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Which is The Best Surgical Approach for Primary Total Knee Arthroplasty ? - A Review

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Introduction

Total knee arthroplasty (TKA) has revolutionized the care of patients with advanced knee arthritis [1–3] and it is one of the most successful procedures in the orthopedic community today, with reported long-term survivorship rates exceeding 95% at more than 10-year follow-up [4–6]. According to a survey, the numbers of joint replacement surgeries in India are increasing every year with the estimates for knee arthroplasty numbers in India to be around 2,00,000 in 2020.[7]

Despite substantial advances in primary TKA patient selection, surgical technique, and implant design, numerous studies indicate only 82% to 89% of patients were satisfied with their primary total knee arthroplasty[1,8–12]. The surgical approach has not traditionally been included among factors that affect outcome after surgery. Midline approach to the knee with medial parapatellar arthrotomy has varied little from what was originally performed by Insall in 1971 in which he described an 8-cm quadriceps muscle split, eversion of the patella, and a dislocation of the tibiofemoral joint.[13] This technique has been most commonly used because it provides excellent exposure and allows for visual confirmation of accurate component placement.

However the disruption of the quadriceps tendon as well as the medial intraosseous and extra-osseous blood supply to the patella and higher incidence of lateral release has been disadvantages of medial parapatellar approach (MPP), resulting in inferior functional outcomes and delayed recovery.[14–18] Therefore, other alternative approaches were searched. Subvastus approach (SVA) was introduced by Hofmann et al in 1991[19] and has become popular in some parts of the world because of improved early functional recovery.[20,21]

The subvastus approach, even if developed to avoid these drawbacks, involves stripping the vastus medialis muscle from distal attachment on the femur before dislocating the patella laterally. The theoretical advantages of this approach are: 1) preservation of an intact quadriceps mechanism[19,22]; 2) better postoperative quadriceps control and strength; 3) decreased postoperative pain; 4) decreased quadriceps scarring; 5) preservation of patellar vascularity; 6) improved patellar tracking and stability; 7) diminished need for lateral release; 8) decreased blood loss; 9) quicker rehabilitation; and 10) shorter hospital stays[22,23]. Potential disadvantages compared with the standard median parapatellar approach include: 1) reduced overall exposure to the joint with an increased incidence of implant malpositioning; 2) increased risk of damaging the neurovascular structures; 3) subvastus hematoma; 4) damage related to over-stretching and ischemia that may occur within the vastus medialis[22–24]. Moreover, some authors report better early post-operative rehabilitation.

To overcome these drawbacks, Engh et al.[22] described midvastus approach (MVA) that disrupts less of the extensor mechanism as compared to the MPP approach with improved exposure to the joint compared to SVA. However, potential damage to neural and vascular structures due to the vastus medialis incision cannot be excluded.

Minimally invasive surgery in TKA was originally described as an exposure that used less than a 14-cm incision,[25] although it is now often described as technique that reduce overall soft tissue disruption and muscle damage during exposure. Multiple approaches have been described, but the objectives remain the same of limiting trauma to the knee extensor mechanism, reducing stress on the patella tendon, and eliminating the need for patella eversion.

The minimally invasive surgical approach (MIS) being used as either: (1) quadriceps muscle sparing, (2) mini-midvastus (MMV), (3) mini-subvastus (MSV), (4) mini-medial parapatellar (MMPP), or (5) minimally invasive lateral. The MMPP approach is consists of a smaller medial parapatellar incision, but also extended superiorly into the quadriceps muscles by up to 3 cm.[26] The MMV approach is similar to minimally invasive medial parapatellar incision, but the opening also extended 1.5 to 3 cm into the vastus medialis oblique muscle, parallel to the direction of the muscle fibers.[27] The MSV approach is a similar approach to the MMV, however, the incision was extended following the inferior border of the vastus medialis oblique muscle, instead of directly through the muscle belly.[28] Proponents of each approach claim to be the best. Hence review of the subject is necessary to decide regarding which is the best approach for the primary total knee arthroplasty.

The purpose of the study is to review the four approaches namely MPP, MVA, SVA, MIS and decide the best approach for primary total knee replacement.

Discussion

Von Langenbeck in 1878[29] originally described dissection of the vastus medialis from the quadriceps tendon with distal extension through the medial patellar retinaculum and along the patellar ligament. Insall in 1971[13] modified the split patella approach, as described by Sir Robert Jones, because of damage to the patellar articular surface. The extensor mechanism is exposed through a midline skin incision, the quadriceps tendon is divided 8 to 10 cm above the patella, and the incision is continued distally in a straight line over the patella and

along the medial border of the patellar tendon. Hofmann et al in 1991 described the subvastus approach[19], which allows direct access to the anterior knee joint, has been heralded as being more anatomic than the medial parapatellar arthrotomy. Proponents of the approach claim that it is extensile compared to medial parapatellar approach. It obviates quadriceps related problems as quadriceps are spared Engh et al. in 1997 described the midvastus muscle-splitting approach[22], which is performed through a standard anterior midline skin incision. The incision is carried down through subcutaneous tissue and deep fascia to expose the quadriceps musculature. The vastus medialis is identified, along with split full thickness, parallel to its muscle fibers. The quadriceps tendon is not incised. The incision is extended to the superior medial corner of the patella and then is continued distally along the medial patella and the patellar tendon to the level of the tibial tubercle.

The mini-midvastus technique results were equal to the standard from the beginning of the reports. Hass and Laskin were able to perfect the technique with minor instrument modifications and modified patient selection[30,31]. The mini-subvastus approach has had mixed reports in the literature. The developers were able to use the original, standard arthrotomy incision with adequate exposure[19]. However, with the introduction of the smaller incision the technique was more difficult and Boerger et al[32] found that the surgical time was greatly increased. Pagnano felt that the technique could be applied to all cases without compromise at al[33]. Most authors advocated the technique for less obese patients with a good range of motion for the involved knee.

The mini medial parapatellar technique is the simplest of the surgeries. The length of the incision into the quadriceps tendon is important and Tanavalee reported improved results that were similar to the quadriceps sparing technique if the quad incision was limited to only 2 cm[34]. MIS approaches are gaining popularity considering instruments in common practice are MIS instruments only.

Conclusions

Medial parapatellar approach is most commonly used approach in practice of total knee arthroplasty, though quadriceps related problems are main source of complications post total knee arthroplasty. Midvastus approach is used selectively. It is not so popular in practice. Subvastus approach is other approach after medial parapatellar approach, popular in practice. Proponents of the approach claim that it is extensile compared to medial parapatellar approach. It obviates quadriceps related problems as quadriceps are spared. MIS approaches are gaining popularity considering instruments in common practice are MIS instruments only.

Though all four approaches have pros and cons, subvastus approach is promising in expert hands and more training is needed to popularize the approach in arthroplasty surgeons. Moreover further long term studies with large sample sizes are needed for better understanding the approaches of total knee arthroplasty.

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