The Early Years

In the 1930's Phillip Wiles from the Middlesex Hospital designed and inserted the first total hip replacements. Prior to this date prosthetic replacement surgery was of the hemi-arthroplasty type with only one arthritic surface being replaced and the results were unsatisfactory. The records of Wiles' cases were lost during the war but one patient is reported to still have their implant in situ 35 years later.

GK McKee was a trainee with Wiles and following his appointment as Orthopaedic Surgeon in Norwich, England, began development of total hip replacement designs. He developed various uncemented prototype total hip replacements in the 1940's and 1950's. McKee presented his results to the BOA meeting in Cambridge in 1951. The results in those early days were initial relief of pain followed by loosening and mechanical failure.

Haboush introduced polymethylmediacrylate for fixation of hip endoprostheses in 1953 and Charnley popularised this use of bone cement.

McKee's cement fixed McKee-Farrar total hip replacement (THR) from 1960 was the first widely used and successful THR. This THR had a Thompson stem, a chrome cobalt metal on metal articulation and both the acetabular and femoral components were fixed with cement.

Professor Sir John Charnley was convinced that the metal on metal articulation of the McKee joint was unsatisfactory. He performed experiments to show that the McKee joint had a high frictional torque in the laboratory and he predicted that this frictional torque would eventually loosen the fixation of the McKee components in their bony bed. He was convinced that the natural elastohydrodynamic lubrication with synovial fluid could not be used to reduce the frictional torque of the metal on metal articulation and he began his search for self-lubricating bearings.

This search took him into the field of polymers and his first attempt at hip arthroplasty in the early 1950's was a Teflon on Teflon bearing used as a resurfacing for the arthritic femoral head and acetabulum. Unfortunately the Teflon on Teflon bearings wore out within two years.

Charnley's next attempt at hip arthroplasty spanned the years 1958-1962. This arthroplasty followed the McKee idea of resecting the femoral head and inserting a stemmed component cemented into the upper femur. The metal head of this component articulated against a Teflon socket inserted into the acetabulum. Several hundred patients were treated by this method but unfortunately, high wear of the Teflon occurred, causing severe osteolysis and loosening in the surrounding bone and a large number of revision operations had to be performed. (Fig.6 & 7).

Charnley Metal/Teflon THR showing marked Teflon wear with surrounding Osteolysis.

Marked linear penetration of 22.25mm head into Teflon cup.

In this series of patients, Charnley used four different head sizes and noted that the larger femoral heads had a higher volumetric polymer wear. He therefore determined to use a small (22.25mm) head against polymer in his future designs in order to minimize plastic wear volume. This had two undesirable side effects. Linear penetration into the polymer cup was increased with the small head and stability was compromised.
Charnley's third attempt at hip arthroplasty began in 1962 and involved a stemmed cemented femoral component, a 22.25 mm femoral head and a high-density polyethylene cup inserted into the acetabulum.

That implant was successful in the elderly inactive population of patients treated and is the basis of all hip arthroplasties developed since. Charnley recognized that the success of this arthroplasty would largely depend on the rate and effect of the polyethylene wear.

He cautioned against the use of his THR in young patients.

"Below the age of 65" the situation is very different. The younger the patient, the more the surgeon must guard against allowing the patient's subjective symptoms to influence his judgment. The decision to operate should be made almost entirely on the surgeon's objective assessment. He must turn deaf ears to exaggerated adjectives used to describe the intolerable quality of the pain".

"Technique of delaying operation": "Obviously not many patients between 35 and 45 years of age will accept the advice to delay surgery for a more or less indefinite period of years (say 5 years) unless the method of presenting this advice is adjusted to their particular psychology. A good way of doing this is never to accept for operation at the first consultation very young patients with only moderate physical signs. It is essential to see the patient several times, at first perhaps at 6 monthly intervals".

"In this age group we look for factors which offer a 'built-in restraint' which will continue after the operation, such as defective knees or ankles, and impose some general physical limitations on the patient. Built-in restraint is any factor which will persist after total hip replacement, to hold back physical activity below that expected of a normal subject of the same age".

Charnley understood well that younger patients with a high activity level were the problem group for this type of replacement, but he did accept for operation young patients whose crippled general condition prevented them from resuming a high activity level and wearing out the joint.

This restriction of surgery to the elderly population or the young crippled population was widely practiced and taught by Charnley.

This is reflected in the case selection in results published from Wrightington and from other centres that adopted the Charnley method. This aspect of patient selection must be clearly understood by those who seek evidence of effectiveness in the published literature relating to the treatment of the young patient with an arthritic hip. The published results do not relate to young patients with an arthritic hip, they relate to young patients who have another built-in restraint giving them the activity level of an elderly inactive patient.

Charnley did use the McKee metal on metal joint in his clinical practice and he conceded that the McKee worked just as well in patients as his own commenting, "It is nice to know that both are British".

Peter Ring from Redhill, Surrey, provided the next development in hip arthroplasty (Fig.8).
He distrusted bone cement and developed a self locking total hip replacement for uncemented fixation. (Fig. 9) This design also had a metal on metal articulation.

Thus, by the 1970's three types of total hip replacement were in common use: the McKee, Charnley and Ring types.

Surgeons across the world experienced initial success with all varieties and attention then focused on which would be more durable. Charnley's intervention at this stage proved decisive. He returned to his favorite theme of frictional torque. He built a pendulum comparator to test the frictional torque of the McKee metal on metal joint versus the Charnley metal on polyethylene joint. (Fig. 10). Under test the McKee metal on metal came to a juddering halt and the Charnley joint kept on swinging. (Fig. 11)

Thousands of visiting surgeons to Wrightington were immediately convinced of the superiority of the Charnley joint and the metal on metal joint finally ended in the late 1970's when McKee and Ring themselves switched to metal on polyethylene articulations for their own hip replacement designs.

End of an era

Chamley died believing that his metal polyethylene joint had been totally vindicated. McKee died believing that his metal on metal joint had been rightly superseded by the metal on polyethylene articulation.

Peter Ring, who is still alive, was initially optimistic about his new polyethylene joint but with the passage of time saw the results ruined by osteolysis from polyethylene debris, a complication unheard of in his earlier metal on metal joint. Ring now deeply regrets ever moving away from the metal on metal articulation.

Satisfactory results have been published for the McKee metal on metal,4-5 the Charnley6 and the best for the Ring Metal on Metal with 5% revision at 17 yrs.7

The Modern Era

It is now accepted that a Charnley type total hip replacement can give perfectly satisfactory results in an elderly inactive population. The results published are a reflection of the quality of the surgical procedure with good results (failure of below 1% per year) reported from specialist centres.6,8,9,10 Less good results are reported from general hospitals, with 9% revision at 5 years and 27% of patients having a poor outcome.11 (Trent Regional Arthroplasty Study)

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