As an orthopaedic surgeon in institutional practice specializing in joint replacement and limb salvage surgery, it has occurred to me that the indigenous populations of South East Asia pose challenges to joint replacement surgeons outside the norm prescribed by standard texts on the subject. The standard aims of joint replacement surgery are, in order of importance - the relief of pain, the restoration of mobility, the correction of deformity, and the restoration of body image. While we may all agree that these aims are still relevant to every patient being treated in the region, my experience over the last decade in caring for the Asian joint replacement patient underscores certain demands that one would not find easily in the (generally Western) textbooks. These are demands that require novel approaches for their solution that push the very boundaries of joint replacement technology and technique. The joints of greatest relevance in this regard are the hip and knee.

Materials science and biomechanics
The hip is a ball and socket joint (Figure 1). The hip joint replacement involves an acetabular liner which has a polyethylene liner (the cup) and a cobalt chrome articulating ball (the head) which fits over a titanium stem. The ball has a classic diameter of 28 mm which has been considered the best compromise of wear and stability. Range of motion is in all three axes, subject to the limitations of the surrounding soft tissue. In this regard, it therefore replaces all hip movements - there is no compromise. There is perhaps a tendency to dislocation in a loose hip at the extremes of motion especially in the early postoperative period and this may be predisposed to by the surgical approach used. Presently, however, the expectations of some patients to do extreme movement necessitate a different approach. A bigger head confers more stability but unfortunately, this result in increased wear rates. To combat this wear, special materials have been developed to reduce wear on the cup. This includes ceramic liners (the author’s preference for its safest profile), highly cross-linked polyethylene (which unfortunately becomes brittle in the process treatment to limit wear) and metal liners (perhaps the least safe alternative due to prevailing concerns of metal hypersensitivity). The knee is a far more complex joint. It is widely thought of as a hinge joint but in reality the knee undergoes internal and external rotation at the extremes of motion. There is also a shifting of the knee at extremes of motion in the coronal plane (i.e. varus and valgus). Knee replacement designs have been far less successful at replicating all aspects of physiological knee movement. While the general ranges of motion of (say) 0 to 120 degrees may be achieved by most contemporary designs, flexion beyond this range can only be achieved by modifications in knee design. Hence, to accommodate deep flexion, some kind of rotatory mechanism needs to be incorporated into the design. This can be a rotating platform or refinements to the knee design, effectively creating a ball and socket type knee replacement mechanism (the author’s preference). The general concerns of increasing range of motion include a state of increased wear at the extremes of motion in deep flexion on the cam mechanism (essentially a peg that functions as a hinge in a knee replacement).

Blood transfusion
Generally, in joint replacement surgery, one can expect to lose about 1.5 litres of blood in the peri-operative period. Hence all evaluation for fitness for surgery centres in large part on whether the patient can tolerate blood loss at this level. For example, a patient with poor cardiac ejection fraction would have a severe inability to compensate for blood loss and thus, should not be a candidate for surgery. In this regard, cultures that are not permitted to receive blood transfusions become severely compromised. While it may be argued that this sort of surgery is considered ‘lifestyle surgery’ and hence justifiable in denying surgery, it has become apparent in recent years that there are solutions to the problem. It would be in fact difficult to deny surgery and the attendant benefits of pain relief and mobility given the availability of these options. In particular, patients of the Jehovah Witness faith offer a unique challenge. These patients are not permitted to receive transfusions.

![Fig 1](image1.png)

Fig 1: (a) A standard hip replacement illustrating the components used. Of note are the ceramic liners, a novel concept which reduces wear and allows for larger heads. (b) A standard total condylar knee design. Each femoral condyle is based on its own radius of curvature. (c) A revision knee replacement device highlighting a rotating platform (arrowed) that allows for greater range of motion. (d) Another competing concept to the rotating platform being a single mediolateral radius (as opposed to b above) which converts a knee to a ball and socket type joint offering greater range of motion. (e) Drainage devices such as this allow for the blood that drains from the joint of an arthroplasty patient in the peri-operative period to be re-transfused into the patient.

![Fig 2](image2.png)

Fig 2: This patient had a sarcoma of her right femur diagnosed on Xray (a) and was offered an amputation due to the massive size (b) in her country of origin. She elected to die with her tumor due to the requirements of her faith. However as the pain became unbearable she travelled from her home in the Middle East and presented to the author’s unit for a limb salvage procedure. The tumor was resected completely and reconstructed with the kind of joint replacement featured in 1(c).
The other options in such instances are also denied, namely the use of erythropoietin, cell savers and autologous pre-donation (as storage is not permitted). Blood lost can be replaced but only with the patients’ own blood and in the process of losing blood. In this case, a device is available that can re-transfuse a patient’s blood that has been lost into a knee. It takes the form of a blood transfusion bottle with a tube that leads into the knee. This blood is passed through a filter and re-transfused into the patient. The author’s experience with the system has been promising and has offered a reliable heterologous donor free environment. A caveat to its use in the case of Jehovah’s Witnesses is that the re-transfusion must be performed while blood is being lost into the drain bottle. Nevertheless, one can expect to regain about 500 ml of blood over 24 hours (Figure 1e).

**Body image**

While it may be suggested that body image recovery is believed to be important in most cultures, generally most cultures will accept the loss of a limb if it is necessary to save a life. The most expressly stated religious requirement for body image integrity has been in the Middle Eastern faiths of Islam and Judaism and perhaps surprisingly, the Buddhist faiths (Figure 2). Limb salvage surgery has become readily available to patients suffering from cancers in the bone and joints in the limbs through the use of many techniques that have evolved throughout the years. In the author’s practice, most techniques have been employed as highlighted. It is a little known fact that the basis of limb salvage surgery was driven by these cultures due to their need for entry into the afterlife in a complete body. The discipline has its roots in the Memorial Sloan Kettering Cancer Centre where surgery to preserve limbs was originally offered. Patients would have the procedure done, knowing that survival was only in the order of 20% before chemotherapy was offered. This has improved to 80% survival now that surgery and chemotherapy has become standard in the management of these conditions. Nevertheless, despite the dismal prospects of survival where chemotherapy was not offered as standard therapy before 1984, patients of these faiths were determined to have it done for the sake of body image.

**The kneeling posture**

The typical kneeling posture is something coveted by patients of the Christian faith. This is readily accommodated by a knee replacement with a few caveats. In general, as kneeling in these situations involves knee range of motion of 0 to 90 degrees or less (if there is a pedestal), the posture can be attained. Difficulties faced by patients include the pressure of the knee cap on the prosthesis. This can be painful and require a cushion. In addition, the process of getting down and up again requires the quadriceps to function well. Frequently in such patients there has been a variable period of decline in muscle function of up to 20 years and so recovery of muscle function is a major challenge. Finally, it seems reasonable to suggest that in patients with patello-femoral replacement buttons (not routinely done for all knee replacements), a kneeling posture is ill-advised as the patella remnant following a patella button replacement represents a sliver of bone that would be susceptible to breaking (Figure 3).

On the hip, the kneeling posture does not pose any significant limitations in the patient who has gotten used to a hip replacement after about 6 months. No modifications to technique are necessary in either hip or knee replacement surgery to accommodate this activity. A variant of the kneeling posture that is desired in the Islamic community is the ability to kneel with the legs off to one side. This posture is of particular concern to hip replacement surgery. In this posture, both hips are in flexion with one hip in external rotation and the other in internal rotation. The hip in flexion and external rotation is not at risk of dislocation. However, the hip in internal rotation and flexion is at risk for posterior dislocation. The measures that can be instituted in these patients to reduce the risk of dislocation include the use of an anterior approach to the hip which would reduce the tendency to posterior dislocation of the hip. Bigger heads can be used, which are now more stable and these bigger heads should be paired with lower wear liners. Increasingly, with these advancements in technology and technique, hip replacements have become available to younger patients with hip disease.

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**Fig 2:** (a) The patient has had both knees replaced using a standard knee replacement endoprosthesis. Her patella was not resurfaced. She was readily able to get into a kneeling posture. (b) This patient has had her right hip replaced. Although not advocated by the author, the patient hailed from a culture that was used to kneeling in this fashion for prayer. She had had a ceramic on ceramic implant inserted which allowed for a bigger head to be used for stability. In addition, the hip was replaced through a small anterior incision of 7 cm length (MIS or minimally invasive surgery) which allowed for this kind of posture without the risk of dislocation.

**Fig 3:** (a) The patient has had both knees replaced using a standard knee replacement endoprosthesis. Her patella was not resurfaced. She was readily able to get into a kneeling posture. (b) This patient has had her right hip replaced. Although not advocated by the author, the patient hailed from a culture that was used to kneeling in this fashion for prayer. She had had a ceramic on ceramic implant inserted which allowed for a bigger head to be used for stability. In addition, the hip was replaced through a small anterior incision of 7 cm length (MIS or minimally invasive surgery) which allowed for this kind of posture without the risk of dislocation.

**Fig 5:** All three of these patients were able to squat following surgery with three different kinds of hi-flexion knee designs. (a,b) This patient had a traditional knee replacement with a prosthesis that has a smaller medio-lateral dimension allowing the knee to flex deeply without too much tension. (c,d) This patient had a prosthesis of the rotating platform type featured in 1(c) above. (e,f) This patient had both knees replaced at the same sitting with a prosthesis of the ‘ball and socket type’ featured in 1(d) above.
The cross-legged sitting posture

This is a posture that compromises both the hip and knee. The hip is forced into an extreme abduction and the knee not only has to flex beyond 120 degrees, it also has to accommodate mild tibial intorsion and varus. This is a posture typically adopted by Hindus at prayer (Figure 4). Similar limitations of quadriceps weakness apply in this scenario. In the knee, high flexion and some degree of rotation becomes necessary. The high flexion designs described above theoretically should be able to accommodate some rotation. However rotating platform designs do not accommodate varus stress. In these settings, the coronal single radius designs would allow for these postures. Nevertheless it is not uncommon for patients of this faith who have had knee replacements to sit in this manner. The knee in this setting generally would not be able to be placed flat on the ground. The hip ironically has to make slightly unstable to accommodate extreme abduction by having a cup that is more vertical as a more horizontal cup would limit abduction. Most surgeons would find this position suboptimal and would advise against it.

The squatting posture

In the squatting position with deep knee and hip flexion, hip arthroplasties can be rendered stable using the measures indicated under the cross-legged sitting posture. Once again the importance of quadriceps strengthening cannot be overemphasized (Figure 5).

In the knee implant design plays a special role to achieve this posture. As mentioned above, either rotating platform or single radius type designs facilitate deep flexion. In addition the antero-posterior dimension and a reduced medio-lateral dimension would allow tissue to flex further before becoming too tight compared to a box-like medio-lateral design. The author has been able to achieve squatting in patients with either design. The odd thing about squatting is that it is a posture coveted by many Chinese patients. The reasons given by all are varied but never religious. It is especially a strange request as many of such patients would not have been able to squat for the last 15 to 20 years and yet they desire it now. Some feel that it is a measure of the quality of the product and surgery to be able to squat and it seems to give them bragging rights. Others feel it is important for housework. Increasingly, retirees now wish to be able to squat so that they can go travelling and not be inconvenient by the presence of squatting toilets.

The high-wear patient

In my practice, I have encountered many patients, typically male between 50 and 60 years of age, who do not wish to have knee replacement surgery under any circumstance. This would allow them one last hoorah as it were – they may wish to jog up the Great Wall of China or run a marathon one last time. These patients are probably not candidates for joint replacement surgery given the present technology. Polyethylene, which is the prevailing dominant artifactual surface, would be prone to wear and fretting (sort of splintered cracks) and ceramics would likely crack. Theoretically, metal-on-metal type articulating surfaces could withstand the impact but the overwhelming concerns of metal hypersensitivity have essentially made this choice moot.

In these patients, one may consider the various classic osteotomies around joints to offload the diseased segments of a joint. The caveat here is that the patient needs to have a good pre-operative range of motion and non-inflammatory arthritis. Such patients can continue to enjoy high levels of activity despite relatively severe-looking arthritis in the knee – an interpretation of the adage “treat the patient, not the x-ray” (Figure 6).

Conclusions

The first joint replacement was performed in Singapore in 1973. The techniques and technology since that time has evolved tremendously, to the point that standard primary joint replacement surgery is thought to residents as part of their basic curriculum. Most orthopaedic surgeons specialising in joint replacement surgery have been trained in the West and in general, the technology has developed to suit a Western lifestyle that does not require the extremes of motion range expected in an Asian context. With a potential Eastern patient load of more than half of the world’s population, and with surgeons in the region getting better-trained and patients becoming more amenable to joint replacement surgery, the industry has made major inroads into the requirements of this demographic.

As joint replacement surgeons serving the needs of this community, such considerations have provided an added and intellectual stimulus for practitioners to consider their requirements above and beyond the standard techniques of joint replacement surgery.