Use of Optimised Positioning System (OPS) and Computer Assisted Surgery (CAS) in direct anterior THR.

Malpositioning of the acetabular cup that occurs at the time of surgery is one of the main reasons for early failure of hip replacements. Currently the methods used by surgeons for positioning of the acetabular cup are visual/tactile cues and use of anatomic landmarks. However, literature has shown that these methods result in cups being positioned outside of what is considered a "safe zone" for dislocation in close to 50% of cases. Another important factor that further complicates this scenario is that the degree of pelvic rotation/tilt varies significantly between individuals in sitting, lying and standing. This means that even if the cup is placed in an ideal position while the patient is lying on the operating table, in a subset of patients this orientation can change significantly when the patient stands or sits, putting the hip at risk of dislocation.

To overcome this, Dr Kalanie uses Optimised Positioning System (OPS). OPS is a computer planning programme that accounts for varying degrees of pelvic rotation that occur from lying to standing and sitting to standing. This allows for bespoke positioning of the acetabular cup based on each individual patient's spino-pelvic mechanics. The first step to obtaining the OPS plan is a CT scan of the pelvis with the patient lying supine, followed by X-rays taken with the patient standing and sitting. This information is then fed into the computer software that then analyses the rotation of the pelvis in these different orientations. Computer modelling is then used to simulate the movements of the femoral head within the socket at different anteversion and inclination angles. The surgeon is then able to choose the best cup orientation for each patient based on their needs.

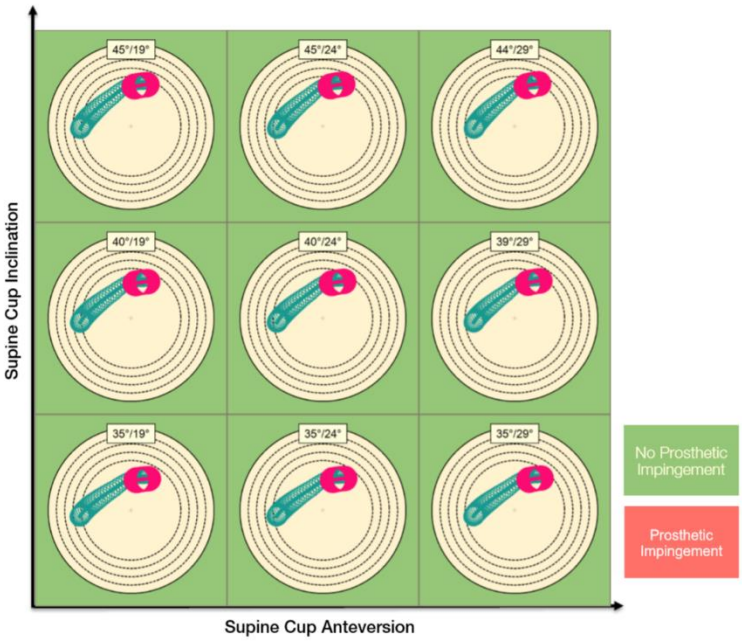
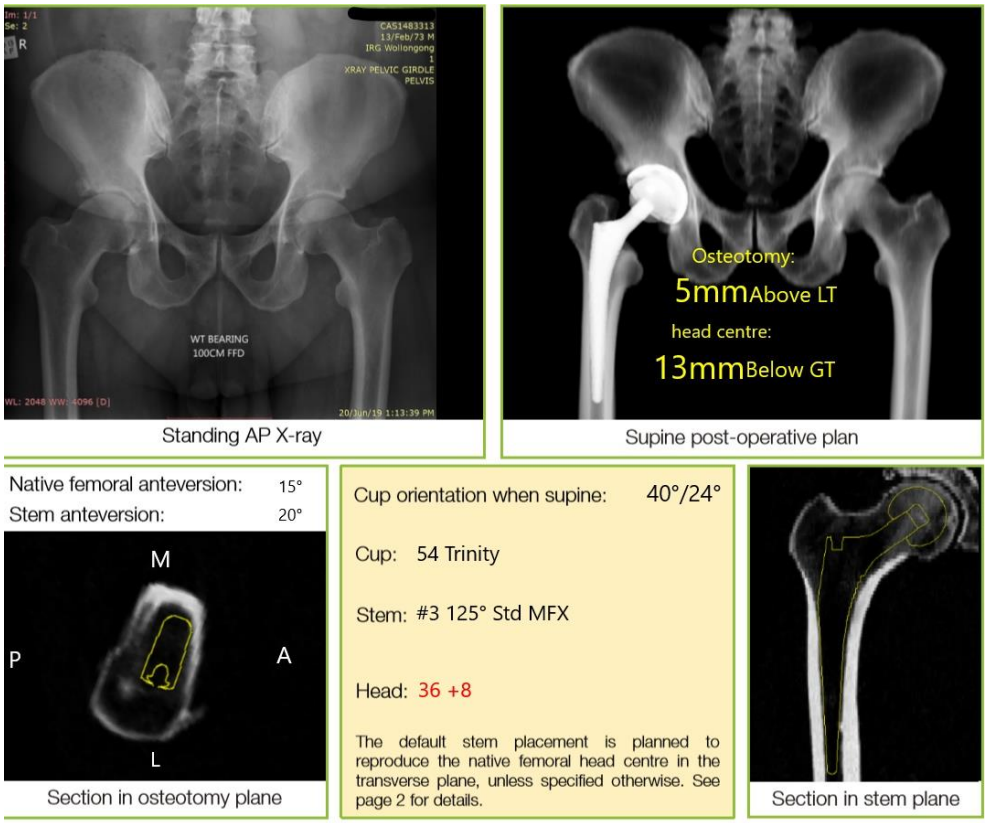


Diagram demonstrating the position of the femoral head inside the cup at different inclination and anteversion angles

The software is also able to use the CT scan to accurately predict the size of the implants and the level of the femoral neck cut, to better restore leg length, soft tissue tension and potentially reduce complications secondary to over or under-sizing of the implants. The level of the femoral neck resection plays a crucial role in restoring leg length. Therefore, to avoid leg length discrepancy (LLD), the engineers, using the CT images, provide the surgeon with a patient specific 3D printed cutting guide that allows the femoral neck to be excised at the desired level with a high degree of accuracy.



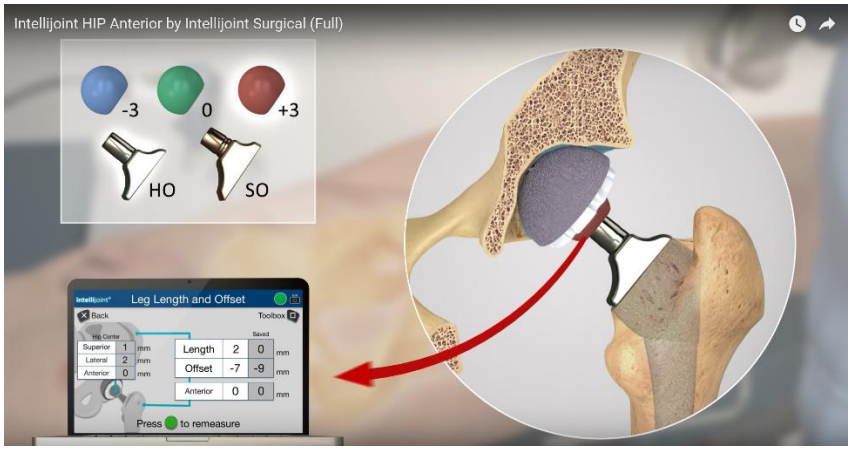
Pre-op CT planning provides the surgeon with the exact size and orientation of the implants required for each patient

Patient specific femoral neck cutting guides

At the time of the surgery Dr Kalanie uses the Intellijoint Computer Assisted Surgery (ICAS) system to implement the OPS pre-operative plan. There are three crucial steps that ICAS plays: First is ensuring that the acetabular cup is positioned in the correct orientation. Here a camera secured to the contra-lateral Iliac crest, communicates with sensors on the handle of the introducer to give real time feedback to the surgeon. This allows the surgeon to position the cup to within +/-1deg of planned orientation.

Intellijoint computer navigation showing the exact orientation of the cup at the time of implantation

The second and third steps involves assessing the leg length and offset following implantation of the trial femoral stem and head. The hip is reduced and once again, the camera communicates with a sensor placed at the top of the femur. The values for leg length and offset are then displayed on the computer screen, allowing Dr Kalanie to ensure that the hip is restored to the desired plan with a high degree of accuracy.



Assessing changes in leg length and femoral offset using the Intellijoint computer navigation system

This ability to pre-operatively plan the orientation and size of the implants using sophisticated 3D computer modelling and delivering that plan using intra-operative computer navigation should greatly reduce intra-operative technical errors, potentially resulting in improved outcomes and longevity of the implants.

For further details on the use of this technique please refer to Dr Kalanie's live surgery video demonstration:
https://www.youtube.com/watch?v=PF08AyPmEFE&t=934s