Navigation in TKR: clinical experience

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Introduction

Computer assisted surgery has been introduced especially to improve implant alignment and to reduce the number of outliers in total knee arthroplasty surgery. The Coxa Hospital has been exploring two different navigation systems for their usability.

A number of studies have demonstrated that the total knee arthroplasty implanted with computer-assisted navigation surgery leads to a more accurate component alignment compared to conventional methods (1–3). Preoperative radiographic measurements have their inherent limitations whereas navigation has shown to produce consistent alignment results. However, a recent multivariated model study demonstrated that this might be a wrong target (4) as out of 399 primary knees (operated on by one surgeon), better survival was unexpectedly shown for those 106 knees deviating more than 3 degrees from the mechanical axis after 14 years. The utility of navigation in determining the component rotation and soft tissue balancing has yet to be determined as current navigation systems do not provide exact tool for this.

Even after a learning period, a navigation assisted operation is a more time consuming procedure. It has been postulated that the benefits would appear especially in minimally invasive knee surgery though one of the most recent studies could not verify that (5).

Personal experience

The two navigation systems used in Coxa differ in that one uses active emitting infrared trackers whereas the other system is so called ”passive” which relies on reflective pointer balls sending the infrared beams back to the detector camera. In general, both systems have had several software updates which on their part have increased their speed and reliability.

Placing the mobile system so that the surgeon is able to see the monitor and/or the camera can see the anchoring pins with the trackers or reflecting balls is the first part of the learning curve. This has been a constant source of frustration even after several operations and the correct positioning of the assistant surgeon often coincides in the way of the infrared beams. With the new operating theather with a roof mounted camera, we are looking forward to avoiding this specific problem (Figure1). The passive navigation system has had the problem of malfunctioning whenever the reflective balls get blood stained or have other impurities affecting their function.

Figure 1.

The second part of the learning curve is placing the achoring pins so that they do not hinder positioning of resection jigs. The resection guides seem to be under development and not universally usable in real operation situation, which has resulted in mixed practise of using conventional cutting guides with navigation instruments.

Computer assisted surgery definitely has certain positive aspects which make it a very attractive tool when performing knee arthroplasties. The medullary canal is left intact thus possibly leading to reduced total amount of blood loss and theoretically reducing the possibility of a fat embolus linked to the use of an intramedullary guiding rod. Likewise, in cases where the distal femur is deformed due to miscellaneous reasons or the intramedullary canal is filled with a long revision hip stem, navigated instrumentation makes the operation a lot easier. Verification of the cutting surfaces increases reliability of correct alignment of components and enables the surgeon to make due corrections if needed. In teaching of junior residents this gives immediate feedback of how a minor misdirection of the saw blade can cause a distinct deviation from the optimal alignment. In knee demiarthroplasty, the possibility of virtual motion analysis and stress distribution between the components if planned implantation positions are used (Preservation), is a true benefit which surely affects to the function of the implant. Anchoring pin track infection and fracture are possible complications, which we have encountered once each. Subsequent periprosthetic infection or a complicated and treatment resistant osteomyelitic local infection are a real threat in those cases.

Conclusion

After an enthusiastic start, the number of navigation assisted operations has declined at Coxa Hospital even though the benefits are eminent in special cases like with a deformed femur. However, the computer directed surgery has good prospects with improved technology to become the routine way in conducting total knee arthroplasties. The most wanted additions to its armament would include a reliable way of defining epicondylar axis and a technology assisting in soft tissue balacing.

As the computer assisted operation system is not fool proof but may give quite exceptional value, it is not for the beginners but is an excellent interactive teaching tool for the junior surgeons.

One of the most attractive features in navigation is that it converts inexact descriptive estimation of deformity or component position into numeric values both preoperatively and postoperatively. It is most convincing to be able to state exactly what for instance is postoperatively the flexion of the femoral component or the posterior slope of the tibial tray. This data may have value in cases of postoperative complications when description of the numeric values could be most demonstrative.

The best way to start computer assisted operations is to play in advance with the software before the actual operation so that one can easily move between the screens if needed, to select enough time for the first operations and to select less demanding cases in the start.

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