

Chapter 2

Joint Replacement: Historical Overview

Rihard Trebše and Anže Mihelič

Abstract Joint diseases have troubled people since the ancient times. Many devoted surgeons have introduced numerous surgical techniques and important progress was made in the development of materials and implant designs. Prosthetic joint infections were the main reason for poor success of the early implants.

Keywords Artificial joints • History • Development • Surgeons

Joint diseases, their wear in particular, and bone fractures have troubled people since the ancient times, as proved by numerous excavations from different time periods [1–3]. Even Hippocrates in his texts considered sprains and fractures separately. From the ancient times until present days, many different and innovative attempts of bone disease treatments have been invented with many successes as well as terrible failures [4].

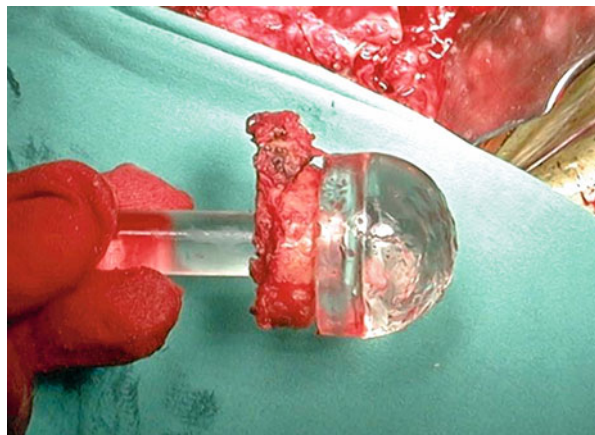
The history of artificial joints and internal fixation of fractures is already very long and infections, were present from the very beginnings. Already the first documented artificial joint had to be removed because of this complication. Historically, infections were the most common cause of failure and very frequently fatal. They represented the main obstacle in the widespread development of bone surgery [5].

In London in 1822 Anthony White (1782–1849) from Westminster Hospital performed the first excision joint arthroplasty [6]. The first surgical principles and techniques for bone fracture treatment developed in the eighteenth and nineteenth century. The first fixation plate was made by Hansmann from Hamburg in 1886. In the early times very cumbersome instruments were used for fracture stabilization, and usually, highly unstable osteosynthesis followed open reduction of the fracture [7].

Artificial joints appeared during this period, too. They were fully unsuccessful in almost all cases, mainly due to septic complications. Professor Themistocles Glück

R. Trebše, Ph.D., M.D. (✉) • A. Mihelič, M.D.
Department for bone infections and adult reconstructions,
Orthopaedic Hospital Valdoltra,
Jadranska cesta 31, Ankaran SI-6286, Slovenia
e-mail: rihard.trebse@ob-valdoltra.si; anze.mihelic@ob-valdoltra.si

Fig. 2.1 The explanted Judet acrylic hemi hip arthroplasty 51 years after implantation



(1853–1942) from Berlin implanted the first artificial knee in 1890 and manufactured and implanted the first artificial hip in 1891 as well. The ivory head was fixed to the bone with a nickel plate and screws [8]. He is also credited for introducing the term arthroplasty in 1902. In 1893 the French surgeon Pean implanted the first artificial shoulder joint. The implant, made of natural, biological materials, lasted for 2 years which is almost incredible [9].

Before Charnley's "low-friction arthroplasty," hip implants were predominating, and most of the development was also concerning the hips. Typically the implants were used as an interposition arthroplasty and made from various materials with unpredictable results. The pioneer of these surgical procedures was renowned American surgeon of Norwegian origins, Marius Smith Petersen (1886–1953). With the introduction of Vitallium® interposition implant (Co-Cr-Mo alloy), he achieved the first predictable and lasting results of this type of surgery [10].

In this period surgeons experimented with real bone-joint replacements from various materials. The acrylic implant from brothers Robert (1901–1980) and Jean (1905–1995) Judet from Paris achieved the greatest popularity. It was introduced in 1948. This implant holds the current world record in the implant in vivo durability – 51 years [11] (Fig. 2.1).

Artificial knees were developed in the same period but they were less successful if compared to hip implants. The reason for the inferior results was probably not in the implants but resulted from inadequate surgical technique. Contemporary principles of mechanical axis balance and the importance of joint stability evolved only in the mid-1980s. Following the example of Smith-Petersen, Boyd introduced Vitallium (Co-Cr alloy) femoral coating. Similar implants for femoral and tibial part were tested also by others, including Smith Petersen, but without success [12]. In 1957 Walldius published his comparison of hinge knee endoprotheses and resection arthroplasties (Fig. 2.2). Good results of the hinged knee implant opened a new era of total knee replacements, which prevailed for the next 30 years, in some centers almost to the present days. The study was a landmark for another reason. It was

Fig. 2.2 X-ray of a failed early hinged total knee replacement 25 years after implantation



the first one with pain as the indication for the implantation of an artificial joint [13]. Until then, limited range of movements was virtually the only appropriate indication.

Following the example of J. Charnleya, in Wrightington Hospital Gunston was the first to used polyethylene against metal in his knee replacement which represented the predecessor of the contemporary condylar type of knee replacements [14]. Gunston devoted considerable attention to the kinematics of the knee but neglected efficient fixation, which made his implant unsuccessful.

Only in 1974, following the example of Freeman's implants (Fig. 2.3), Insall introduced the first successful total condylar knee replacement and developed a surgical technique that was indispensable for this type of knee replacement to function effectively [15].

In the same fashion, implants for other joints were developed. These are, however, much less frequently used today, although the incidence is increasing, especially for the shoulders.

Further development of the implants was based on the introduction of new materials, different ways of fixation, advances in implant design, properties and coatings, and new, less invasive surgical techniques [16]. Today the list of materials used for production of artificial joints is very extensive.

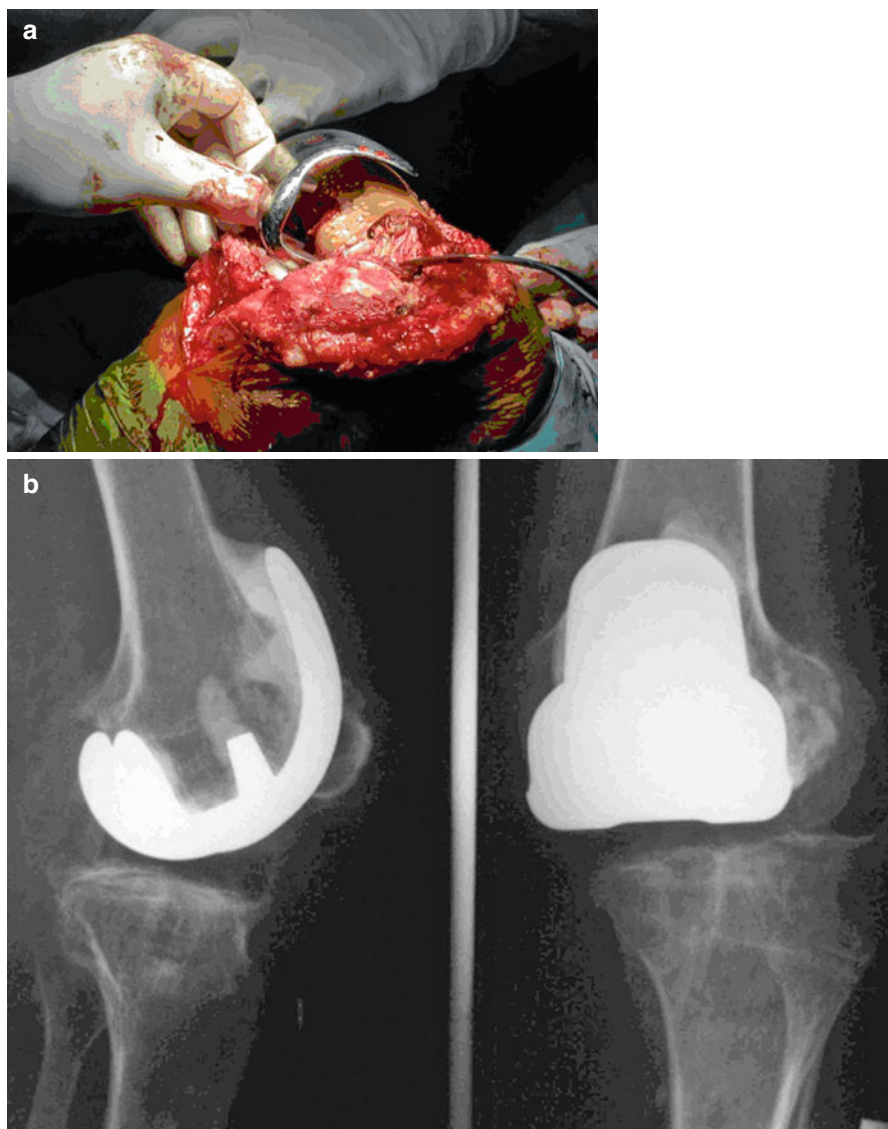


Fig. 2.3 (a) Revision of a Freeman total knee arthroplasty 20 years after implantation that failed due to instability. (b) X-ray of the same knee before explanation

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