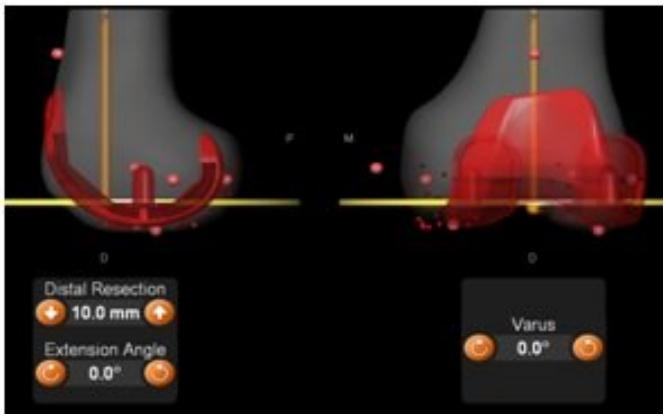
# Navigation

*Dr. Ashish Singh*
*MBBS,MS Orthopaedics, MCh.Orth.(UK),PG Diploma C.A.O.S.(UK), SICOT Diploma Orth.(Sweden)*
*MEDICAL DIRECTOR AND CONSULTANT ORTHOPAEDIC SURGEON*
*ANUP INSTITUTE OF ORTHOPAEDICS AND REHABILITATION, PATNA , BIHAR*

Knee arthroplasty and Hip Arthroplasty has been indicated with growing frequency, especially over the last decade. Its success depends on various factors, such as component design, the quality of the material used to make the component, the manufacturing process, adequate patient selection and the surgical technique.. Within this field, the most significant advance over the past decade has been the emergence of navigation systems ( Computer assisted Surgery -CAS) for knee arthroplasty. Computer Assisted Orthopedic Surgery (CAOS) is a field of technological evolution that has been developing particularly over the last 10 years. These include workstations for preoperative planning and simulation and robotics for use in carrying out surgical procedures, and among these, navigation systems. With these systems, the precision of measurement actually super cedes the capability of the hands behind the instruments, part of which comes from predictive planning in cuts prior to actually performing the next step. The end result is a logarithmic enhancement in precision of rotation, angulation, elevation, and attitude. All of these are necessary prerequisites for successful implant performance and patient satisfaction. Someday when this process is available to all surgeons, it is hoped that the enhancement of surgical precision can realize an improvement in performance, rehabilitation, and hopefully longevity of the prosthesis

**NAVIGATION SYSTEMS – How does it Work ?**

Navigation systems take the special positions of patients' anatomical reference points and surgical instruments are transferred to a computer and processed using software that is capable of providing surgeons with information relating to various steps of the operation in a visual or graphical and numerical form, thereby giving surgeons a greater degree of control and precision in carrying out the procedure. During knee replacement surgery, the surgeon uses infrared markers and trackers to mark the patient's own bony landmarks. The data is captured by the Infrared cameras in the navigation system which generates a real time 3D model of the patient's knee or hip  joint. the landmarks which are vital for implant positioning but cannot be seen by human eye or approximated with conventional instruments (hip centre and ankle centre) are accurately located with the help of software algorithms. Finally each step of the surgery is monitored real time and errors up to 0.5 degrees and 0.5 mm can be precisely fine-tuned. As a result, the knee is implanted with 100% accuracy in every patient




**Benefits of Navigation**

Recent Studies also show that the navigation system aids in precision and better alignment and patient have a better functional outcome.

Incisions can be made smaller and the soft tissue dissection can be kept less invasive.

The use of computer navigation augments other minimally invasive surgical techniques. The net result is greater

protection of the quadriceps muscle and tendon during surgery. It is the protection of the quadriceps mechanism that is the key component of minimally invasive surgery.

1. Studies show that bone cuts can be made more accurately and more reproducibly when guided by computer navigation versus other systems.

2. Computer navigation guidance eliminates the need for a rod to be placed inside the intramedullary (IM) canal of the bone. For the last two decades use of an IM rod has been the standard method of aligning cuts and has proved quite effective. The elimination of this rod, however, furthers efforts at keeping the procedure “minimally invasive”.

3. At the completion of total knee replacement surgery balancing the ligaments surrounding the knee has always been the most difficult and “subjective” part of knee arthroplasty. In conventional surgery the knee ligaments are balanced chiefly by the surgeons “feel” to determine if the ligaments are appropriately taut. Though experienced surgeons can achieve excellent ligament balance in most cases, reproducibility is difficult and results are subjective. With computer navigation, ligament balancing can potentially be quantified to the nearest millimeter of ligament laxity or tautness. As computer navigation software improves, the surgeon will be able to more precisely balance the ligaments of the knee. This, in the end, may prove to be computer navigation’s greatest advantage over conventional surgery.

4. In TKR surgery if there is significant deformity in the femur above the knee or in the tibia below the knee conventional alignment systems can be difficult or impossible to use. This is due to the fact that intramedullary systems require an unobstructed femoral and tibial canal. Similarly if as a result of previous surgery any hardware is present such as plates, screws or rods in the bone blocking the femoral or tibial canal, conventional alignment systems often cannot be utilized. With computer navigation systems deformity and /or the presence of hardware provides no obstacle since access to the intramedullary canal is not a requirement. Thus, patients

with bony deformity or hardware above or below the knee are ideal candidates for utilizing computer navigation guidance systems.
5. Studies have shown that computer navigation eliminates alignment “outliers”. Experienced surgeons using conventional alignment systems can accurately align the knee replacement in over 90 – 95% of cases. However, studies show that in as much as 5 to 10% of surgeries, postoperative knee alignment will be less than ideal. These patients in this 5 to 10% group are considered “outliers”. It is felt that computer navigation’s accuracy can help the surgeon shrink this percentage of postoperative alignment outliers.

The first navigation systems for total knee arthroplasty aimed to control the alignment and thickness of the proximal tibial and distal femoral bone cuts, so as to obtain correct limb alignment. Today, several other parameters have been incorporated by different systems, such as the size and rotational alignment of the components, the ligament balance, equalization of the flexion and extension spaces, and alignment of the extensor apparatus.

The navigation system used for total knee arthroplasty is therefore a precision instrument for carrying out the operation, and it also has the potential for aiding the surgeon making intraoperative decisions, through the resource of simulating actions before implementing them. It has also been shown to be a good teaching tool, given that the effect of each action performed during the operation can be seen immediately. This does not mean that the navigator does away with the need for the

surgeon’s skills or diminishes the value of his experience, since the navigator does not point out the path to follow or make the surgeon’s decisions for him, but only helps him to obtain and measure the result planned for each action. Thus, on the contrary, the navigator adds power to the surgeon’s knowledge and experience through providing him with precise and objective parameters in real time during the operation.

Conditions that impose difficulty in using conventional anatomical reference points for positioning cutting guides, such as the presence of synthesis material obstructing the access to the medullary canal, and/or conditions that imply that the ligament balance is more complex, such as in cases of major deformity inside or outside the joint or in patients with previous surgery such as osteotomy, make the use of the navigator more significant. Under such conditions, the discernment capacity of the navigator remains unaffected, and the system continues to supply precise parameters to the surgeon. Likewise, another situation in which navigation has great potential for application is in minimally invasive arthroplasty, in which the reduced direct viewing of the surgical field can be compensated by the virtual reference provided by the navigator.

Navigation is a way of performing a surgery with the help of computers which may help us in achieving more precision and this would enable a better outcome. Without the help of these systems it makes me stop and then ask why? Intraoperatively and not when I see the post operative X ray coz it shows cumulative mistakes which may go unnotices with non navigation. It also improves motor skills as it gives a feedback and gives trainees added security.