases where one of the fragments has been so small, or so scantily supplied with blood, as to be unable to contribute its part in the restorative process; being sufficiently vascular only to retain its own vitality, as in case of the separation of the head of a bone. If, therefore, ossific union should be arrested, ligamentous adhesions would maintain the connexion. Writers observe, and it is confirmed by my own experience, that when a fracture does not become consolidated, in the course of time, the rugged edges are removed by absorption; the separated ends become condensed, smooth, and polished, and tipped with a kind of cartilaginous substance; they are likewise inclosed within a sort of capsule. Observation has also proved to me, that this ligamentum structure, formed around and connecting the ends of an old fracture, is possessed of great strength; so much so, that I have, in several instances, witnessed persons sustaining the entire weight of their bodies on the ligaments of a false joint, requiring only lateral support to the limb. The freedom and latitude of motion, in such

cases, and total insensibility to pain, after a sufficient lapse of time, I had also witnessed, and [they] were encouraging arguments. In the operation here proposed, no such great strength of ligaments as will support the body, would be required; since, from the *transverse* section of the trochanter, bone will rest against bone, and strength in them only to prevent dislocation, would be necessary. From my inquiries into the manner in which this joint was to be lubricated, I did not expect that a synovial membrane and fluid, in all their characters, would be generated; but ample proofs were not wanting, of the immediate resources of nature in defending parts from injurious friction, in whatever part of the body it might be required, either by an exhalation from the adjacent structure or by the intervention of a bursa. In the common false joint, where motion is discouraged as much as possible, sufficient moisture is there exuded to prevent painful attrition. It might reasonably be expected, therefore, that where motion was continual, the lubricating moisture would be more abundantly exhaled. In un-united fractures, the false joint is uncontrollable, because there are no muscles specially adapted for its restraint; but in the joint thus to be formed, *the will* alone must influence the movements, since nearly all of the muscles which exercised their control over the original joint, would be carefully preserved, to have a similar power over this; which is, in fact, a mere transfer of the point of articulation and resistance, from the head of the bone in the acetabulum, to the upper end of the shaft of the femur, against the great trochanter.

Although I did not think it essential to the melioration of my patient's condition, that the ends of the bone should at its section undergo any change, further than by absorption of the asperities, I did believe, that nature would not passively witness my labours to effect what she has so often herself endeavoured, unaided by art, to accomplish, but that she would be ready to co-operate with me, and to extend to completion, that which human art alone would be incapable of—the formation of a new and useful joint, as a substitute for that which disease had annihilated, either by the conversion of the trochanter into a socket, or by some more wise design. . . .

These views were fully explained to my colleagues, and were accompanied by the assurance, that my patient had been fairly appraised of his present condition, and of the nature and intentions of the operation proposed; that he had not merely acceded to it, but that, after placing the sufferings, the difficulties, the risks to life, the chances of failure, and the dangers

eventually of aggravated lameness, in the strongest and most exaggerated light, he had expressed his willingness to endure any pain, or duration of suffering, and to subject himself to all hazards, for the remotest prospect of relief.

Accordingly, on the 22nd day of November, 1827, assisted by Doctors Hewson and Parrish, I proceeded to the operation publicly in the Pennsylvania Hospital. . . .

The integuments and fascia being divided and raised, the muscles in contact with the bone, around part of the great trochanter, were carefully detached, and a passage thereby made, just large enough to admit of the insinuation of my fore-fingers, before and behind the bone; the tips of which now met around the lower part of the cervix of the femur, a little above its root. The saw (Fig. 3) was readily applied, and, without any difficulty, a separation of the bone was effected. The thigh was not released, and I immediately turned out the knee, extended the leg, and placed the limbs side by side; by a comparison of which, in reference to length, the unsound member betrayed a shortening of about half an inch. This might have been caused partly by a distortion of the pelvis. Not one blood-vessel required to be secured. Union by the first intention was not attempted; the lips of the wound were only supported by adhesive plaster and slight dressings. The patient was put to bed, and Oesault's splints were applied, to support the limb.

The operation, though severe, was not of long duration, it being accomplished in the space of about 7 minutes.

Barton dressed the wound daily and noticed the anticipated secretion of pus on the sixth day and the appearance of healthy granulations on the eleventh day. Beginning on the twentieth day after operation, and while the wound still was granulating and draining, the limb was moved cautiously by Barton in each direction to resemble the natural movement of a sound hip joint. In doing this he was careful never to use violence or to continue it or repeat it so often as to occasion any permanent irritation. A sufficient time always was allowed for the patient to recover from the soreness of the last motions before the limb was disturbed again. At first it was necessary to allow an interval of several days between the movements in order to obtain a subsidence of the soreness. However, in the course of a short time, as the part became more insensible to pain from this disturb-

ance; the limb was moved more frequently. Active motions of the hip were encouraged at about the sixth week. On the patient's sixtieth day, the wound, having healed entirely and all appearances of inflammation having gone, Coyle was assisted carefully from his bed and, aided by crutches, stood erect with both feet reaching the floor. Coyle estimated that he bore 10 or 12 pounds of weight on the weakened limb for a few minutes. He was able to advance the leg actively and to rotate it slightly without pain. The following day the limb felt a little sore, and some fluctuation was discovered anteriorly which, the next day, drained a quantity of fluid.

At his eighth week:

. . . the patient, in the presence of the medical class of the hospital, walked around the room several times, then held out his crutches, showing he was capable of sustaining much of the weight of his body on the limb without pain. On being asked whether he felt as if he had, at the hip, solid support for his body, he answered in the affirmative.

The following month Coyle developed an attack of erysipelas with abscess formation in the previously healed sinus. This cleared up within a few days and did not cause any pain on movement of the joint there, nor did it seem to impede the movement of the joint.

By the end of the third month, Barton noted:

. . . he arises in the morning and retires not until night, in the meantime amusing himself by exercise in walking, which he now begins to accomplish by the aid merely of a cane. Time only seems to be required to enable him to walk without even this assistance. The following is the degree to which he can perform the movements of his limb with perfect ease: By measurement from a straight line, he can advance the foot 24 inches; in stepping backward, 26 inches; in abduction, 20 inches; in rotation inward, 6 inches; and outward, 6 inches. By the fourth month the patient was able to walk a short distance without the aid of a cane and continued to improve from that point onward.

In concluding his paper, Barton stated:

Having now established the fact that an artificial joint can be substituted for the loss of a natural articulation at the hip, it becomes a

matter of importance to ascertain how far the same principles are applicable to the formation of new joints in other parts of the body where natural motion has been lost. My reflections on this point have not presented any forbidding circumstances but it is not in every joint that the loss of motion would be sufficiently important to call for the aid of a painful operation. The most serious evil is sustained by the loss of the hip, knee, shoulder, elbow, great toe, and finger joints, and of the lower jaw. These, I believe, may all come within the reach of amendment by an operation, if the muscles which move these respective joints are in a sound and effective state. If they have been lost, it would be probably wrong to form a joint, since its unrestrained motion would be more troublesome than a rigid limb. A transverse section of the bone would be proper if the operation were to be attempted at the shoulder, knee, fingers, or toes, but an angular division would be necessary at the elbow, in order to preserve some resemblance to the natural point at this part. I have, therefore, given in the plate, a sketch of an ankylosed elbow in the straight and angular position and the manner in which the section would be most advantageously made.

Coyle enjoyed the use of his artificial joint for 6 years, during which time he worked as a trunk maker. In a subsequent paper, *On a New Treatment for Certain Cases of Ankylosis*, Barton gave a follow-up on Coyle:

The patient upon whom this operation was performed enjoyed the use of his artificial joint for six years, during which period he pursued a business (trunk making) with great industry, earning for himself a comfortable sustenance and a small annual surplus. Pecuniary losses, however, through the reverses of those in whose hands he had confided his means, sunk him into a state of despondency and desperation, followed by habits of intemperance. This, with all the train of evils, abuse of health, etc., was no doubt the cause of the change which afterward took place in the artificial joint. It gradually became more and more rigid and finally all motion ceased in the part. With this exception the benefits of my operation were retained and fully appreciated until the period of his death; for, as the limb had been freed from deformity and restored to a useful position, he had no occasion, even for a cane, to aid in walking. During an attack of Asiatic cholera he expressed a desire that I should be sent for, in order that he might renew his bequest to me of the parts interested in the operation. He recovered from the cholera, but subsequently died of phthisis

pulmonaris. The autopsy exhibited the parts as described in the published case, with the artificial joint ankylosed; a change which had been effected within the two years previous to his death. With ordinary care, in all probability this would not have taken place.

The final history of this case presents now the important fact that benefit had resulted which fully requited the individual for the pains he had endured and were considered by him, even after the closure of the joint, yet an ample reward for the operation he had undergone.

John Rhea Barton, the son of Judge William Barton, was born in Lancaster, Pa., in April, 1794. His grandmother was the sister of the well-known astronomer David Rittenhouse; an uncle was the early naturalist and antiquarian Benjamin Smith Barton. John Rhea Barton served his apprenticeship in medicine in the Pennsylvania Hospital, taking his medical degree in 1818. He worked under the celebrated Philadelphia physicians Philip Syng Physick (who treated bone nonunions by the seton), Dorsey and Hewson. In 1823, when he was 29 years of age, he was appointed to the surgical staff of the Pennsylvania Hospital. He showed unusual manual skill and ingenuity, which directed his endeavors toward the treatment of fractures. In operating, he was ambidextrous and rarely changed his position at the operating table. He is credited with devising the figure-of-eight bandage for the head and thus dispensing with the clumsy devices then in vogue in dealing with fractures of the lower jaw. He introduced bran dressings in the treatment of compound fractures, which, as his biographer Kelly states, actually were an excellent breeding place for myriads of bedbugs. His careful, precise observations led him to describe a rare type of subluxation of the carpus that was associated with a fracture of the articular rim of the radius which to this day is known as a Barton's fracture of the wrist. In the absence of roentgenographic confirmation, it is astonishing that he could separate this entity out of the large group of Colles fractures presenting themselves to him for treatment. His three most noteworthy surgical contributions to the literature are the paper described

above, his *Longitudinal Section of the Lower Jaw for the Removal of a Tumor*, and his *New Treatment for Certain Cases of Ankylosis*, in which he presented the principle of a wedge osteotomy at the knee for the correction of a right-angle bony ankylosis of the knee. He wired a fractured patella as early as 1854, and, although his patient died of postoperative suppuration, Barton believed that he had established a new principle in the treatment of these injuries.

Born of distinguished forebears and educated under the tutelage of great teachers of his day, his ingenuity and incentive were stimulated to place him in the forefront of that group of early American surgeons forming the vanguard of the new American School of Surgery. As Oliver Wendell Holmes said, "Genius comes in clusters, and shines rarely as a single star." Personally, he possessed an easy dignity of manner, a cheerful disposition and a heart full of human kindness. His quality of personal magnetism was noted particularly as he made rounds in the hospital; he spoke words of encouragement to each bed inmate and left sympathy and comfort in his wake. Agnew said of him:

With all his other qualities of head and heart, Barton was a man of great simplicity of life, and entirely free of all appearance of ostentation or display. He moved quietly among his fellow-townsmen without drumbeat or flaunting banners. I remember well his equipage. Not a showy phaeton drawn by fiery steeds whose pedigree might be traced to the stalls of Solomon, no buttons, no tigers, no obsequious lackeys to herald the presence of the man, but a plain substantial horse and buggy, driven by those hands whose cunning had wrought so many marvels of surgical skill.

His first wife died; later he remarried.

Although the *Dictionary of American Biography* states that he retired from active practice in 1840, his obituary in the *Lancaster Intelligencer* of 1871 states that in the steady pursuit of his profession for 30 years he acquired an ample fortune which was increased largely by his marriage to the daughter of Mr. Jacob Ridgway. At any rate, it is difficult to unearth further bio-

graphical material of this distinguished man who, in the first 17 years of his practice, was responsible for several important landmarks in surgery. In his later years his practice was chiefly a consultative one; his advice was solicited by both physician and patient when difficult surgery was contemplated.

Upon his death in his seventy-seventh year, his wife bequeathed \$50,000 to the University of Pennsylvania to endow a Chair of Surgery, the incumbent of the Chair to be designated as the John Rhea Barton Professor of Surgery. The distinguished surgeon I. S. Ravdin now occupies that Chair.

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Indications and Contraindications for the Early Use of an Intramedullary Hip Prosthesis

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In discussing the indications and the contraindications for the early use of an intramedullary hip prosthesis, one must keep in mind 3 salient facts:

1. A well-healed and well-nailed fracture of the femoral neck that has not developed circulatory changes is better than any type of hip prosthesis. Such a femoral head is alive, and, with normal metabolism, it should serve the individual until his death. Ultimate breakage of any prosthesis is possible.

2. An arthritic or aseptic necrotic head of the femur in a young adult wage earner has no better therapy to provide long hours of hard work without pain or fatigue than an arthrodesis of the hip.

3. The prime indication for the use of an artificial hip of any type is as a salvage procedure (Fig. 6).

If these sound orthopaedic dicta are kept in the forefront of the surgeon's mind in forming surgical judgments, there will be found justifiable indications and special situations that call for the early use of an intramedullary hip prosthesis.

In general, the intramedullary type of hip prosthesis can be used in all instances in which the Judet, or femoral neck, type can be used. The early reluctance of some to cut away a seemingly healthy neck of femur has disappeared, in view of the mechanical stress advantages to be gained from this type as opposed to the Judet type. Either type will work satisfactorily if it is inserted under the proper conditions and indications.

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but there is less chance of subsequent trouble if the intramedullary type is used standardly.

The most common abuse of the use of endoprostheses is in fresh fractures of the femoral neck. One's surgical judgment may be influenced more by fascination for the new surgical tool than by the sound orthopaedic dicta mentioned above. More often it is a case of one's surgical judgment being influenced by the immediate advantages, economically and functionally, to be obtained from an artificial hip rather than the long-term advantages of a more costly, longer convalescent procedure of primary hip nailing. Often the surgical judgment of the surgeon is based on his own particular experience with the type of fracture involved rather than on the over-all picture of what is to be expected with that especial fracture throughout the land. Common instances of the improper use in fresh fractures of the endoprosthesis are in (1) the high head fracture, (2) the aged and (3) the Pauwels Type 3 fracture.

The High Head Fracture. In those high fractures of the femoral neck in which the break has occurred close to the head itself and has left only a small bony fragment to be engaged by the Smith-Petersen nail, some surgeons believe that an endoprosthesis is indicated because the head fragment is dead and will not unite (Fig. 1). The bone in these small head fragments is no more dead than in fractures that occur at farther distances down the femoral neck. It is dif-