

Minimally Invasive Joint Replacement Surgery: Where Are We Now?

Since the establishment of joint replacement surgery, arthroplasty surgeons have been experimenting less invasive joint replacement procedures involving smaller incisions and novel approaches. Yet not until recent two decades the concept of MIS was introduced into the field of joint replacement surgery [1].

MIS joint replacement surgery is neither a single type of surgery nor a certain surgical approach. It is a concept which aims to achieve a smaller incision and, more importantly, less soft tissue trauma [2]. Through MIS approach joint surgeons hopefully can improve surgical outcome and patient's satisfaction by reduction of blood loss, postoperative pain, improvement of cosmesis, accelerated discharge, and enhanced recovery.

Knee Arthroplasty

MIS total knee arthroplasty (TKA) was initially introduced to the orthopedic community in the early 1990s by Repicci and was originally designed for unicompartmental knee arthroplasty (UKA) [3]. Not until early 2000s, TKR surgeon started to apply the same concept to TKA. Four major approaches to MIS TKR have been developed: Quadriceps sparing, mini-midvastus, mini-subvastus, and mini-para-patellar [4, 5, 6]. Quadriceps sparing approach was coined by Alfred Tria in 2000 [7]. The skin incision was 10 cm in length and the arthrotomy extended from the superior pole of the patella to 2 cm below the tibial joint line over the medial side, without cutting through quadriceps tendon and muscle. His visit to Hong Kong in 2006 with his surgical demonstration had popularized this approach in this territory for as a MIS TKA approach for some time.

Nevertheless, most of these MIS approaches require special instruments due to restricted operative field [8]. Moreover, to guarantee correct implant alignment, adjunctive technologies such as computer navigation [9, 10], patient specific instrumentation, or robotic-assisted surgery may be required in the same setting. All these factors will lead to prolonged operative time and extra difficulty in surgical training. It is not difficult to understand a long learning curve is required for arthroplasty surgeon to acquire the essential skill to perform MIS TKA [11].

Hip Arthroplasty

MIS total hip arthroplasty (THA) was introduced to orthopedic surgeons by pioneers including Richard Berger and Dana Mears since mid-1990s. The two common approaches to MIS include single-incision and two-incision approach. The former involves one single mini incision (usually defined as <10 cm) through either posterior, anterolateral [12], or posterolateral approach. The latter comprised of one anterior incision for preparing the acetabulum and cup insertion, and a second posterior incision for femur preparation and stem insertion [13].

Due to the limited visual field, intraoperative verification of stem and cup position commonly require fluoroscopic assistance [2]. Similar to MIS TKA, especially designed instrument including retractors, handle, reamers, and bone-shaping tool are needed in MIS THA due to limited surgical exposure.

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Dr. Cheung Man Hong

¹Department of Orthopaedics and Traumatology, Division of Joint Replacement Surgery, The University of Hong Kong, Hong Kong.

Address of Correspondence

Dr. Cheung Man Hong,
Department of Orthopaedics and Traumatology, Division of Joint Replacement Surgery, The University of Hong Kong, Hong Kong.
E-mail: steve_cheung115@yahoo.com.hk

Current Trend

A number of studies and meta-analysis have been published comparing the short-term result between MIS and conventional joint replacement. While the results are heterogeneous, it is generally agreed that current evidence does not demonstrate clear superiority of MIS toward conventional joint replacement [14, 15, 16, 17, 18, 19]. Moreover, there are modest evidence demonstrating inferior outcome of MIS joint replacement in terms of radiological component alignment [20, 21]. Other potential complications include increased risk of neurovascular injury, fracture, patella tendon disruption, soft tissue interposition at interfaces, bone over-resection, and retained cement [11]. Given the fact that there is no long-term data available, current evidence make the hypothetical benefits of MIS questionable.

Combined with factors such as long operative time and long learning curve, the initial enthusiasm for MIS quieted and pendulum was then switched back to conventional approach. Currently, most arthroplasty surgeons apply the MIS approach to specific operation only (e.g. UKA).

Conclusion

While the concept of MIS is theoretically sound, scientific evidence to support its universality is lacking. Joint replacement surgeons who plan to use MIS in usual clinical practice should critically evaluate the procedure and pay extra attention in patient selection.

Cheung Man Hong¹

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