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Hip Replacement in Patients with Ankylosing Spondylitis

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Abstract

Hip involvement in Ankylosing spondylitis (AS) patients with preexisting spinal deformity further compromises their posture and limits their mobility. Although medical management has improved the outcome and may have reduced the need for surgery, orthopedic surgery and in particular Total Hip Arthroplasty (THA) is often required to manage pain and restore function and mobility.

THA remains the most effective treatment strategy to relieve pain and improve ambulatory status in these patients. However many important considerations regarding preoperative evaluation and surgical technique must be taken into account in order to improve the results of THA in this subgroup of patients.

Keywords Hip; Ankylosing spondylitis; Total hip arthroplasty

Introduction

Ankylosing spondylitis (AS) is a chronic inflammatory disease of unknown etiology which primarily affects the sacroiliac joints, spine, hips and, less commonly, the knee joints [1,2].

The prevalence of AS is generally believed to be between 0.1% and 1.4% globally; however there are geographic variations. AS is more common within Europe and Asia and much less common in Latin America and Africa. The prevalence typically reflects the associated prevalence of the HLA B27 gene in that population [3]. AS typically affects young adults, most commonly males (M:F = 3:1) in their second through fourth decades [4].

Hip involvement occur in 30–50% of patients with AS, and 90% patients among those with the affected hips have bilateral involvement [4]. In a more recent cross-sectional database study from Belgium, Spain and South America, hip involvement was present in 24–36% of patients with AS. It is deemed that the younger the age at the onset, the greater is the likelihood of hip involvement. Male, axial disease and enthesitis are also regarded as risk factors of hip involvement and the need for total hip arthroplasty (THA) in AS [5].

Hip joint involvement in AS often results in severe deformities and in combination with a stiff spine, leads to further deterioration in function. For patients with fixed kyphotic spinal deformities, hip involvement, and the subsequent development of flexion contractures limits their ability to walk and further compromises their posture leading to severe functional impairment in approximately 30% of patients [4].

Orthopaedic management primarily involves correction of hip deformity through THA and, less frequently, correction of spinal deformity with spine osteotomy.

Although a trend towards reduced need for hip replacement surgery has been shown since the introduction of TNF- α inhibitors, AS patients with end stage arthritis often require total hip replacement (THA) [6].

The aims of THA are pain relief, eradication of flexion contractures, increased range of motion of the hip joint, improved mobility, and correction of posture. However many important considerations regarding preoperative evaluation and surgical technique must be taken into account in order to improve the results of THA in AS patients.

Preoperative Considerations

Meticulous preoperative planning of the surgical procedure is essential and there are technical considerations for both anesthetists and surgeons.

Anesthetist's perspective

Problems anticipated from an anesthetist's point of view relate to management of the upper airway, presence of pulmonary restriction, cardiac involvement and access to the neuroaxis [7,8].

A rigid and flexed cervical spine along with limited mouth opening due to involvement of the temporomandibular joints makes intubation difficult [7]. Fibreoptic intubation is generally preferred.

Due to the high frequency of thoracic restriction, pulmonary function testing is advised before surgery. Respiratory insufficiency and the limitation of chest expansion increase the incidence of pulmonary complications such as atelectasis and pneumonia in the postoperative period and ICU backup may be required. In view of the potential conduction defects, preoperative ECG is necessary, while an echocardiogram is also required to evaluate the severity of valvular disease caused by AS [2,7,8].

Radiographs of the lumbar spine may be useful to evaluate the possibility of spinal anesthesia. However, lumbar spine disease associated with ossified ligaments may make spinal or epidural anesthesia technically difficult [8].

Surgeon's perspective

Presenting complaints of the patient should be carefully evaluated. Pains in the hip and reduced mobility are the disabling features, however in developing countries patients not uncommonly present with stiffness due to ankylosed hips. Patient's age, activity levels and expectations from surgery are important considerations while planning hip replacement surgery. A thorough physical examination should be carried out to evaluate and document spinal involvement, pelvic obliquity, and limb length discrepancy, status of the contralateral hip, bilateral knees and integrity of the sciatic nerve.

Radiographs of the entire spine should be examined to rule out presence of pseudarthrosis or Anderson lesion [9]. In case of pseudarthrosis or severe spinal involvement, a spinal consultation should be sought.

A preoperative standing lateral view of the pelvis should be obtained so as to prevent a positioning error of the acetabular component [10]. Preoperative templating is of paramount importance to have an estimate of the component size and position of the acetabular cup.

Perioperative management of medications used in the treatment of AS patients is an important issue. Prospective data on perioperative infection risk have not shown an increased risk with methotrexate, and it is generally not withheld in the perioperative period. The risk of infection with anti-TNF agents is however well recognized, and it is therefore recommended to stop these drugs before elective orthopaedic surgery [2,11].

Order of Surgery Spine/Hip

Controversy exists regarding the order in which spine surgery and hip arthroplasty are to be performed in patients with severe spine and hip involvement. While some authors state that correction of deformities of the hips is carried out before considering corrective spinal osteotomy [12-14], others take the opposite view [15].

Recommendations for performing THA before spinal osteotomy are based on the reasoning that improvement in hip ROM and pain relief may obviate the need for spinal osteotomy or give a more accurate assessment of residual spinal deformity in patients with severe hip flexion deformity [12]. However, based on the findings of a recent study involving 28 consecutive patients with AS who underwent both spinal osteotomy and THR, Zheng et al. [15] recommend that a spinal osteotomy be performed before THR for two reasons. Firstly, AS patients with a severe kyphotic deformity have the potential risk of anterior dislocation of the prosthesis, as pelvic hyperextension to compensate for a kypkotic spine brings the cup to a more open position with an exaggerated anteversion. Secondly, hyperextension of immobile spine during THR could lead to intra-operative thoracic vertebral body extension fractures with resultant acute traumatic paraplegia [9,16].

Technical Considerations

THA in AS patients can be technically demanding, especially in patients with an ankylosed hip. Problems relate to positioning of the patient, femoral neck cut, original joint line identification, acetabular component positioning, and adequate release of soft tissues.

In case of bilateral hip involvement, the opposite hip may hinder positioning of the pelvis. The operating surgeon should be present at the time of positioning the patient in order to acquaint him with the deformities in the pelvis and the spine, in order to ensure optimum component positioning.

In patients with a preoperative external rotation deformity, there may be difficulty in visualizing the femoral neck through the posterior approach. Identifying the neck by dissection anterior to the greater trochanter and the abductors, sacrificing 2-3 mm of the posterior acetabular wall or performing the neck osteotomy under image intensifier control with the patient in the supine position are some of the options in such a situation [17].

Identifying the location of the original joint line while reaming the acetabulum could also be difficult. However, foveal soft tissue and incomplete gray ossifying cartilage usually remains at the location of the original joint plane, which can aid in identifying the original joint line. Otherwise, intraoperative radiographs could be helpful in such a situation [18].

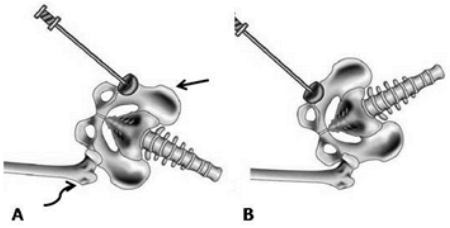

Figure 1 A) The pelvis is tilted cephalad (straight arrow) if the contralateral limb is fixed in an abducted position (curved arrow). Inserting a cup with an inclination of 40 referenced to the ground level creates the possibility of inserting the cup in a more horizontal inclination than desired. B) If the contralateral limb is fixed in adducted position, the opposite happens.

In the presence of pelvic obliquity, accurate positioning of the acetabular component is technically difficult. Malposition of acetabular component often results in anterior dislocation [10,17]. According to Tang and Chiu [10] AS patients with a fixed kyphotic spine tend to hyperextend their hips once they stand upright, in an attempt to look forward. If the cup is inserted according to the anatomy of the acetabulum, it becomes abnormal when the patient resumes an upright position. The pelvic hyperextension brings the cup to a more open position with an exaggerated anteversion. In a 3-D CT based study, Tang et al. [19] found that anatomical positioning of the cup in a pelvis with more than 20° of sagittal pelvic malrotation resulted in a cup positioning with an anteversion of more than 30° and an inclination of more than 55°. According to them, for each 10° of sagittal pelvic malrotation above 20°, the cup position should be modified so that it is 5° less inclined and anteverted.

Apart from this, in patients with the contralateral hip fixed in abduction or adduction deformity, there may also be an error in determining the true inclination of the acetabular cup. The pelvis is tilted cephalad if the contralateral limb is fixed in an abducted position. Inserting a cup with an inclination of 40 referenced to the

ground level creates the possibility of inserting the cup with less inclination than desired (Figure 1A). If the contralateral limb is fixed in adducted position, the opposite happens [20] (Figure 1B).

Finally, adequate soft tissue releases are required before trial reduction. Adductor tenotomy, iliopsoas muscle release, and anterior capsulotomy is often required to correct severe contractures. Forcible correction of the flexion contracture without adequate soft tissue release can result in fracture of the stiff spine with dire neurological consequences [9]. In patients with hips stiff in full extension, gluteus maximums contractures are often present and may require release.

Clinical Results

Outcome

The aims of hip replacement surgery in AS are pain relief, increased range of motion of the hip joint, improved mobility, and correction of posture. As these patients are mostly young males, durability of the implants is also an important issue.

Cemented THA [10,13,14, 21-29] (Table 1), Cementless THA [10,17,18,30-32](Table 2) (Figure 2A), and more recently resurfacing arthroplasty (HRA) [31,33-37] (Table 3 and Figure 2B) have been used for the management of hip arthritis in AS with good results.

STUDY(Year)	Hips	Mean Follow Up (years)	Pain Relief (%)	ROM	HO(%)/SHO(%)/ Reankylosis(%)	Survivorship	Revisions (n)
Bisla [14] (1976)	34	4	91	148	62/26/6	-	2
Resnick [21] (1976)	21	3	NS	NS	57/43/29	-	None
Williams [22] (1977)	86	3	NS	NS	55/11/7	-	10
Baldurson [23] (1977)	18	3.8	94	90FL	28/0/None	-	None
Shahnahan [24] (1982)	16	7.4	94	NS	100/36/None	-	1
Finterbrush [25] (1988)	35	7.5	NS	86FL	17/NS/None	-	5
Walker [13] (1991)	29	4.8	97	168	77/23/15	-	None
Gulateri [26] (1992)	73	7.5	89	NS	NS/21/None	-	None
Sochart [27] (1997)	43	23	100	185	14/0/None	92% at 10y; 72%at 20y; 70%at 30y	12
Tang [10] (2000)	46	16.5	94	NS	74/24/None	100% at 5y; 98% at 10y; 66% at 15y	17
Lehtimaki [28] (2001)	76	NS	NS	NS	NS	80% at 10y; 66% at 15y; 62% at 20y	3
Joshi [29] (2002)	181	10	96	NS	12/0/ None	87% at 10y; 81% at15y; 72%at 27y	25

Range of movement expressed as either an arc of flexion (FL) or a total cumulative range (ROM)

HO Heterotropic Ossification; SHO significant HO- Brooker Class 3 and 4

-Survivorship analysis not performed using the Kaplan Meier technique

NS Not specified

Table 1: Review of total hip arthroplasty for ankylosing spondylitis (cemented)

Kilgus et al. [35] and Shih et al. [38] have used both cemented and cementless components. Separate analysis was not performed. They are therefore not included in the tables.

STUDY	Hips	Mean Follow Up (years)	Pain Relief (%)	ROM	HO(%)/ SHO(%)/ Reankylosis	Survivorship	Revisions (n)
Brinker [30] (1996)	20	6	90	187	35/0/None	-	None
Tang and Chiu [10] (2000)	49	6.3	96	NS	74/18/None	95.5% at 10y; 66% at 11 years	2

Bhan#[17] (2008)	92	8.5	62	156	13/1/None	99% at 5y; 86% at 8.5y	13
Li [31] (2009)	41	NS	SI	162	15/0/None	-	None
Baba [32] (2010)	31	12	SI	NS	31/6/None	100% at 10y; 63.5% at 15y	4
Bangjian# [18] (2012)	24	4.2	100	84FL	12/0/None	-	None

Authors reported on ankylosed hips in AS

Range of movement expressed either as an arc of flexion (FL) or a total cumulative range(ROM)

HO Heterotropic Ossification; SHO significant HO- Brooker Class 3 and 4

-Survivorship analysis not performed using the Kaplan Meier technique

NS Not specified

SI significant improvement using pain scores

Table 2 : Review of total hip arthroplasty for ankylosing spondylitis (cementless)

STUDY	Hips	Mean Follow Up (years)	Pain Relief	ROM	HO(%)/SHO(%)/Reankylosis(%)	Revisions (n)
Li [31] (2009)	39	3	SI	202	5.3/0/none	1
Malhotra [33] (2012)	21	3.5	NS	204	6.4/0/none	1

Table 3 : Review of hip resurfacing (HRA) for ankylosing spondylitis

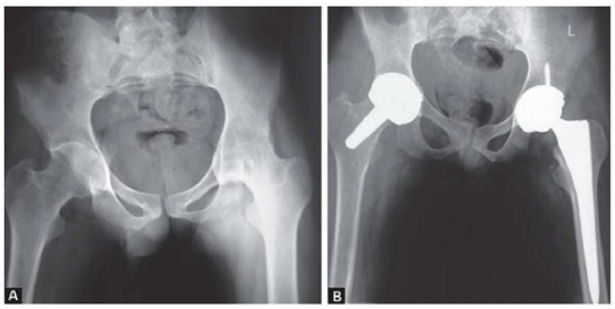

Figure 2: A) Preoperative radiograph of a patient with ankylosing spondylitis. The left hip has bony ankylosis, while the right hip has fibrous ankylosis. B) A Hip resurfacing Arthroplasty [Birminghan mid head resection implantTM (Smith and Nephew)] has been done on the right hip and Cementless THA [R3 cup-Synergy stemTM (Smith and Nephew) implanted in the left hip].

Pain relief after hip replacement in AS has been reported by most authors. A high percentage of patients continue to remain pain free even in the long term. Importantly, patients with bony ankylosis may have severe deformities but do not have pain in their hips at presentation. These patients may however complain of pain after surgery, and should be counseled about the possibility of pain after THR [17].

Several authors originally suggested that the gains in range of motion following total hip arthroplasty for AS would be relatively modest [13,14,21]. This was the result of the presence of joint contractures, grossly restricted movements, and ankylosis prior to surgery. A significant risk of developing heterotopic ossification (HO) or re-ankylosis following surgery was also suggested [34]. However, when the results are analyzed, there appears to be an almost universally significant increase in the range of movement, which is maintained in the long-term thereafter, with few cases of significant HO or re-ankylosis. Higher rates of HO after THA have been reported in AS patients who have undergone repeat operations, who have experienced postoperative infection, and, who were treated with a transtrochanteric approach [35]. These patients should be considered for HO prophylaxis with indomethacin or low-dose radiation [4].

An improvement in ambulatory status following THA has been reported by most authors, even in patients with preoperative ankylosis [7,18]. Walker and Sledge [13] analyzed the results of THA in 19 AS patients, at an average follow up period of 4.5 years. Preoperatively, only 15.7% (3/19) of the patients were able to ambulate without assistive devices; postoperatively, this figure improved to 53% (10/19). After surgery, 42% (8/19) were able to walk unlimited distances, and none remained housebound. Sochart and Porter [27] found the improvement in function to be less consistent because many patients were limited by polyarticular disease. However, 71 per cent of the patients in their series were able to walk long distances without the aid of a cane. Various authors [10,17,30,31,33] have used the Harris hip score (HHS) to evaluate the functional outcome after THA in AS patients. The HHS improved from an average of 27.4 preoperatively to 88.8 postoperatively in the study by Tang [10] from an average of 49.5 before surgery to an average of 82.5 in the study by Bhan et al. [17] and from an average of 48.4 before surgery to an average of 89.1 at a mean follow up of 6 years in the study by Brinker et al. [30].

Survivorship

Long-term survival characteristics of THA in patients with AS has been well documented. The overall survival of primary THAs in AS patients is similar to THA survival in OA patients [36]. Sweeny et al. [37] reported on 276 primary and 64 revisions THA in AS patients. Survival analysis using the Kaplan-Meier estimate revealed a survival probability after 10, 15, and 20 years to be 90%, 79%, and 65% for primary replacement, and 75%, 61%, and 61%, respectively, for

revisions. However, as it was a questionnaire-based study, they could not specify or compare different types of THA (cemented or cementless).

Several authors have reported long-term results of THA using cemented prosthesis [21-29]. Sochart and Porter [27] evaluated 43 Charley low friction arthroplasties at a mean follow up of 23 years. Using revision as the end-point, survivorship of both the original components was 92% at 10 years, 72% at 20 years and 70% at 30 years. Aseptic loosening of the acetabular components was the most common cause of revision.

Lehtimaki et al. [28] analyzed the results of 76 Charnley low-friction arthroplasties with a follow up of between 8 and 28 years. The average age of the patients was 40 years (16-67). Survivorship of both the original components was 80% at 10 years, 66% at 15 years and 62% at 20 years.

Joshi et al. [29] analyzed the results of 181 Charnley low -friction arthroplasties performed on 103 patients, with an average follow-up of 10 years (range : 2–27 years), and an average age of 47 years (17–77 years). Survivorship of both of the original components was 87% at 10 years, 81% at 15 years and 72% at 27 years. Seventeen hips were revised because of mechanical loosening.

Shih et al. [38] reported on the long-term outcome of THA in 46 patients (74 hips) with AS. Both cemented (52 hips) and cementless (22 hips) prostheses were used in their study. According to the Kaplan-Meyer survival curve, 78% of the prostheses were still functioning after 10 years. Fifteen cemented implants (28%) were found to be loose during follow-up, while only one cementless prosthesis (5%) had femoral stem loosening. While they were unable to make any definitive conclusion about the superiority of cementless fixation, the development of good bony in growth on the follow-up radiographs suggested that there may be a more important role of cementless fixation in young patients with AS.

Tang and Chiu [10] analyzed 95 THAs out of which 46 were cemented and the rest were cementless. The probability of survival of cemented prostheses, which were predominantly Charnley prostheses , was 100% at 5 years, 97.7% at 10 years, and 66.5% at 15 years. The survivorship for the uncemented components was 95.5% at both 5 and 10 years. However, it fell sharply at 11 years to only 66%. They could not comment on whether one type of prosthesis was superior to the other because patients with cemented prostheses were significantly younger than patients with cementless prostheses , and therefore the two groups of patients were not comparable.

In a study from our institute, Bhan et al. [17] evaluated 92 cementless arthroplasties in AS patients at a mean follow up of 8.5 years. Kaplan-Meier survivorship analysis with revision as end-point revealed 98.82% survival at 5 years and 85.8% survival at 8.5 years follow-up. Overall, 13 (14%) hips were revised due to aseptic loosening. The average time to revision was 8.5 years (range, 5-12 years). Of these, 2 had revision of acetabular component, 9 had revision of femoral component, and 2 had revision of both the components. In another study from Japan, Baba et al. [32] reported on 31 cementless arthroplasties in AS patients at a mean follow up of 12 years. The 10-year survival rate was 100%, which dropped to 63.5% at 15 years.

A larger prospective, randomized study would be able to give a better conclusion on whether cemented prostheses are more durable than cementless prostheses in AS patients.

Is there a role for hip resurfacing arthroplasty (HRA) in these patients?

Given the young age at presentation, and decreased mobility due to stiff spines, HRA seems like an attractive option in AS patients. Two studies [31,33] reporting the results of HRA in AS patients have shown promising results at short term follow up. Li et al. [31] compared the results of HRA with THA in AS patients. Twenty-three patients were treated with 38 HRA. In the same period, another 41 primary ceramic-on-ceramic THAs were performed in 25 patients with AS. All patients had significant pain relief. The improvements in ROM were significantly better in the HRA group. One revision was required in the HRA group due to femoral neck fracture.

In a study reported from our institute, 21 hips in 15 patients with AS were treated with HRA. One patient required revision at a mean follow up of 43 months due to femoral neck fracture. The increased ROM provided by large-diameter articulations could be particularly beneficial in patients with stiff spines [33]. However, as the use of metal-on-metal bearings has largely fallen out of favor, owing to concerns about reactions to metal debris, we now counsel the patients before offering them resurfacing arthroplasty.

Complications

Apart from an increased propensity towards anterior dislocation [10,17] of the hip and susceptibility to spinal fractures during THA [9,16], other reported complications include sciatic nerve palsy [30,32] and intraoperative fracture at the level of the calcar-femorale [17,18,30,32]. These fractures have been managed successfully with circumferential wiring [17,18,32].

Aseptic loosening remains the main reason for revision surgery in patients with AS [10,17,38]. Active lifestyle and rigid spines in young patients with AS may be risk factors for increased stress on the prostheses; thus resulting in early aseptic loosening [38].

Summary/Conclusion

THA provides long-term pain relief in a large percentage of AS patients. The range of hip movement is significantly increased leading to a marked improvement in their overall walking ability. The percentage of clinically significant HO and re-ankylosis rates is low. Component survivorship is an important issue given the young age of these patients. Good long-term survivorship has been reported with cemented THA. Studies on cementless THA in this subgroup have relatively shorter duration of follow-up and therefore any definite conclusion about their superiority cannot be made. Hip resurfacing has shown promising results, especially in improvements of range of motion and may be a reasonable option for young AS.

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