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Review Article

Minimally invasive total hip arthroplasty

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A B S T R A C T

Total hip arthroplasty through a reduced wound has been popularized in the past decade. Supporters advocate that the minimally invasive approach can have better functional recovery by decreasing tissue trauma as compared with the conventional approach. Accumulated data published recently, however, demonstrated no additional benefits and possible more complications associated with the minimally invasive techniques as compared with conventional approach.

No matter how controversy remains about the clinical outcomes and benefits of minimally invasive total hip arthroplasty, surgeons nowadays adopt some forms of the minimally invasive approach into their practice and patient care. The advocate of minimally invasive technique has revolutionized the perspectives of patient care in joint replacement surgery. The perception of a successful joint replacement has also shifted from surgeons to patients. An excellent result is no longer excellent radiographic measurements and functional scores. Patient's satisfaction is now prioritized by holistic implementation of multidisciplinary collaborations. Orthopedic surgeons should take the full responsibility and master their most familiar and comfortable technique of minimally invasive approach, in the best interests of the patients, to provide long-lasting clinical outcomes and minimize trauma to the patients.

1. Introduction

For many years, laparoscopic surgeries have been adopted as one of the standard procedures in general surgery by reducing wound sizes and surgical trauma. In the mean time, total hip arthroplasty (THA) through a reduced wound has also been performed in patients on a selective base by many orthopedic surgeons. However in the past decade, the issue about minimally invasive THA (MIS-THA) has provoked great attention and controversy among the society and the publicity. Supporters advocate that the MIS approach can have better functional recovery by decreasing tissue trauma as compared with the conventional approach.[1–7] However, the complications might also be increased because of the limited surgical field visualization and the technical difficulties.[8–11] Furthermore, the benefits of the MIS approach still need to be justified by the underlying risks.[4] The purpose of this mini review is to appraise the currently published evidence on the efficacy and risks of MIS-THA.

2. Definition and types of MIS-THA

It is generally agreed on that an incision less than 10 cm can be defined as MIS-THA. To date, the MIS-THA can be divided into two categories.[1] One minimizes the wound and muscle cutting and emphasizes the tissue repair through either a transgluteal or a posterior route.[6,12,13] The other spares muscle sectioning during the procedure through one,[14,15] two,[1–3] or multiple[5] incisions. The first abridges the incision length and can be extensile when difficulties are encountered during surgery. The second uses muscular intervals for implantation and could be complicated if difficulties happened. In the literature, the complication rates are significantly higher in inexperienced, low-volume surgeons in the “learning curve” period for the muscle sparing technique.[16]

3. Abridged incision MIS-THA

The transgluteal approach to the hip joint is also known as the direct lateral approach that incises the musculotendinous portion of gluteus medius and minimus to facilitate anterior dislocation of the hip joint. Care should be taken not to overstretch the muscle fibers to avoid damage to the superior gluteal nerve. Few reports exist in the literature discussing the surgical techniques and clinical outcomes. By using matched cases, historical controls, or prospectively blinded

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cases, this abridged incision transgluteal approach was reported to be a reliable and safe procedure.[4,17–19]

The posterior MIS-THA incises the short external rotators with posterior dislocation of the hip. By preserving the piriformis tendon, the quadratus femoris tendon, and emphasizing on the repair of short external rotators and posterior capsule, this approach is a reliable and safe procedure and the dislocation rates are significantly decreased.[12,13]

Because the only difference between the abridged incision techniques and the conventional techniques is the incision length and most surgeons are confident and familiar with the surgical anatomy of these approaches, these abridged incision techniques are now more popular and acceptable to the orthopedic surgeons.

4. Muscle-sparing MIS-THA

The muscle-sparing MIS-THA uses tissue intervals and avoids muscle sectioning for prosthesis implantation. Single-incision or multi-incision muscle-sparing MIS techniques have been described in the literatures.

In the single-incision techniques, patients are either placed in the lateral or supine position. By using the mini Watson-Jones approach, both acetabular cup and femoral stem can be implanted in a single incision with the patients in the lateral position.[14,15] With the patients in the supine position, most single-incision techniques use the Smith-Peterson interval and can be facilitated by using a fracture table or by lowering the leg to hyperextend the hips.[20,21]

In the multi-incision techniques, the acetabular cup and femoral stem are separately implanted through two or three incisions depending on the musculatures and sizes of the patients. Patients can also be placed in supine or lateral position. Intraoperative fluoroscopy is usually advised because direct visualization of the femoral stem implantation is more difficult and the procedure is very similar to the closed femoral intramedullary nailing technique.[2,3,5] However, by modifying the direction of the skin incisions and position of the patients, the procedure could be done without intraoperative fluoroscopy because direct visualization of the proximal femur is possible.[1]

The muscle-sparing techniques are less popular than the abridged incision or conventional techniques. The techniques are challenging because the surgical anatomy and surgical landmarks are less apprehensible among most surgeons and their surgical team members as well. Special instruments, operation table, or additional training are highly demanded to facilitate and to safeguard the procedures.

5. Clinical results of the MIS-THA

The growing popularity of MIS-THA has led to some controversies regarding to the safety and outcomes for the “new technologies.” Unfortunately, because of the inadequate follow-up length and few good quality randomized control studies, the literature appears to be inconclusive for the MIS-THA to date.

The randomized control trials about the MIS-THA using the posterior approach were compared with the standard approach by different groups of surgeons. Ogonda et al[22] found that the MIS-THA using mini-posterior approach was safe and reliable but provided no extra benefit as compared with the standard posterior approach.[23] Kim[24] reported on 60 simultaneous bilateral hip arthroplasties in 30 patients, with each patients serving as his or her own control. The only difference between the MIS technique and the standard technique was less blood loss in the MIS group. As a contrast, Dorr et al[25,26] found that the MIS-THA using the posterior approach had shortened hospital stays, earlier mobility, less pain, and higher satisfaction in the early postoperative period.

Clinical results of muscle-sparing MIS-THA are controversially reported. By using the two- or three-incision techniques, rapid functional recovery and high satisfaction were found in patients treated by experienced surgeons.[1–3,5] However, different results were reported by different groups of surgeons. Pagnano et al[27] reported that the muscle-sparing two-incision technique had only modest outcomes but with higher complications and evidences of more muscle damage that were found in cadaver studies.[28] We had modified the two-incision technique and reported that the muscular recovery of the hip flexors was earlier in the postoperative period than the hip extensors.[29] When compared with standard transgluteal approach, the modified two-incision technique had comparable hospital courses and operative results.[30] Duwelius et al[31] had compared the two-incision technique with the posterior MIS technique by using historical match-pair control cases and found that the mini-posterior technique had less blood loss and shorter operation time and the two-incision technique had better functional recovery and shorter hospital stays.

There are fewer clinical results of the single-incision muscle-sparing MIS-THA available in the literature except those from the technique developers.[14,15,20] Laffosse et al[21] had compared the modified Watson-Jones technique with the posterior MIS-THA and reported comparable and reliable surgical results by using either technique in regards to the implant positioning.We had used the modified Watson-Jones MIS-THA in more than 300 cases and had perceived similar clinical outcomes as compared with other MIS techniques. However, it is usually recommended that special surgical tools, operative table, or implant design are often needed to facilitate the procedure.[14,15,20,21]

6. Navigation and MIS-THA

Visualization of the surgical field is often limited in the MIS-THA. It is especially true for the muscle-sparing multi-incision techniques. To overcome the difficulty, intraoperative fluoroscopy is generally recommended to provide real-time verification of the surgical results. Fluoroscopy can be combined with navigation system to verify the size and position of the implants intraoperatively. It has been acknowledged that by using CT-based or imageless navigation, the cup positioning could be improved by reducing the outliers either by conventional or MIS techniques.[32,33] We had successfully adopted the navigation system to the two-incision MIS-THA and found the imageless navigation system could be a reliable tool for cup placement as compared with intraoperative fluoroscopy.[34] However, the navigation technology for stem implantation is still not well established. So, intraoperative fluoroscopy is still recommended especially for the muscle-sparing MIS-THA.

7. Safety and complications of MIS-THA

It is prudent to assume that the complication rates would be higher in MIS-THA when compared with the conventional THA and it would be even higher if they were done by muscle-sparing techniques. The enthusiasm for MIS-THA has rapidly declined recently because serious complications have alarmed surgeons not to embrace an immature technique in the learning curve period.[8,9,27,28] The MIS-THAs, especially the multi-incision techniques, are considered as unsafe techniques with no proven benefits in clinical recovery or muscle damages.[22,28] The adverse events associated with the two-incision MIS-THA included higher complication rates of proximal femoral fractures (2.8%) and partial temporary injures to the lateral femoral cutaneous nerve in the so called “learning curve.”[16]