

EARLY ATTEMPTS AT HIP ARTHROPLASTY—1700s TO 1950s

Pablo F. Gomez M.D.* and Jose A. Morcuende M.D., Ph.D.

ABSTRACT

Over the last three centuries, treatment of hip arthritides has evolved from rudimentary surgery to modern total hip arthroplasty (THA), which is considered one of the most successful surgical interventions ever developed. We here review the history of the early hip arthroplasty procedures for hip arthritis that preceded Charley total hip arthroplasty. An evaluation of such past enterprises is relevant, and reminds us of the ephemeral nature of human industriousness, and how medical research and procedures are not isolated developments, but correlate to the social, economical, and cultural framework of their time.

INTRODUCTION

*“Comme le Medecin, qui desire trencher
Quelque member incurable, avant que d’aprocher
Les glaives impiteux de la part offense,
Endort le patient d’une boisson glacee,
Puis sans nulle douleur, guide d’usage et d’art,
Pour sauver l’homme entier, il en coupe une part . . .”*
—Guillaume de Saluste Seigneur Du Bartas.
*La Sepmaine ou Creation du Monde,
Le sixieme jour (960-65). 1581*

Arthritides have defied the effectiveness of many interventions for several thousand years.¹ Joint pathologies have been evidenced in *Homo sapiens* from Saxon,² medieval² and Roman³ excavations. *Homo sapiens neanderthalensis* bones also harbor the pathological marks of articular disease.⁴

EARLY HIP ARTHRITIS SURGERY IN THE 1800s

Toward the end of the eighteenth century, the field of operative orthopaedics was considerably advanced

as a result of the progress made in identifying the physiology of the skeletal tissues that occurred during the first half of that century.

Excision of the joints was practiced liberally for many types of joint diseases. Liverpool, in the United Kingdom, had gained notoriety for its skilled surgeons, where Henry Park (1744-1831) worked at The Royal Infirmary. In a letter to Percival Pott (1717-88), a luminary of surgery and his teacher, Dr. Park described his principles of treatment:⁵

The resource I mean is the total extirpation of the articulation, or the entire removal of the extremities of all the bones which form the joints, with the whole, or as much as possible of the Capsular Ligament; thereby obtaining a cure by means of Callus.

The enthusiasm shown at that time for joint excision was, as with all surgical innovations, the result of special circumstances. It was a reaction to the appalling frequency with which amputation was being practiced in Europe and America. Liverpool was a large commercial port and sailors arrived with wounded limbs, in many instances injured months before. These types of injuries required a radical treatment, which in the late 1700s meant amputation. Amputation of the extremity in these cases often offered a simple but, as Park thought, unnecessary solution to the problem.

Because of warfare that afflicted some of Europe, military surgeons were applying amputation too. As a matter of fact, amputations became so common that Johann Ulrich Bilguer (1720-96), surgeon-general of the Prussian army, wrote *De membrorum amputatione rarissime admnistranda*⁶ in 1761, pleading for the conservation of injured extremities among the unfortunate soldiers who crowded the military hospitals after every great victory. However, the technical ease of amputation when compared to joint excision slowed the acceptance of this technique by Park's colleagues. During the pre-anesthesia era, expeditiousness of a procedure was most valued.

Anthony White¹ (1782-1849) of the Westminster Hospital in London, is credited with the first excision ar-

Department of Orthopaedics and Rehabilitation
University of Iowa Hospitals and Clinics, Iowa City, Iowa

Correspondence:

Pablo F. Gomez, M.D.
University of Iowa Hospitals and Clinics
4120 D MERF
375 Newton Road
Iowa City, IA 52242
Email: pablo-gome@uiowa.edu

¹ Anthony White was the first to give an account of *phlegmasia alba dolens* (deep venous thrombosis in an extremity, a common complication of THA) and was described by his contemporaries as “the most eminent surgeon by much in the North of England.” Leonardo RA. *History of Surgery*. New York: Froben Press; 1943:237.

throplasty in 1821 though he did not make a personal report of the operation. This procedure ameliorated pain and preserved mobility, but at the expense of stability. It was this surgery that gained him recognition in the medical community, as described in his obituary that appeared in *Lancet*.⁸

He who first excised the head, neck and trochanters of the femur, the patient surviving the operation twelve years, and then dying consumptive Mr. White had been unable, from his extensive practice, to contribute any literary work to the advancement of medical science . . . although he did deliver an Hunterian Oration before the Royal Society.

However, John Rhea Bartonⁱⁱ (1794-1871) in Philadelphia, is credited with performing the first osteotomy on an ankylosed hip in 1826.⁹ He performed an intertrochanteric osteotomy without anesthesia in only seven minutes. After twenty days, he manipulated the extremity to provoke a fibrous reaction at the ends of the severed bone, and thus created a pseudarthrosis. Barton reported the surgery in the *North American Medical and Surgical Journal*.⁹

. . . to divide the bone through the great trochanter and part of the neck of the bone

. . . to extend the [adducted] limb and dress the wound. After the irritation from the operation shall have passed away, to prevent, if possible by gentle and daily movement of the limb, the formation of bony union, and to establish an attachment by ligament only, as in cases of ununited (sic) fractures, or artificial joints as they are called.

Three months after the operation, the patient walked reasonably well with a cane, but six years later all motion had been lost. Barton provided the first evidence that motion would prevent the fusion of bone. This popularized hip osteotomy as a rational plan for overcoming bony ankylosis, a hitherto untreated lesion. However, although there were some spectacular successes, the outcome was generally disconcertingly unpredictable. Most of the operated joints eventually became ankylosed, a disappointing outcome for such a perilous procedure that had a mortality rate of approximately 50 percent, high even by the day's standards.ⁱⁱⁱ

ⁱⁱ Barton's name is also associated with a fracture of the dorsal ulnar articular surface of the distal radius; a figure-of-eight bandage that provides support to the lower jaw; and an obstetrics forceps with one fixed curved angle and a lunged anterior blade for application to a high transverse position of the fetal head during complicated labors.

ⁱⁱⁱ Asepsis, which was the most important of Joseph Lister's (1827-1912) contributions to the surgical setting, was introduced in the second half of the nineteenth century. Anesthesia was around the corner, but until William Morton's sulphuric ether miracle in 1846, the most appreciated quality of a surgeon was, besides precision, speed. So, with such expedited procedures, and with the almost certain fate of infection, it was surprising that some patients actually survived many operations. For a marvelously written review of the

Although Auguste Stanislas Verneuil (1823-95), from Paris, France, performed soft tissue hip interpositions in 1860, it was Léopold Ollier's^{iv} (1830-1900) work at the Hôtel-Dieu hospital in Lyon, France, that generated tremendous interest in the concept of interpositional arthroplasty. In 1885, he described the interposition of adipose tissue in uninfected joints.¹¹ However, he did not fix the interposed material to the subjacent bone and his procedures were generally ineffective.

Subsequently, Czech surgeon Vitezlav Chlumsky (1867-1943), working in Breslau, Germany (now Wroclaw, Poland) systematically experimented with many interpositional materials. Among the wide variety of materials he used was muscle, celluloid, silver plates, rubber struts, magnesium (which had the detestable characteristic of fomenting exactly the opposite of what it was supposed to do, this being consolidation of bone osteotomies or fractures), zinc, glass, pyres, decalcified bones, wax and celluloid.^v

Berliner Professor Themistocles Glück (1853-1942) led the way in the development of hip implant fixation. In 1891, Glück produced an ivory ball and socket joint that he fixed to bone with nickel-plated screws.¹³ Subsequently, he experimented with a mixture of plaster of Paris, and powdered pumice with resin to provide fixation. The resemblance between his craftwork and the work of a carpenter or sculptor is remarkable.

Eventually, around the turn of the century, a more reasonable approach was advocated by John Benjamin Murphy^{vi} (1857-1916) from Chicago, to just alter symptoms of localized osteoarthritis of the hip joint.^{vii} He de-

loud and bloodier world of English surgery in the last decade of eighteen and the first half of nineteenth century, see Stanley P. *For Fear of Pain, British Surgery, 1790-1850*. Amsterdam: Editions Rodopi B.V.; 2003.

^{iv} Léopold Ollier has been referred to by some as "The Father of Orthopaedic Surgery." He was born in Les Vans, Ardèche, France and developed his professional life in Lyon, France. He pioneered the use of skin grafts, and his research on periosteum allowed him to devise new surgeries for the management of joints and extremity pathologies. He was also the first to demand bone surgery be recognized as a separate discipline, in a speech at the 1867 Congress of French Surgeons.

^v Chlumsky's experiments are described in Chlumsky V. *Zentralblatt für orthopaedische Chirurgie (Continued Centralblatt für orthopaedische Chirurgie un mechanik from 1887-1890)*. 1896. He used laboratory animals for testing before actually implanting the materials in his patients. Not all surgeons at that time were as considerate as he, and most of them, without hesitation, introduced their ideas directly into their clinical practice.

^{vi} John Benjamin Murphy was born in Wisconsin, in a log cabin in 1857. Murphy eventually became chief of surgery at the Mercy Hospital in Chicago, a position he held from 1895 until his death in 1916. A controversial figure for his flamboyant style, Murphy held an immense range of interests. He is most famous for his work on appendicitis, where he described the clinical sign that would eventually bear his name.

^{vii} Murphy called the disease by its Latin name *malum coxae senilis*.

scribed neither implant surgery, nor resection, but just removed overhanging bone osteophytes from the base of the head of the femur and the rim of the acetabulum, a procedure described as hip cheilotomy.¹⁴

INTERPOSITIONAL HIP ARTHROPLASTY IN THE 1900s

Earlier in the 1900s, Murphy,¹⁵ along with Erich Lexer (1867-1937) from München, Germany, had advocated the hip interposition of *fascia lata*.¹⁶ This was a modification of the technique described in 1893 by another German surgeon, Heinrich Helferich (1851-1945),^{viii} who worked in Tübingen and performed a similar procedure for the treatment of temporomandibular joint arthritis.¹⁸

Other interesting interpositional material was introduced at the turn of nineteenth century by a French surgeon, Foedre (b. ca. 1860), who noted that pig bladder was sufficiently strong to withstand the stresses of weight bearing and intra-articular pressure.¹⁹ By 1918, William Steven Baer (1872-1931)^{ix} had popularized pig bladder arthroplasty at the Johns Hopkins Hospital.^{20,21} The modern concept of informed consent authorizing surgical procedures was, obviously, nonexistent at the time and surgeons acted in the best Hippocratic tradition, with authoritative decisions that most times were not discussed with the patient.

During the same period, Sir Robert Jones (1855-1933)^x used a strip of gold foil to cover reconstructed femoral heads. Twenty-one years later, he was able to report that the patient still retained effective motion at

the joint.²² This was the longest follow-up report recorded, to that point, in the history of arthroplasty.

In 1924, Royal Whitman (1857-1946), from The Hospital for Ruptured and Crippled (now The Hospital for Special Surgery) in New York City, published the first description of hip osteoarthritis^{xi} surgery by means other than fusion. He described his surgery in *Annals of Surgery*.²³

The reconstruction operation may be defined as a mechanical adaptation of a hip joint disabled by injury or disease to the essential requirements of locomotion. . . . In this operation, the head of the femur is removed and the trochanter is cut from the shaft in an oblique direction with all its attached muscles so that the additional area thus obtained, together with the part of the neck that remains, may provide a secure weight.

Following this, several modifications of the procedure were attempted with variable, but not definitive success, as it was necessary to sacrifice either mobility or stability of the joint in order to achieve remission of pain.

It was the Norwegian-born American surgeon Marius Smith-Petersen (1886-1953) from Boston, Massachusetts who in 1923 provided synthetic interpositional arthroplasty with a mold prosthesis. This arthroplasty was intended to facilitate bone-implant movement both at the femoral and the acetabular sides of the implant. Initially, Smith-Petersen had observed a smooth membrane around an excised piece of glass during an unrelated procedure. Encouraged by this finding, he designed a glass mold to be placed between the femoral head and the acetabulum. This device, according to Smith-Petersen's reasoning, would "guide nature's repair" of the joint. He also described the anterior surgical approach to the hip for use in this procedure, which bears his name, and began implanting the devices in 1932. Unfortunately, some of the molds broke, and although he was extremely excited during the revision surgeries to find glistening linings on the broken pieces of glass, the stubbornness of his patients, who persisted in their ailments regardless of the surgical evidence of success, convinced him to abandon such material. He subsequently experimented with celluloid, Bakelite, and Pyrex. In 1937, his dentist suggested he try Vitallium[®], which had been recently introduced to the dentistry market. Smith-Petersen implanted 500 Vitallium[®] moulds in the ensuing ten years with good clinical results. This device provided the first predictable result in interpositional hip arthroplasty.²⁴

^{viii} In 1882, Helferich presented an eloquent defense for use of muscular interposition in the treatment of joint afflictions during the German Surgical Congress, Helferich H. *Über Muskeltransplantation beim Menschen*. Paper presented at: *Verhandlungen der deutschen Gesellschaft für orthopaedische Chirurgie*, 1882. His subsequent work advocated use of that technique in the hip. Murphy's and Lexer's use of the *fascia lata* are based on his original work.

^{ix} Baer founded the Orthopaedic Surgery department at Hopkins after an invitation by William Halsted, Chief of Surgery at that hospital in 1900. He also developed new procedures for low back pain and the treatment of osteomyelitis.

^x The most important orthopaedic surgery figure at the turn of the century, Sir Robert Jones, grew up in Liverpool, United Kingdom, where he worked as an apprentice of Hugh Owen Thomas. He organized and systematized the diagnosis and treatment of bone and joint injuries during his service in World War I, when he worked as Director of Military Orthopaedics in the British Army. He was a champion of crippled children. He also produced several of the most important books in orthopaedic history such as *Orthopaedic Surgery of Injuries* (Oxford Medical Publications, London: Henry Frowde, 1921), *Injuries of Joints* (London: Henry Frowde, 1915) and *Notes on Military Orthopaedics; with an Introductory Note by Sir Alfred Keogh* (London: Cassell and Co., 1917).

^{xi} In his paper, he called this disease *arthritis deformans* of the hip.

EARLY PROSTHETIC HIP ARTHROPLASTY IN THE 1900s

The first to use a rubber femoral prosthesis was at Pierre Delbet (1861-1925) at La Ferté Gaucher, Departement Seine-et-Marne, France. He used a rubber femoral prosthesis in 1919 to replace one-half of the hip joint. In 1927, British surgeon^{xii} Ernest W. Hey-Groves (1872-1944) preferred ivory, with dubious results. In 1933 he described what, in his opinion, was a preferable method to treat hip arthritis.

A better method of altering the disproportion between the ball and the socket of the joint, is to enlarge the socket by cutting away its lower and anterior margins.

However, a lot of attention for early prostheses was garnered by the Judet brothers—Robert (1901-80) and Jean (1905-95), from Paris, France. They used an acrylic prosthesis in 1948.²⁵ The Judet prostheses turned out to be exceptionally susceptible to wear, and failed even before the general acclaim had ceased. In the often quoted words of Francis Darwin (1848-1925):²⁶

In science the credit goes to the man who convinces the world, not to the man to whom the idea first occurs.

In the 1940s, resection of the femoral head, especially for tuberculosis and infection, was popularized by Gathorne Robert Girdlestone (1881-1950) from the military orthopaedic center that was established at the Wingfield Convalescent Home in Headington, Oxford, United Kingdom.²⁷ It was Girdlestone who, following the precepts of the biblical references, decreed:^{28,xiii}

If thine femoral head offend thee, pluck it out and cast it from thee.

The radical excision arthroplasty that bears his name is occasionally used today as last resort in failed THA, a procedure that is euphemistically called “conversion to a Girdlestone.”

The Judet brothers’ concept²⁹ was refined by Frederick Röeck Thompson, (1907-83) who developed a Vitallium® prosthesis in 1950 which featured a distinctive flared collar below the head and a vertical intramedullary stem,³⁰ by Harold R. Böhlman (1893-1979) from Nebraska, and Austin Moore (1899-1963). Dr. Moore inserted the first such metal prosthesis at John Hopkins Hospital in 1940.³¹ The procedure replaced the

proximal twelve inches of a femur, destroyed by a recurrent giant cell tumor, with a custom made Vitallium® prosthesis. Böhlman and Moore refined their implant and in 1952 described a model that featured a fenestrated stem to allow bone ingrowth. Both designs were produced in collaboration with *Howmedica Inc.*, (at the time, *Austen Laboratories*, now merged with *Stryker Corporation*) East Rutherford, New Jersey, United States. These were the first hip arthroplasty products that were widely distributed. They eventually became legendary and are still widely used for replacement of the femoral head and neck, especially following femoral neck fractures in the elderly.

In 1938, Philip Wiles (1899-1966)^{xiv} of the Middelsex Hospital in London described the first THA using precisely fitted stainless steel components which were fixed to the bone with screws and bolts.³² However, he did not achieve satisfactory results.

Edward J. Haboush (1904-1973) of the Hospital for Special Surgery, and Kenneth McKee (1905-1991) of Norwich, England, developed prostheses in the late 1940s and experimented with dental acrylic cement for fixation. In the early 1950s, McKee, who had trained with Wiles in London, started using the Thompson prosthesis on the femoral side that articulated with a three-claw type cup that was screwed into the acetabulum. His high incidence of failure resulted from loosening of the components.³³ Another Briton, Peter Ring (b. 1922), working in parallel with the Russians, in Redhill, Surrey, started his clinical experience with cementless components with a metal-on-metal articulation in 1964. Some of his early arthroplasties provided surprisingly good results with up to 97% of implants surviving at 17 years of follow up.³⁴ Both the McKee-Farrar and the Ring models were abandoned in the 1970s in favor of Charnley’s model. Nevertheless, these implants continued functioning extremely well and were “rediscovered” in the 1980s by Swiss and British surgeons. Today another wave of metal-on-metal bearings is on the rise.

However, the stage was set for Sir John Charnley to drive the evolution of a truly successful operation in orthopaedics, modern Total Hip Arthroplasty.

^{xii} Indeed, Hey-Groves was not considered eligible to be a member of the British Orthopaedic Association because of his activities in general surgery. Regardless, he introduced several main orthopaedic procedures such as intramedullary nailing of fractures, repair of the ACL of the knee and the described *ivory* arthroplasty of the hip.

^{xiii} Girdlestone’s life was governed by deep religious precepts. He was also a strong advocate on social causes.

^{xiv} Wiles served in both World War I and II, and achieved the grade of Brigadier Colonel in the British Army Medical Corps. Similar to Sir Robert Jones, Dr. Wiles gained most of his knowledge about traumatic injury care during his service at the battle front. Origins of modern trauma surgery can be traced to their experiences in the military. Orthopaedic surgery owes a great part its development as a medical specialty to the military conflicts that occurred during the first half of the century.

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