Dissertation On

CLINICAL AND FUNCTIONAL OUTCOMES IN PATIENTS WITH SPONDYLOARTHROPATHY WHO HAVE UNDERGONE A TOTAL HIP ARTHROPLASTY

Submitted to

THE TAMIL NADU DR. M.G.R. MEDICAL UNIVERSITY CHENNAI.

M.S. BRANCH II ORTHOPAEDIC SURGERY

DEPARTMENT OF ORTHOPAEDIC SURGERY CHRISTIAN MEDICAL COLLEGE

VELLORE – 632004.

MAY 2020

REGISTRATION NUMBER

221712405

CERTIFICATE

This is to certify that the dissertation titled, “Clinical and Functional Outcomes in Patients with Spondyloarthropathy who have Undergone a Total Hip Arthroplasty” is the bonafide work of Dr. Mathew Kiran Jacob, in partial fulfillment of the requirements for the M.S Orthopaedics (final) examinations of The Tamil Nadu Dr. M.G.R medical university to be conducted on May 2020.

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DECLARATION

I hereby declare that this dissertation titled, "Clinical and Functional Outcomes in Patients with Spondyloarthropathy who have Undergone a Total Hip Arthroplasty" was prepared by me in partial fulfillment of the regulations for the award of the degree of M.S Orthopaedics of The Tamil Nadu Dr. M.G.R Medical University, Chennai. This has not formed the basis for the award of any degree to me before and I have not submitted this to any other university previously.

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ACKNOWLEDGMENT

I am deeply indebted to my beloved and kindhearted Professor Dr. Anil Thomas Oommen, Professor of Department of Orthopaedic Surgery, for his invaluable help, guidance, and encouragement in preparing this study.

I wish to thank Dr.Pradeep Punnoose, Professor and Head of Department of Orthopaedic Surgery unit II, Hospital for guiding me to complete this study. I am also very thankful to Dr.V.J Chandy, Assistant Professor of Department of Orthopaedic Surgery, and Dr.John Mathew, Professor of Department of Rheumatology, who has been a constant source of inspiration and encouragement.

I would also like to express my gratitude to Dr. Jayaseelan, Ms. Ambily and Mr. Madhan from the department of Biostatistics for their expert advice and contribution during the entire process. My heartful thanks and appreciation to all my fellow postgraduates for their constant help and encouragement in completing this study.

The constant support and encouragement of my wife deserve special mention. Also, I would like to acknowledge my parents for their constant invaluable love and support.

Last but not least, I express my sincere gratitude to all my patients without whom this study would not have been accomplished.

Thank you, God, for this opportunity and with whose grace this was possible.

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Analysed Document:	Thesis final for Plagiarism.docx (D57539285)
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Significance:	0 %

Sources included in the report:

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0

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LIST OF ABBREVIATIONS

AS	Ankylosing Spondylitis
SSA	Spondyloarthropathy
MHHS	Modified Harris Hip Score
SF-36	Short Form 36
THA	Total Hip Arthroplasty
HLA	Human Leukocyte Antigen
ERAP	Endoplasmic Reticulum Aminopeptidase
TLR-7	Toll-Like Receptor 7
IL	Interleukin
Th	T-Helper
NK	Natural Killer
KIR	Killer Cell Immunoglobulin-like Receptors
TNF	Tumor Necrosis Factor
MRI	Magnetic Resonance Imaging
STIR	Short Tau Inversion Recovery
ESR	Erythrocyte Sedimentation Rate

CRP	C-Reactive Protein
IBD	Irritable Bowel Disease
NSAID	Non-Steroidal Anti-Inflammatory Drugs
DMARDs	Disease-Modifying Anti-Rheumatic Drugs
bDMARDs	Biological Disease-Modifying Anti-Rheumatic Drugs
TNF	Tumor Necrosis Factor
U.S	United States
JAK	Janus Kinase
ASAS	Assessment of Spondyloarthritis International Society
MTX	Methotrexate

ABSTRACT

Objectives

The aim of this study was to assess the improvement in range of movement and function following THA using a modified Hardinge approach in spondyloarthropathy with ankylosed or stiff hips.

Methods

69hips who underwent THA with a modified Hardinge approach in 40patients were evaluated at a mean follow up of **38.33** months (0 to 83 months). Modified Harris hip scores were evaluated preoperatively. Postoperatively, along with MHHS, Short Form 36 scores were calculated at the time of review for the patient's clinical and functional improvement. All 69 hips had a significant decrease in range of movement preoperatively with 27 ankylosed hips having 0 degrees of movement. The improvement in ROM as well as the clinical and functional outcomes were calculated in these patients using the Modified Harris Hip Score (MHHS) and Short Form 36(SF-36) scores in the treatment of stiff hips in order to evaluate the effect of using Mallory modification of Hardinge approach on the quality of life of these patients.

Results:

All 69 hips in 40 patients showed significant improvement in the range of movement. The ROM Score preoperatively was **1.06 ± 1.28(range degrees)**. This includes **27** Ankylosed hips with no ROM. The follow-up ROM Score was **4.54 ± 0.63(range degrees)** at a mean of **38.33** months range. This indicated a significant increase in the ROM in these hips. MHHS improved from **16.85 ± 6.14** preoperatively to **93.35 ± 9.41** postoperatively, which was found to be statistically significant (P value <0.001). SF 36 scores at follow up were : Physical Functioning (PF) **69.63 ± 18.58**, Role limitations due to Physical health (RP) **85.00 ± 33.87**, Bodily Pain (BP) **80.00 ± 19.23**, General health (GH) **63.12 ± 24.22**, Vitality (VT) **71.87 ± 16.63**, Social functioning (SF) **86.25 ± 16.70**, Role limitations due to emotional problems (RE) **94.17 ± 19.81**, and Mental Health (MH) **84.10 ±11.58**, in the eight domains assessed.

Our study suggests that Mallory modification of the Hardinge approach with cementless implants for THA in spondyloarthropathy with stiff hips achieves significant improvement in ROM, harris hip score and quality of life.

Keywords: Ankylosing Spondylitis, Spondyloarthropathy, Harris Hip Score, Hip range of motion, Short Form 36 Score, Total hip arthroplasty, Mallory modification of Hardinge approach, Quality of life.

INTRODUCTION

Ankylosing spondylitis (AS), is a chronic systemic rheumatic disorder, also known as Von Becheterew's disease or Marie – Strumpell disease. Its Etiology is unknown. (1) This spondyloarthropathy has a global prevalence of 1%. (2) Its etiology and pathogenesis have not been fully understood, and its diagnosis is tough. As a result, the management and treatment of AS are often insufficient. (1) It is rare after 45 years and about 15% to 45% of patients show disease onset before 16 years of age. (3) The average age of onset of AS is lower in developing nations. There is a higher male to female ratio of about 2:1 to 3. (4)

Total Hip Arthroplasty in a significant percentage of patients with Ankylosing spondylitis provides long-term pain relief. There is a significant increase in the scope of a hip movement contributing to a marked improvement in their overall walking efficiency.

In this study, we intend to study the functional and Clinical outcome in Ankylosing spondylitis and seronegative spondyloarthropathy patients post-operatively following the Arthroplasty of the hip, performed during the years 2012 to 2017 in our Unit. Functional Outcome assessment of the patients will be done using the Modified Harris Hip Score (MHHS). Each Patient's Health status will be evaluated using SF-36 scores.

AIMS AND OBJECTIVES

Aims:

To measure functional outcomes in patients with Spondyloarthropathy who underwent total hip arthroplasty.

The aim of this research is to review the clinical outcomes of total hip arthroplasty in Ankylosing Spondylitis and SSA patients.

Objectives:

Primary objectives:

- To clinically assess and document the functional and clinical outcomes of patients above the age of 18 years with Spondyloarthropathy who underwent Total Hip Arthroplasty (Unilateral/bilateral), under Orthopaedics unit –II, Since January 2012.
- To correlate the change in range of movements and functional scores at follow-ups.

Secondary objectives:

To document any complications

- Pulmonary Embolism
- Wound Infection
- Dislocations
- Sciatic Nerve Palsy
- Heterotopic Ossification
- Loosening of the implant
- Reankylosis
- Peri-Prosthetic Fractures

REVIEW OF LITERATURE

Historical Perspective

Earlier studies of Egyptian mummies showed that the disease now known as AS has afflicted humankind since antiquity(5). However, historically what may be the foremost description of AS did not appear in the literature until 1559 when an anatomical description of two skeletons with abnormalities typical of AS was provided by Realdo Colombo in his book De Re Anatomica(6). More than 100 years after Colombo's description in 1693, an Irish doctor, Bernard Connor, described an unearthed human skeleton that had a spine with a marked curvature. Moreover, the ilium, sacrum, five lumbar and ten dorsal vertebrae, and three left and five right ribs appeared to be fused at "the joinings," resulting in one continuous bone. Connor subsequently described the possible consequences of spinal curvature on movement and respiration during the patient's lifetime(7–9).

Between 1691 and the first half of the nineteenth century, there were very limited reports or clinical descriptions of spondyloarthritis (SpA) or AS. Clinical descriptions of AS became more frequent during the latter half of the nineteenth century. Sir Benjamin Brodie published a book, Diseases of the Joints (1850), in which he described the association between iritis, a complication of AS, and AS. A. Strumpell of Leipzig, Germany, Vladimir Bechterew of St. Petersburg, Russia, and Pierre Marie

of Paris, France, all neurologists, wrote three of the most detailed clinical descriptions of AS. The contributions of these three individuals were so significant that at one point, AS was known as Morbus Strumpell-Marie-Bechterew (10).

Most if not all of the early descriptions of the disease, of course, were made from autopsy studies. Technological innovations beginning in the late nineteenth century and continuing through the twentieth century allow for a more precise examination of the human body during life and thus provide physicians with additional data with which to make a diagnosis of AS. One of the most noteworthy contributions was made by Wilhelm Roentgen, who discovered the X-ray, a diagnostic technique that enables physicians to take a picture of the spine and to observe changes in the spine as the disease progresses during a patient's lifetime. Another important diagnostic tool available to physicians is magnetic resonance imaging (MRI). MRI provides a detailed view of the internal structure of the body and shows the contrast between different soft tissues in the body based on how these tissues line up in a magnetic field. An MRI can reveal inflammation of internal body structures, and this evidence of inflammation helps us make an earlier diagnosis of AS(10).

Genetics

Over 90% of the risk for the development of AS, which is considered as an inherited disease relies on genes(11). The HLA-B27 allele, however, accounts for only 20% of the genetic effect(12). Other alleles are thought to play an important role in AS, especially HLA-B, like HLA-B*13:02, HLA-B*40:01, HLA-B*47, and HLA-B*51 are few examples(13). Over the past few years the most significant discovery has been the interaction of HLA- B alleles and the protein endoplasmic reticulum aminopeptidase 1, ERAP1, which demonstrated a higher risk of developing AS. The main variant of the ERAP1 gene (rs30187, K528R), has found to interact only with the HLA-B27 allele and in HLA-B27 negative patients, ERAP1 interacts with HLA-B40 allele(14). Even though the mechanism of how the increased risk remains unclear, it's understood that the radiographic severity of the disease is not related to the presence of this gene(15).

One of the recent studies reported that a lower copy number of the TLR7 gene was a marker for susceptibility in Males and behaves as a protective factor in women towards AS(16). Genetic Polymorphisms of IL-12B (rs6871626) and IL-6R (rs4129267) were found to be associated with increased risk of AS independently of gender and it could also function as biomarkers for diagnosis and prognosis(17).

T- Helper 17/23 (Th17/23) axis and its multiple genetic polymorphisms are involved not only in AS but also in inflammatory bowel disease (IBD) and psoriasis. Genome-wide association studies have supported the hypothesis that there is a common underlying pathogenic mechanism and the development of these diseases can be implicated on to the microbiome(18).

Pathogenesis

As mentioned earlier, it is unclear how HLA-B27 initiates AS or the Spondyloarthropathy. Many of the early hypothesis is still being investigated. The original Hypothesis which was called the 'arthritogenic peptide theory', which suggested that cell-mediated immune reaction leading to AS due to presentation of bacterial peptides either by HLA-B27 or by self-mimicking HLA-B27 binding peptides from certain bacteria. (19)

The second hypothesis is the 'unfolded protein response'. According to this hypothesis, HLA-B27 misfold and gets accumulated in the endoplasmic reticulum, which triggers a stress response that results in the release of IL-23(20,21). However, these two hypotheses have been questioned in a study by Schittenhelm et al(22), as the absolute binding preferences of HLA-B27 allotypes are not sufficient to explain the association of the disease.

The third hypothesis was based on the 'HLA-B27 homodimer model'(23). According to this hypothesis, HLA-B27 homodimers have an abnormal reaction with CD4 T cells and natural killer (NK) cells. IL-17 is released when a homodimeric form of HLA-B27 binds with certain killer cell immunoglobulin-like receptors (KIRs), which are expressed on T cells and NK cells(24–26). In the study by Ridley et al. (27), it was proven that CD41 T cells upregulate the expression of KIR-3DL2 on the surface of cell and T cell Survival and Th17 cell differentiation is potentiated thorough the binding of this receptor to HLA-B27. Th17 cells produce IL-17(28). IL-17 is a cytokine that can increase T-cell priming and stimulate immune cells such as fibroblasts and macrophages, which promotes the release of TNF-α, IL-6 and other chemokines(29).

Diagnosis of AS

AS is the most severe subtype of spondyloarthropathy. Its main clinical manifestations are inflammatory back pain (IBP), inflammation in other parts of the body or the axial skeleton, anterior uveitis, enthesitis, as well as peripheral arthritis. (30)

It’s been found that there is a delay in diagnosis between five to ten years due to the fact that there are no diagnostic criteria, making early diagnosis difficult, leading to unnecessary diagnostic and therapeutic procedures as well as increased morbidity (30,31).

The onset of the disease is usually insidious with the onset of low backache associated with a stiffness that is worse late at night and in the morning hour or after a long duration of rest. The stiffness is alleviated activity. The pain is usually a dull aching pain that cannot be well localized and is present in the gluteal area initially on one side and which later progresses to both sides. The pain then progresses on to the lumbar spine.

According to literature chronic inflammatory back pain as having at least four of the following features(32):

1. Back pain starting insidiously before the age of 45 years, of at least 3 months duration.
2. Worsening with inactivity.
3. Improves with activity.
4. Associated with spinal morning stiffness.

Aortic insufficiency and cardiac conduction disturbances or heart blocks are other uncommon extraskeletal features of AS. Aortitis of the aortic root leads to fibrosis. Some patients develop aortic insufficiency after aortic root dilation and may become hemodynamically unstable. Varying degrees of heart block is seen there is an inflammatory involvement of the atrioventricular conducting system(33).

1-2% of patients present with slowly progressing bilateral apical pulmonary fibrobullous or cavitatory disease(34). Patients with AS are more predisposed to developing coronary artery disease due to systemic inflammation(35).

European Spondyloarthropathy Study Group in 1991, brought about the first standardized classification criteria(36). The classification criteria for SpA were seen as the presence of inflammatory back pain (IBP) or asymmetric synovitis, along with one of the following:

1. Positive family history of SpA or related disease
2. Inflammatory bowel disease (IBD)
3. Psoriasis
4. Enthesopathy
5. Alternating pain in the buttocks
6. Preceding infection in the urogenital or enteral tract(30,36)

In 2009, Assessment of Spondyloarthritis International Society (ASAS), also published a statement which was written with the objective of validating and refining the classification/diagnostic criteria of axial SpA(31,37,38). The brief criteria from this publication, which can be seen in Figure 1, have a sensitivity of 82.9% and a specificity of 84.4%(31,38).

Earlier criteria include the Rome criteria (published in 1963 and revised in 1968)(39), and modifications made to this in New York (1984)(39), which have been studied for some shortcomings, including the inability to establish an early diagnosis of AS(31,40).

Figure 1 (41)

Classification criteria for axial spondyloarthritis defined by the Assessment of SpondyloArthritis International Society, to be used for patients with back pain for more than 3 mo and an onset of less than 45 years

Sacroiliitis on imaging plus one or more axial spondyloarthritis feature
or
Positive test for *HLA-B27* gene plus 2 or more other axial spondyloarthritis features
Sacroiliitis on imaging
Active (acute) inflammation on magnetic resonance imaging highly suggestive of sacroiliitis associated with axial spondyloarthritis
Definite radiographic sacroiliitis according to the modified New York criteria
Axial spondyloarthritis features
Inflammatory back pain Arthritis Enthesitis (heel) Uveitis Dactylitis Psoriasis Crohn's disease or diagnosis of colitis Good response to non-steroidal anti-inflammatory drugs Family history of axial spondyloarthritis Positive test for *HLA-B27* gene Elevated C-reactive protein levels

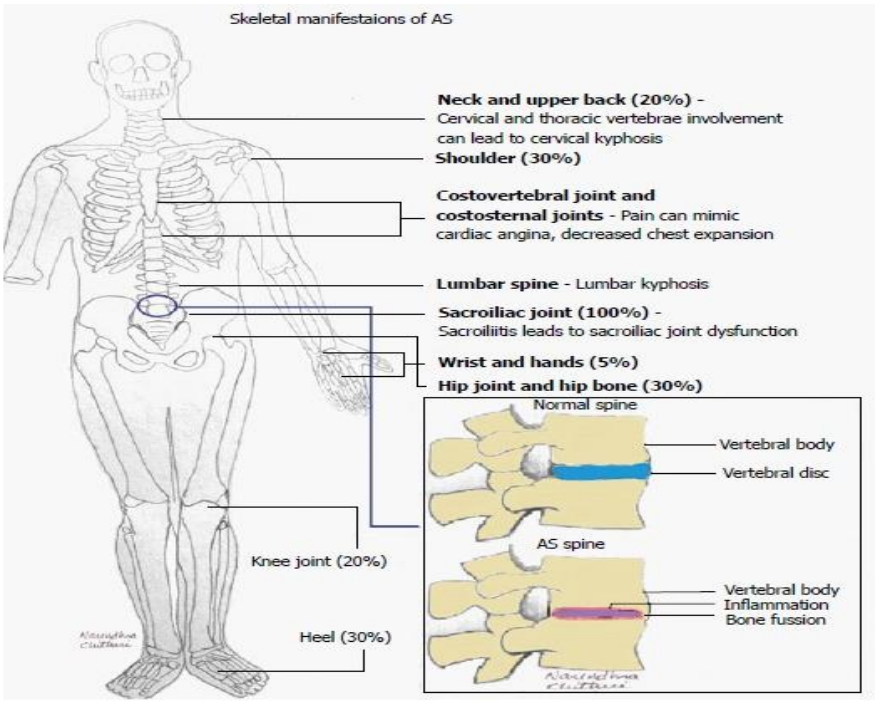
Clinical Manifestations

Patients usually present with multisystemic symptoms. The most common symptoms being low back pain or neck pain of insidious onset, more during the night and early mornings, relieved with physical activity but aggravated by rest according to the Assessment of Spondylarthritis international Society (ASAS) criteria. (42) Other criteria used are the Calin and Berlin criteria, which also include morning stiffness. (32,43)

Structural abnormalities as a result of progressive spinal fusion may lead to severe impairment of spinal mobility and chest expansion and this form are more common in advanced AS. Postural abnormalities like hyperkyphosis or the typical stooped posture are caused by a combination of flexion deformity of the neck, thoracic hyperkyphosis, loss of lumbar lordosis and flexion deformities of the hip. (44)

Other features that are involved are peripheral arthritis involving ankle, knees, hips, shoulder, and sternoclavicular joints and enthesitis, more common at the site of attachment of Achilles tendon; other sites being calcaneal attachment of the plantar fascia, the shoulders, the costochondral junctions, the manubriosternal and sternoclavicular joints, and along the superior iliac crest.

Figure 2 (41)



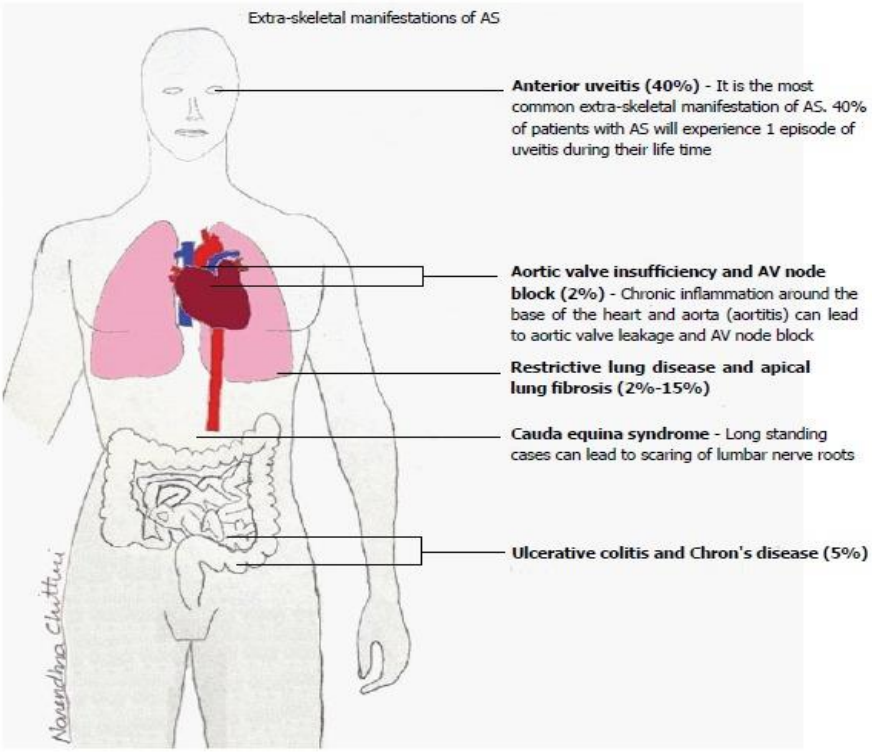
Extra-articular manifestations are some coexisting diseases that are strongly associated with Ankylosing spondylitis. These diseases include acute anterior uveitis, psoriasis, and inflammatory bowel disease. Long-standing inflammation can lead to cardiovascular and pulmonary diseases.

Acute anterior uveitis – most commonly presented as unilateral uveitis constitutes approximately 25 to 35 % of the cases and maybe the first manifestation that requires medical attention. Symptoms include acute unilateral pain, photophobia, and blurring of vision. The median duration of an attack is said to be around six weeks and the median times of recurrence are around three times. It is also associated with posterior synechiae, increased intraocular pressure and cystoid macular edema.

Inflammatory bowel disease – inflammation of the ileum and the colon can be detected in about 50% cases of ankylosing spondylitis. (45–47) A minority of those with histological inflammation develop clinically apparent IBD with an incidence of 4.1 % in those with AS when compared to other spondyloarthropathies.

Psoriasis – Psoriasis is present in up to 10 % of cases with AS. Patient with concomitant psoriasis has more peripheral joint involvement and a more severe axial spondyloarthropathy disease course when compared to those patients without psoriasis.

Figure 3 (41)



Clinical Signs

Usually, the patient on examination has sacroiliac joint tenderness on palpation or stress. Stress tests include testing for FABER (flexion, abduction, external rotation and extension), testing for Patrick or Gaenslen's maneuver. Lateral pelvic compression or pelvic compression tests for anteroposterior compression also show stress tenderness.

An initial physical finding in patients with AS can be a mild to mild restriction of lung expansion, and the severe restriction is typically a late physical finding. The degree of expansion of the chest has limited diagnostic sensitivity. Schober's exam and lateral spinal mobility flexion measurements may be superior clinical markers of AS.(48) The anterior chest wall is gradually flattened, shoulders are stooped, the abdomen becomes protuberant, and respiration becomes progressively diaphragmatic. The involvement of the cervical spine results in a gradual restriction of the capacity to turn or fully extend the neck completely and also contributing to an increase in occiput-to-wall or tragus-to-wall distances. It takes nearly 10 years for spinal deformities to develop and do so at varying rates and patterns. Patients with AS may have a stiff osteoporotic spine that after relatively minor trauma is prone to fracture. Spinal osteoporosis is partly induced by ankylosis and absence of movement, but may also be induced by proinflammatory cytokines. The prevalence of osteoporosis is approximately 19-62 percent in terms of low bone mineral density. (49)

In individuals with AS, there is an enhanced likelihood of vertebral injuries and the comparative incidence is about 7.6%. (50) Clinical vertebral fractures have an incidence of about 10-17 percent. (51) Wedging spine fractures results in a progressive kyphosis. The incidence of significant spinal fracture with neurological deficits ranges from 29% to 91%.(52)

Displaced Transverse neck fractures are linked with considerable morbidity and mortality and could even lead to paraplegia or quadriplegia. In individuals with cervical spine illness, aseptic spondylodiscitis is more prevalent and appears mostly in the midthoracic spine. It is generally asymptomatic, and with minimal or no trauma it can happen. Cauda equine syndrome may happen due to acute adhesive arachnoiditis, although this is an uncommon and early complication(53). Spontaneous atlantoaxial subluxation has also been reported(54).

Radiology

The traditional feature of diagnosing AS is the radiological proof of sacroiliitis. In most cases, a pelvis anteroposterior radiograph is enough(49). However, a computerized tomography scan or MRI can be useful in some cases with elevated suspicion of AS when symptoms appearing prematurely but where the sacroiliac joints are normal or show only ambiguous changes.

Figure 4 (55)

Grading of sacroiliitis:

GRADE	LEVEL	DESCRIPTION
0	Normal	Clear margins, uniform width, and no juxta-articular sclerosis.
1	Suspicious	Suspicious but not definite abnormality.
2	Minimal sacroiliitis	Evidence of some sclerosis and minimal erosions but no marked joint space narrowing.
3	Moderate sacroiliitis	Definite sclerosis on both sides of the joint, erosions, and widening of the interosseous space.
4	Ankylosis	Complete joint obliteration with or without residual sclerosis.

Early modifications seen in conventional radiography include vertebral squaring and syndesmophyte formation. There may also be spondylodiscitis, ligament ossification, and facet joints involvement. Spinal osteoporosis is commonly seen in AS patients, particularly in people with serious long-term illnesses. In individuals with spinal osteoporosis, the likelihood of fractures of vertebral compression and pseudoarthrosis is elevated(56). MRI is an outstanding aid for showing sacroiliitis, enthesitis, and bone erosion. The STIR method may demonstrate sufficient proof of inflammation and edema of the bone marrow, suggesting active persistent inflammation(57,58). MRI can also identify significant changes in dura mater, soft tissues and spinal cord related to disease, as well as inflammatory alterations induced by enthesitis, injuries, or pseudoarthrosis. MRI methods are preferred in females of the child-bearing era, kids and adolescents to recognize sacroiliitis.

The discovery of the 'backfill sign' was another finding of the MRI. It has been first described by Weber et al. (59) who defined the Sacroiliac Joint Space as high signals in T1-weighted images, which could constitute a fat metaplastic tissue that can fill subchondral bone pits; however, the histopathology has not yet been evaluated. Studies have recently verified that the "backfill sign" is highly specific for SpA (between 95.8 percent and 98 percent)(60) with a sensitivity of only 59%(61). Its existence could, therefore, be used to help axial spa diagnosis, but its absence should not be used to rule it out.

As an osteoporosis testing device in patients with SA, dual-energy X-ray (DEXA) Absorptiometry may be helpful, however, the existence of hip arthroplasty or extensive ligamentous ossification (bamboo spine) can affect findings. Enthesitis can be identified radiographically, but not in the early phases; premature inflammatory modifications can also be identified even before they emerge on standard radiographs(62).

Laboratory Investigations

There are no particular lab indicators for the diagnosis of ankylosing spondylitis. The laboratory studies on inflammatory rheumatic illnesses usually use acute stage reactants such as high C-reactive factor (CRP) and erythrocyte sedimentation frequency (ESR). In AS patients with peripheral arthritis, ESR and CRP are more

frequently found elevated than in those suffering from axial disease only(63). Other acute phase reactions include high ferritin, low-albumin and mild thrombocytoses(64). There really is no specific rheumatoid factor and antinuclear testing or fluid analysis and synovial biology. The results are not specific. Stool occult blood testing can be useful for inflammatory bowel disease. HLA-B27 test should not be done regularly as HLA-B27 can exist in the absence of AS and other spondyloarthropathies. In healthy individuals, HLA-B27 is found (approximately 6% to 10% in Europe and a moderately greater spectrum of 10% to 16% in the Scandinavian nations)(65).

There is a risk of 20 percent in HLA-B27-positive individuals with a first-degree relative with HLA-B27-Positive AS, in developing any type of spondyloarthropathy(64).

Calprotectin is a dimer of calcium-binding protein used as a surrogate marker for inflammation of the gut. Its primary application is the surveillance of IBD illness occurrence(66). It is known that AS is connected with both Crohn's disease and ulcerative colitis. The mechanism is not evident; there are discrepancies as to whether the cause or effect of the musculoskeletal disease is inflammation of the intestine. Studies have therefore attempted to assess calprotectin for AS management. Duran et al. (67) discovered that CRP, ESR, BASDAI (Bath Ankylosing Spondylitis Disease Activity Index), and BASFI (Bath Ankylosing Spondylitis Functional Index) was

correlated with a greater illness incidence and a stronger predictor of bowel involvement.

Treatment

To present, treatment choices in AS have been limited to patient education, physical therapy, and non-steroidal anti-inflammatory drugs (NSAID), the cornerstone of efficient therapy.

The finding of cell necrosis factor-a (TNF-a) antagonists was a leap in AS therapy. Despite these therapy alternatives, however, the therapy of AS has been suboptimal. Treatment includes both pharmacological and non-pharmacological methods. Physical therapy includes drills and the promotion of suitable posture. Exercise/physical therapy programs have been shown to improve pain, spinal mobility, patient function, and well-being. Supervised programs are more efficient than personal programs at home(68).

Tumour Necrosis Factor Inhibitors

Several years ago, the first bDMARDs were approved. As some of these medication's patents were nearer to expiry, pharmaceutical businesses concentrated on creating

more cheap drugs. The first one released was CT-P13, the biomedical infliximab(69), followed by the etanercept biosimilar Benepali (SB4), in 2016(70). Multiple studies support comparable safety and effectiveness of CP-P13 and infliximab not only in AS patients but also in the therapy of rheumatoid arthritis (RA).

Etanercept, infliximab, and adalimumab are TNF—antagonists approved for AS therapy by the U.S. Food and Drug Administration. These drugs have shown swift and sustained effectiveness in AS therapy. Injection site responses, upper respiratory tract infections, and accidental injury include adverse effects on TNF-α antagonists. In patients receiving TNF-α antagonists, rare instances of tuberculosis were recorded. Infliximab and adalimumab have a black-box warning that highlights the tuberculosis likelihood. In patients with pre-existing demyelinating disease or moderate to severe heart failure, these medicines are avoided.

In one of the clinical trials in patients with AS, Etanercept at 25 mg twice weekly proved consistent efficacy. Studies demonstrate an increase in function, mobility of the spine, and quality of life. After 12 weeks of therapy with Etanercept, some patients underwent remission. Drug relapse cessation within 3 months was also found(71).

Infliximab used in multiple research showed consistent efficacy in partial remission, which was seen in approximately 20 percent of patients treated with infliximab.

Adalimumab is being investigated for AS therapy. In brief research of 20 weeks, adalimumab 40 mg produced substantial improvements in spinal symptoms in AS patients every other week. In 21.6 percent of patients, partial remission was observed.

Switching from infliximab to its biosimilar does not have any adverse safety or efficacy effects(72). With respect to Benepali (SB4), the most significant efficacy and safety trials were conducted in RA, demonstrating comparable outcomes to those acquired with Enbrel(73).

Interleukin Inhibitors

Secukinumab, a fully living monoclonal antibody capable of neutralizing IL-17A, was a significant step forward in AS treatment(74). It is recognized that patients with AS have elevated concentrations of this interleukin, which is critically associated with disease pathogenesis(75). IL-23 is secreted by antigens and stimulates Th17 cells identified by their IL-17cytokines production(76).

In SpA pathogenesis, IL-23 is immediately linked to enthesitis development(77), and the IL-23/IL-17 axis carries a key position. Ustekinumab is a monoclonal human antibody that targets IL-12 and IL-23 p40 subunits. It is regarded as one of the most

efficient medicines for psoriasis(78); however, its effectiveness in AS has not been as anticipated, and the findings have been contradictory.

With respect to potential solutions, ABT-122, an immunoglobulin molecule that targets both IL-17A and TNF-α, has lately proved its effectiveness for RA and psoriatic arthritis(79,80) in stage I and II studies ; however, considering the significance of IL-17 in AS pathogenesis, it is anticipated that studies will begin shortly in individuals with AS.

Janus kinase inhibitor

Janus kinase inhibitors, also known as JAK inhibitors or jakinibs, are a type of medication that functions by inhibiting the activity of one or more of the Janus kinase family of enzymes (JAK1, JAK2, JAK3, TYK2), thereby interfering with the JAK-STAT signaling pathway(81).

Cytokines play key roles in controlling cell growth and the immune response. Many cytokines function by binding to and activating type I and type II cytokine receptors. These receptors, in turn, rely on the Janus kinase (JAK) family of enzymes for signal

transduction. Hence drugs that inhibit the activity of these Janus kinases block cytokine signaling (81).

Tofacitinib, a Janus kinase (JAK) inhibitor, can also interfere with the IL-17, IL-21and IL-23 inflammatory cascade. Van der Heijde et al. recorded the effectiveness of the 5 mg dose twice a day versus placebo in a 16-week clinical trial (with 12 weeks of therapy and 4 weeks of washout period): 63% and 40% of patients, respectively, achieved ASAS20 after 12 weeks(82).

Other Therapies

bDMARDs are not the only therapies developed over the last couple of years. Fattahi et al. (83) revealed the outcomes of B-D-mannuronic acid, a new non-steroidal anti-inflammatory medication (NSAID), in a randomized, placebo-controlled trial. The 12-week ASAS result was comparable to that acquired with naproxen, and the safety profile was significantly better; no renal side effects were observed, and excellent gastrointestinal tolerability was also seen.

DMARDs are a potential second-line therapy, but there is no evidence of their effectiveness in AS. It has been shown that sulfasalazine improves peripheral arthritis but not back pain. Methotrexate (MTX) has also not shown significant efficacy in back pain associated with AS, but few small trials demonstrated that it improves results faster than placebos. Leflunomide showed improvement in peripheral arthritis, though not very effective in improving axial pain.

The administration of NSAIDs has also been controversial. Wanders et al. (84) documented that regular NSAID administration decreased radiographic progression as opposed to on-demand therapy, while more lately Sieper et al. (85) observed that ongoing 2-year diclofenac treatment did not decrease radiographic progression opposed to on-demand administration.

Surgical options for treatment in AS are for the following :

1. Treatment of painful conditions such as arthritis of the hip or knee.
2. Providing motion in ankylosed joints.
3. Correction of deformities as in the spine.
4. Management of fractures.
5. Improvement in posture.

Surgical Anatomy of Hip Joint

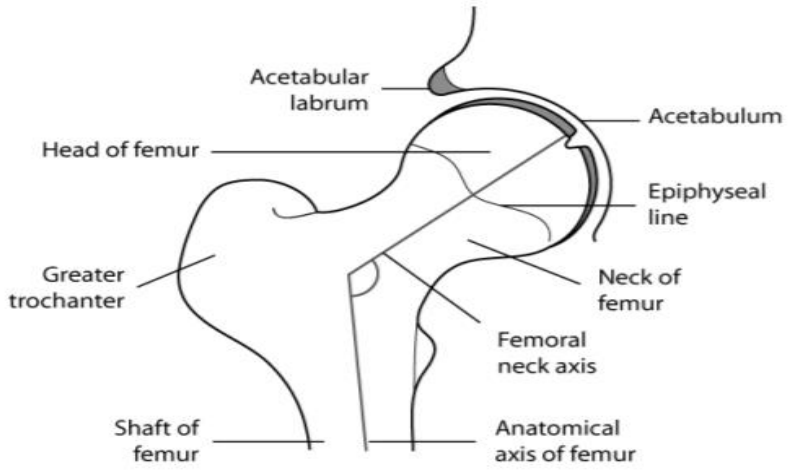
The hip joint is a multi-axial ball and socket set of synovial joints. It is associated with four characteristics: it has a joint cavity; joint walls have articular cartilage; it has a synovial membrane that contains the synovial liquid; a ligamentous capsule surrounds it.

The cup-shaped acetabulum consists of the innominate bone with components from the ilium (about 40% of the acetabulum), ischium (40%) and pubis (20%)(86). Pelvic bones surrounding the acetabulum from the ischium to the ASIS make up only 160°(87) and the acetabular component of the hip replacement prosthesis is 180° hemisphere.

The hip joint is highly stable and mobile owing to multiple factors such as,

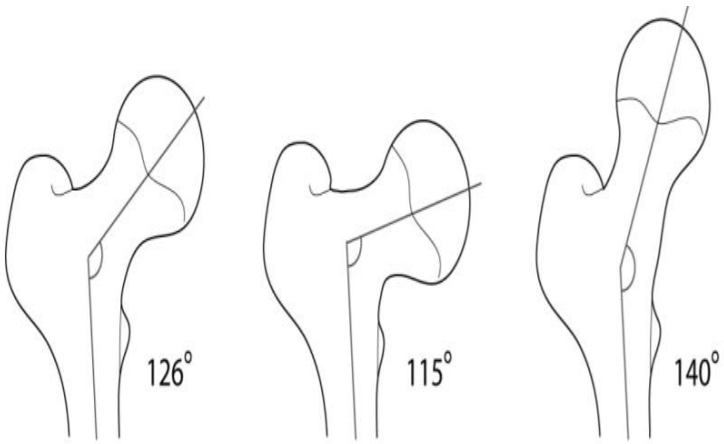
I. The depth of acetabulum made by acetabular labrum with a narrow mouth.
II. Tension and strength of ligaments.
III. Strength of the surrounding muscles.
IV. Length and obliquity of the neck of femur.
V. The atmospheric pressure.

Figure 5 (88): Cross-Sectional view of Normal Hip Joint



The femoral neck attaches the head of the femur to the femoral shaft, which varies in length depending on the size of the body. In normal adults, the angle of the neck-shaft is usually 125±5 °, with coxa valga exceeding 130 ° and coxa vara when the inclination is less than 120 °.

Figure 6 (88): (i) Normal femoral neck angle, (ii) a decreased femoral neck angle (coxa vara), and (iii) an increased femoral neck angle (coxa valga).



If the angle outside this typical range differs significantly, the lever arms used to produce movement by the abductor muscles are either too small or too large. The angle of the neck-shaft decreases steadily from 150 ° after birth to 125 ° in the adult owing to bone remodeling in reaction to stress.

The anteversion angle is measured as the angle through the knee between a mediolateral line and a line through the head and shaft of the femur. The average femoral anteversion angle is between 15 ° and 20 °.

The Femoral neck is narrowest in the center of the neck. Abnormalities in this zone and the area neighboring to the articular surface, such as a prominence resulting from a slipped capital upper femoral epiphysis (SCUFE), may disturb the standard femoroacetabular articulation arising in Cam type of impingement. In contrast, acetabulum abnormalities such as osteophyte formation with increased femoral headcover may result in a Pincer type of impingement.

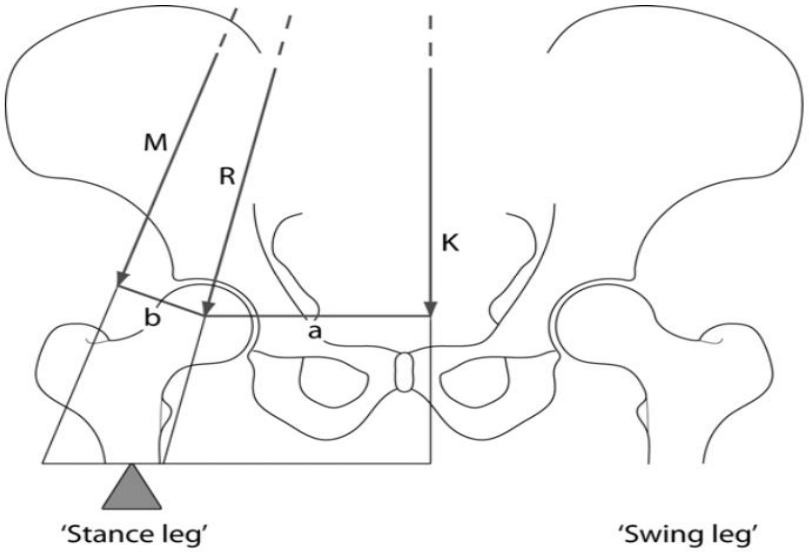
The Biomechanics of the Hip Joint

Total hip arthroplasty biomechanics differ from those used in fracture fixation plates and nails as they only provide partial support and only function until the fracture union is established In total hip arthroplasty, the components can endure at least three

to five times the bodyweight for several years of cyclic loading and are sometimes 10-12 times the body weight. (89)

The effective center of gravity moves distally from the supporting leg in a single leg position since the non-supporting leg is now calculated as the component of the body mass acting on the weight-bearing hip.

Figure 7(88): Figure showing the calculation of hip force, **K** is the bodyweight (subtracting the weight-bearing leg), **M** is the abductor muscle force, and **R** is the joint reaction force.



The strength of the forces is essentially dependent on the proportion of the lever arm, which is the ratio between the arm of the moment of body weight and the arm of the moment of abduction (a: b). (90)

Hip Involvement in Ankylosing Spondylitis

Ankylosing spondylitis, which is typically a disorder of the sacroiliac joints and spine, is often correlated with a peripheral joint disease (91,92). Hip joints involvement is especially common and it's a disabling problem for the patients (93).

Hip involvement occurs in 30–50 percent of AS patients and there is bilateral involvement in 90 percent of patients with affected hips(94). Hip involvement was present in 24–36 percent of AS patients as reported by few latest cross-sectional database studies from Belgium, Spain, and South America. The younger the age at the beginning of AS, the higher the likelihood of hip involvement. Often the risk factors of hip involvement and the need for full hip arthroplasty (THA) in AS are considered to be male gender, axial and enthesitis. (95) Hip involvement in AS could occur as hip, fibrous or bony ankylosis arthritis. Nearly 40% of AS-involved hip patients have bony ankylosis.

Hip involvement is a classical trait of AS that is considered to be the product of coxofemoral joint inflammation and is either characterized as an excess of synovial

inflammatory fluid and/or cartilage destruction. The interface of bone cartilage includes inflammatory cells (especially T cells), hypervascularization and high levels of osteoclast activity resulting in subchondral inflammation. (96)

The definition of hip ankylosis includes restrictions on the movement of hip flexion, extension, and rotation below 10 degrees and can be achieved either spontaneously or after surgery. Hip joint ankylosis is usually painless and the joint is stable, but in the long run, the pain will occur in the lower back of the hip and knee due to degeneration changes, particularly when the hip joint is poorly functional(97).

In comparison to new bone growth in the axial spine, hip joint synovial inflammation causes bone erosion and narrowing of joint space. (98)

Spine Involvement in Ankylosing Spondylitis

Spine involvement in AS is very important in terms of function, range of movement and joint reaction forces owing to the related impacts of a deformed spine on the hip. There is a fusion of the spine in severe AS and a resulting kyphosis arises, likely due to the practice of using pillows under the neck, among other things.

There is a gradual decrease in the horizon as the kyphosis progresses and becomes severe, and the visual axis is sometimes perpendicular to the floor. In such a case, to be functionally independent becomes very difficult for the patient. A rigid or ankylosed hip compounds the deformity of the spine even more. Also, the patient develops severe abdominal and thoracic pain.

Also, patients are predisposed to develop vertebrae fractures. Osteoporosis has been recognized as a significant risk factor for these fractures to occur. The existence of femoral neck osteoporosis with comparatively greater amounts of posterior spine osteoporosis relative to the anterior spine demonstrates that inflammation is the cause of bone mineral density decrease(58).

The existence of low bone density with a stiff spine with low-stress tolerance is prone to low-velocity fractures.

There were also neurological complications with reduced intensity forces rather than high-energy trauma.

Indications for Total Hip Arthroplasty in Ankylosing Spondylitis

A number of processes can affect the hip joint, including synovitis(99), enthesial inflammation(100), medullary bone involvement(101), progressive degeneration, and secondary osteoarthritis. A hip with bony ankylosis is usually painless and in a functional position can provide a stable ambulatory platform. (102,103)

In activities causing low back or knee pain, loss of function caused by both hips immobility or malposition, extreme limping or walking disability, hip arthroplasty may be considered. One indication is discomfort in adjacent joints due to hip stiffness. (104–106)

Preoperative Evaluation of Ankylosing Spondylitis Patients

Patient complaints should be thoroughly assessed. Hip pain and decreased mobility are the disabling characteristics, but patients with stiffness owing to ankylosed hips are not uncommon in developing nations. The age of the patient, levels of exercise and surgical expectations are significant factors when planning surgery to replace the hip. A detailed physical examination should be carried out to determine and record spinal involvement, pelvic obliquity and disparity in limb length contralateral hip status, bilateral knee joints, and sciatic nerve integrity. (107)

The presence of pseudarthrosis or of the Anderson lesion should be excluded by examination of radiographs of the entire spine(108). A spinal consultation should be sought in case of pseudarthrosis or severe spinal involvement.

An important issue is the perioperative control of medications used in the care of AS patients. Prospective data on the risk of perioperative infection with methotrexate have not shown an increased risk and are not usually withheld during the perioperative time. Nevertheless, the risk of infection with anti-TNF agents is well known, so it is recommended that these medications be stopped before elective orthopedic surgery. (109,110)

The anticipated problems of an anesthetist related to upper airway management include pulmonary obstruction, cardiovascular involvement, and access to neuroaxis. (111,112)

Because of temporomandibular joints involvement, a stiff and flexed cervical spine together with limited mouth opening makes intubation difficult. (111) It is usually preferred to have fibreoptic intubation.

Pulmonary function testing is recommended before surgery due to the high frequency of thoracic limitation. Respiratory insufficiency and chest expansion restriction may increase the incidence of postoperative pulmonary complications such as atelectasis and pneumonia and also a requirement of ICU backup. Given the potential conduction defects, preoperative ECG is required, while an echocardiogram is also necessary to assess the seriousness of AS-caused valvular disease(109,111,112).

Lumbar spine radiographs may be helpful in assessing the possibilities for spinal anesthesia. However, ossified ligament-related lumbar spine disease can technically render spinal or epidural anesthesia difficult(112).

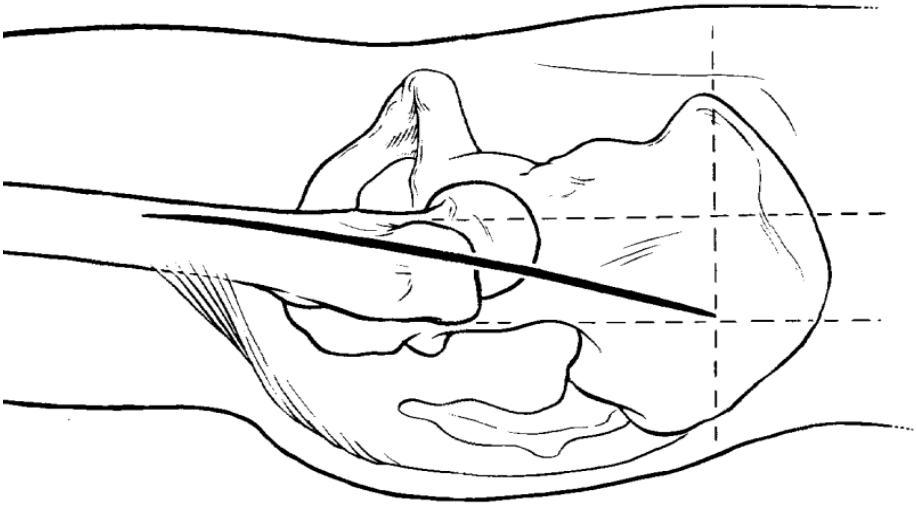
The antibiotics are given 15-30 min before the skin incision in the ward before shifting the patient to Operation theatre. 20 minutes of parenteral dosage is accomplished at peak serum and tissue levels. A cephalosporin of the third generation such as cefuroxime 1 gm is generally provided preoperatively. There is no proof to suggest that antibiotic administration is advantageous for more than 48 hours. With the use of prophylactic drugs, the infection rate reduces from 11% to 1%.

Surgical Procedure

All the patients in our study underwent THR, using the Mallory Modification of Hardinge translateral approach. It is performed with the patient in a full lateral position. Here greater trochanter osteotomy is avoided. The incision is made parallel to the femur's shaft along its anterior margins. The incision also extends cephalad in a caudad direction from the top of the greater trochanter. The upper end of the incision parallels the iliac spine level. Distally, it extends roughly 5 cm distal to the greater trochanter along the femur's anterior shaft.

Fascia lata is split below the skin incision. Tensor fascia lata is retracted anteriorly and gluteus maximus posteriorly, which eventually exposes the origin of vastus lateralis and gluteus medius insertion.

Figure 8 (113): Surgical Incision



The Mallory Modification of Hardinge approach is a translateral abductor split approach. The term "split" refers to cleavage separation within the muscle mass of the abductor. The surgeon palpates the femur's neck under the abductor muscle mass to assess the point of entry, identifying the femoral neck (Fig. 9). The positioning of the femoral neck is used to define exactly where the muscle break is made within the muscle mass of the abductor, producing a more anterior incision compared to the Hardinge approach (114) (Fig. 10).

Figure 9 (113): The location of the abductor muscle “split.”

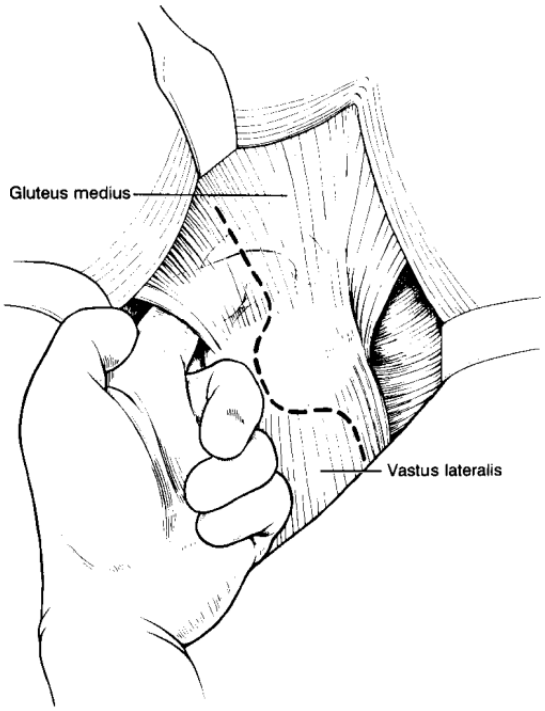
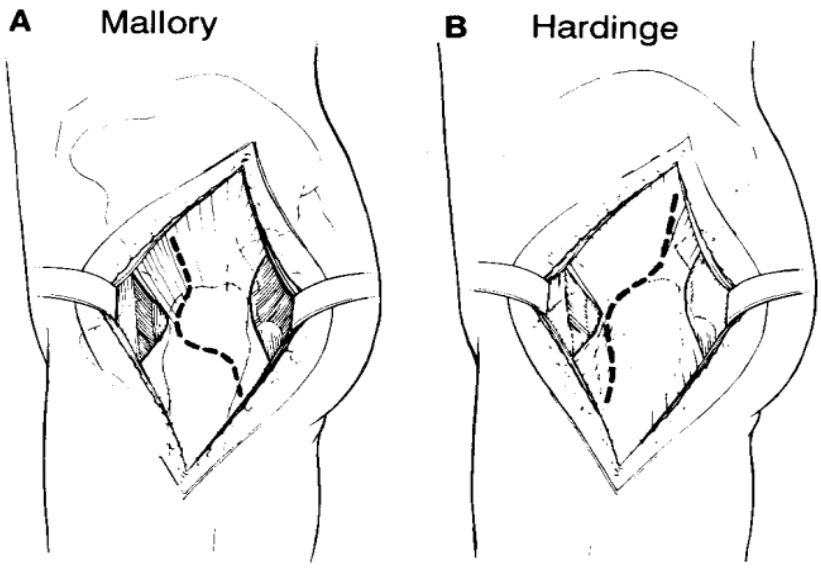


Figure 10 (113): (A) Abductor “split” is located anterior over the femoral head and neck. (B) Abductor “split” is located laterally, requiring greater muscle separation.



The muscle fibers are spread around anatomic planes by dividing the fibers in a longitudinal and vertical direction, thereby preserving the integrity of the muscle fiber. With the abductor muscle complex, the myotendinous cleavage created remains distally in continuity with the vastus lateralis. In order to avoid damage to gluteal neurovascular structures, the" split" must not extend past 2 cm above the lateral lip of the acetabulum. (113)

In the original Hardinge approach, the gluteus minimus and vastus lateralis are elevated at the muscle tendinous insertion. The incised anterior capsule is exposed by the abduction of the thigh. The splitting muscle incision through gluteus medius and minimus allows anterior hip dislocation and provides excellent acetabular exposure. Due to direct injury to the superior gluteal nerve, the residual abductor weakness and limp may arise(114).

Post Operative Protocols In Ankylosing Spondylitis Patients after Total Hip Arthroplasty

The IV antibiotics continue for two days and stopped. On the second day after the surgery, the drain is removed and X rays are taken. The hip is placed in roughly 15 degrees of abduction in the immediate post-operative period by using a triangular abduction pillow to avoid post-operative dislocation. The patient is educated over do's

and don'ts preoperatively such as, not to squat, not to sit cross-legged on the ground, to avoid strenuous exercise and need for maintaining the ideal body weight.

Exercises and limited mobilization start in the first post-operative day in bed. Deep respiration, ankle pumps, quadriceps, and isometric gluteal, soft rotational exercises are started. On the first or second postoperative day, patients can sit on the side of the bed or in a chair in a semi-recumbent position.

Gait training will usually start on the first day after the surgery. Mostly it is possible to use a walker or bilateral axillary crutches for balance and stability. The extent of weight-bearing depends on the components used for surgery, the involvement of structural bone grafts, stress risers in the femur and trochanteric osteotomy. A restricted weight-bearing for 6-12 weeks is recommended for cementless implants.

Patients were advised to walk on 2 crutches on the 3rd post-operative day. Weight-bearing should not exceed one-third of body weight. In normal circumstances, discharge and suture removal ranges from 10th to 12th day after surgery. The first follow-up examination takes place 6 weeks after surgery, with a gradual increase in weight-bearing in the following 6 weeks with 2 crutches still in use. Then it is important to rapidly reduce the use of a cane. Hip extension exercises are encouraged particularly when the flexion deformity is pre-existing. The patient may be

recommended to use a western toilet or modified stool for toilet purposes. It is possible to resume sexual activity in the supine position.

Nearly 50% of muscle strength is regained around 3 to 6 months postoperatively. After 6 to 8 weeks, patients with sedentary occupations may return to work. They can do limited lifting and limited bending at 3 months(115–117).

Complications of Total Hip Replacement in Ankylosing Patients (118–120)

The following are common complications:

a) **Nerve injury:** Sciatic, femoral, peroneal and obturator nerves can be injured as a result of direct surgical trauma, traction retractor pressure and positioning of limbs, lengthening of limbs. Transacetabular screw positioning can also damage the nerve of the sciatic or obturator.

b) **Vascular injury:** The transacetabular screws can injure the obturator vessels in the anterior-inferior quadrant and the external iliac vessels in the anterior-superior quadrant. The removal of soft tissues from the lower acetabulum wall could damage the vessels of the obturator. Acetabulum's medial wall penetration may damage the common iliac artery or superficial iliac vein.

c) **Formation of hemorrhage and hematoma:** It may occur in patients with bleeding disorders, steroids, anti-coagulant treatments, recent salicylate, hepatic disorder, Paget disease, and Gaucher disease.

d) **Limb length discrepancies:** lengthening occurs most often due to insufficient resection of the femoral neck or using a prosthesis for longer neck and altering center of rotation.

a) **Dislocation and subluxation:** This occurs due to inadequate restoration of limb length and horizontal offset**.**

b) **Heterotropic ossification:** The Brooker classification of Heterotropic ossification is divided into four classes

i. The Islands of bone in soft tissues
ii. The Bone spurs arising from the proximal part of the femur or pelvis with at least 1cm between them.
iii. The Bone spurs with less than 1cm between the opposing bony surfaces.
iv. Ankylosis.

c) **Thromboembolism:** It's the most common cause of death in the first three months after total hip arthroplasty.

d) **The Trochanteric nonunion and the trochanteric migration.**

e) **Loosening:** This is a serious complication in the long run. This can be caused by particulate debris or wear of polyethylene which could be either septic or aseptic.

f) **Infection:** It is a devastating condition that is painful, debilitating, and a deep-seated infection that requires removal of the implant.

g) **Osteolysis:** This is primarily associated with cement and is known as cement disease. However, due to pressure shielding and as a host reaction to particulate debris osteolysis may also occur in cementless implants.

h) **Stem failure or fracture**.

i) The other problems in the postoperative phase include **gastrointestinal bleeding, myocardial infarction, congestive cardiac failure, fat embolism.**

Yavuz saglam et al (121) in 2016 in his study of 150 hips of 61 patients with AS who underwent THA, assessed the functional and radiological outcomes. Functional status was assessed with the Harris hip score (HHS), which showed that the average preoperative score was 46.6± 16.3 had improved to 80.7± 18.7 ($p < 0.01$) postoperatively with a significant statistical difference. Similarly, the BASDAI score,

which shows the activity of the disease had decreased from 7.3±1.6 preoperatively to 4.1± 1.1 postoperatively, ($p < 0.01$). survival rates 2 years after surgery 97.7% and with an average follow-up of 5.4 ± 3.3 years, 78% of hips had minimal or no pain, 68.8% of patients had good function. Early and late complications are lower in cemented THA compared to cementless THA (Table 1). (121)

Table 1: Complications found in his Study. (121)

	Early (within the post-operative first year)		Late (after the first post-operative year)	
	Cemented	Cementless	Cemented	Cementless
Girdlestone pseudarthrosis	0	0	1	1
Superficial wound infection	1	2	0	0
Deep infection	0	1	2	3
Dislocation	1	1	0	0

	Early (within the post-operative first year)		Late (after the first post-operative year)	
	Cemented	Cementless	Cemented	Cementless
Heterotopic ossification (HO)	1	1	4	8
Aseptic implant loosening (number of hips)	0	0	4	4

Assessment of Clinical and Functional Outcome

In every aspect of their lives, ankylosing spondylitis affects patients. The disease itself, its clinical effects and the deformities arising from the disease affect the patients. They are sometimes so disabled by the disease that for their daily living activities they become completely dependent on their family members.

Evaluation of a person with AS can not be limited to one or two areas, but different aspects of the condition must be evaluated. This has led to the development of patient-assessed health instruments that assess the quality of life in these patients related to

health. These health tools are in the form of a questionnaire of specific issues that may be in the form of a set of choices.

Modified Harris Hip Score (MHHS) is a standardized tool for measuring an individual's functional status and has historically been used to determine a patient's condition with hip disease. (122)

Previously, it was used in most studies to evaluate THR outcomes. Harris hip score involves a physical examination aspect with high inter-observer variability. (123) Western researchers found the physical examination aspect of HHS to be of minimal significance. (124)

Also, the significance and reliability of the Modified Harris Hip Score (MHHS) in the Indian population was proved by Kumar et al. in their study. (122)

The maximum range of scores was 0 to 91. The range of scores was rescaled to 0 to 100 for ease of presentation as described by Mahomed et al. in his study. (125)

ROM score also was calculated along with the Modified Harris Hip Score.

SF-36 was a part of the Medical Quality Study (MOS), a four-year study that looked at specific effects on the quality of treatment. (126,127) The SF-36 measures eight scales: **Physical Functioning** (PF), **Role limitations due to Physical health** (RP), **Bodily Pain** (BP), **General health** (GH), **Vitality** (VT), **Social functioning** (SF), **Role limitations due to emotional problems** (RE), and **Mental Health** (MH).

Validity and Reliability of SF-36 in India were done by Sinha et al. (128) and they had concluded that the translated version reliable and valid.

A 1999 study by Shi et al analyzed the responsiveness of the Harris Hip Score and the SF-36 after total hip arthroplasty and concluded that both measures should be weighed equally by clinicians and health researchers. (129)

Through our study, we aimed at determining the role of Total hip arthroplasty using a Hardinge lateral approach in patients with Ankylosing Spondylitis by assessing the clinical and functional outcome of the patients who underwent THA by Modified Harris hip score and SF 36 scoring system. There are many kinds of literature that looked into postoperative improvement in these subsets of patients using MHHS, ROM Score or Postoperative flexion improvement (97,130–142), However there is not much literature out there that looks at the quality of life using SF 36 Form in Ankylosing Spondylitis patients after total hip arthroplasty(143) , We also aim to

compare the value that we got to those studies that looked into SF 36 scores in Ankylosing Spondylitis patients.

We also aim at looking at the use of DMARD's in these patients pre and postoperatively. The complications, if any, in the peri-operative period will be assessed and its relation to the outcomes will be noted.

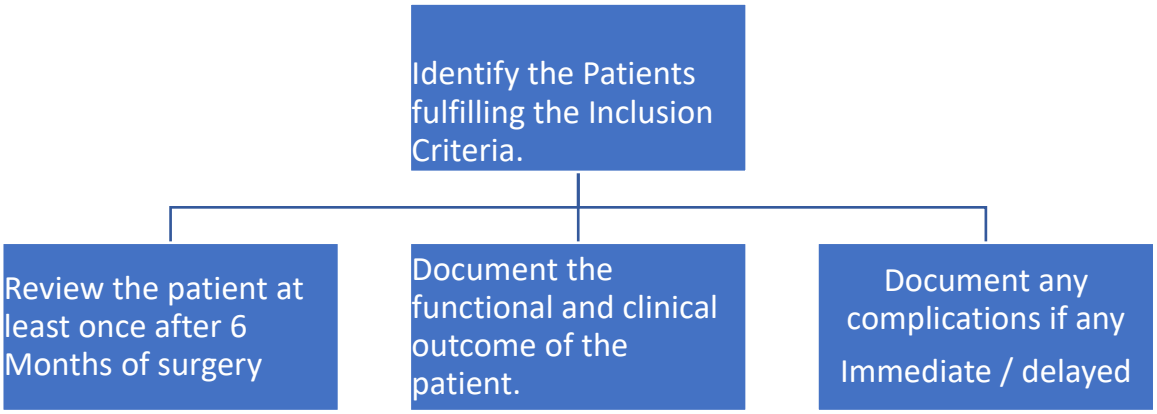
MATERIALS AND METHODS

Patients with Ankylosing Spondylitis and Other related disorders present to us with severe hip problems. They have restricted or zero movements of the hip. This study focuses on the improvement clinically as well as functionally in such kinds of patients who underwent Total Hip replacement in the Department of Orthopaedics II.

The Details of Patients suffering from Ankylosing Spondylitis and other related disorders were collected from the surgery register maintained by the Department of Orthopaedics II. The details of the surgery and other data were collected from outpatient records and inpatient records.

The patient's post-operative range of movements was collected, pre-operative range of movements, Modified Harris Hip Score (MHHS), Preoperative ROM Score if available pre-operatively or these scores were calculated from the data available from the history sheet as well as notes available in the hospital records was used for this study. If there are any post-operative complications documented in the Outpatient chart or Inpatient chart then those complications will also be documented as immediate and delayed complications.

Figure 11: Detailed diagrammatic Algorithm of the study



a) Study Setting

The study was based on patients in the Department of Orthopaedics – Unit 2, Christian Medical College, Vellore. The study intends to include all patients having Ankylosing spondylitis and other related disorders who underwent Total Hip Arthroplasty between 01/01/2012 to 31/12/2018.

b) Participants

The diagnosis of ankylosing spondylitis (AS) is generally made by combining clinical criteria of inflammatory back pain and enthesitis or arthritis with radiologic findings.

The Assessment of SpondyloArthritis International Society (ASAS) has developed criteria for the classification of axial and peripheral SpA. These criteria incorporate the emerging concept of nonradiographic axial SpA, which refers to patients who have signs and symptoms of the axial disease.

ASAS classification criteria for axial SpA are as follows:

- Back pain for 3 months or longer
- Age at onset < 45 years
- Sacroiliitis on imaging (radiographs or MRI) plus one or more SpA features or
- HLA-B27 plus two or more other SpA features

SpA features are as follows:

- Arthritis
- Crohn disease
- Dactylitis
- Elevated C-reactive protein level
- Enthesitis (head)
- Family history of SpA
- Good response to NSAIDs

- HLA-B27
- Inflammatory back pain
- Psoriasis
- Uveitis

Inclusion criteria:

- Patients with Ankylosing Spondylitis and other SAs
- who underwent Total Hip Arthroplasty (Unilateral/Bilateral), under Orthopaedics unit –II, Since January 2012.
- At least one follow up after 6 months.
- Age More Than 18 years.

Exclusion criteria:

- Patient Not a diagnosed case of Ankylosing spondylitis or other related disorders.
- Operated elsewhere.
- Chronic Hip arthritis due to avascular necrosis.
- Chronic hip arthritis due to trauma.
- Revision Arthroplasty

- <18 years age

Rationale:

- Expected Improvement after total hip arthroplasty in patients with Ankylosing Spondylitis and other SAs is very Good this study aims to document the change in patient's life after the surgery.
- Age and Follow up criteria were chosen keeping in mind the subset of patients we see in our unit and according to the standard review of a patient post hip arthroplasty surgery.

c) Variables

- Primary Outcome is to evaluate and document the functional and clinical improvement in the patients.
- Functional Analysis
    - SF-36
- Clinical Analysis
    - Harris Hip Score
- The secondary outcome is the postoperative complications in these patients.
    - Complications
        - Hematoma

- Wound break down
- Infection
- Deep vein thrombosis
- Pulmonary embolism
- Myocardial Infarction
- Pneumonia
- Peri-prosthetic fractures
- Dislocations
- Percentage of ICU admissions following arthroplasty of hip or knee; the reason for and the duration of the same. The mortality rate expressed as a percentage.

d) Data Sources / Measurements

- Functional analysis was done using the SF-36 questionnaire. Patients during their follow up will be evaluated using this.
- Clinical Outcomes were evaluated using the Modified Harris Hip Score and also goniometer will be used to measure the range of movements.

Goniometer measurements were done according to the following methods

Table 2: ROM Measurements Using Goniometer

Motion	Recommended Testing Position	Stabilization	Center	Proximal Arm	Distal Arm
Flexion	Patient is supine, the knee is extended, but the flexion should be allowed as hip flexion continues	Stabilize pelvis to prevent rotation or posterior tilting	Lateral aspect of hip referencing greater trochanter	Lateral midline of pelvis	Lateral midline of femur referencing femoral lateral epicondyle
Extension	Prone, hip in 0^0 of abd, add, & rot. the knee is extended, but the flexion should be allowed as hip extension continues	Stabilize pelvis to prevent rotation or anterior tilting	Lateral aspect of hip referencing greater trochanter	Lateral midline of pelvis	Lateral midline of femur referencing femoral lateral epicondyle
Abduction	Supine, hip in 0^0 of flex, ext, & rot. Knee is extended.	Stabilize pelvis to prevent rotation or lateral tilting	Over anterior superior iliac spine	Imaginary horizontal line extending from one ASIS to other ASIS	Anterior midline of femur referencing patella midline
Adduction	Supine, hip in 0^0 of flex, ext, & rot. Knee is extended. Contralateral hip is abd to allow full ROM	Stabilize pelvis to prevent rotation or lateral tilting	Over anterior superior iliac spine	Imaginary horizontal line extending from one ASIS to other ASIS	Anterior midline of femur referencing patella midline
Internal rotation	Sitting, knee flexed 90^0. Hip in 0^0 abd - add & 90^0 flexion. Roll towel under distal femur	Stabilize distal femur to prevent add or further hip flex. Avoid rotation & lateral tilting of pelvis	Over anterior aspect of patella	Perpendicular to floor or parallel to supporting surface	Anterior midline of lower leg, referencing tibial crest & point midway between malleoli
External rotation	Sitting, knee flexed 90^0. Hip in 0^0 abd - add & 90^0 flexion. Roll towel under distal femur. Contralateral knee may need to be flexed to allow full ROM	Stabilize distal femur to prevent abd or further hip flex. Avoid rotation & lateral tilting of pelvis	Over anterior aspect of patella	Perpendicular to floor or parallel to supporting surface	Anterior midline of lower leg, referencing tibial crest & point midway between malleoli

- Incidence of complications: Was obtained from Inpatient and outpatient charts
- ICU admission: Of the total number of patients, the number which required ICU care and the number of days stayed in ICU will be documented from information obtained from the IP chart.
- Mortality: Number of deaths will be obtained from IP chart or death summary and will be expressed in percentage.

e) Statistical Methods

The data will be entered using EPI DATA. The Modified Harris Hip score, ROM Score and SF 36 score were presented using mean with SD or median with IQR based on the distribution of Harris Hip score and SF 36 score. The distribution was assessed using the histogram and/or QQ plot. The distribution of the summary measure of the Harris Hip score and SF 36 and was presented for all patients and for patients with Ankylosing Spondylitis and SA separately. 95% CI for the means was be presented for all patients and separately by groups as well. The incidence of ICU admissions, the incidence of complications were expressed as frequencies and percentages with 95% CI. Correlation of change in range of movements and functional scores was done using Spearman's or Pearson's correlation coefficient. SPSS 22.0 was used for statistical analysis. P value < 0.05 was considered as statistical significance.

f) IRB Clearance

This study was approved by the Institutional Review Board of the Christian Medical College, Vellore. The IRB min. the reference number is 11164. Institutional Review Board approval was obtained on Feb 6th, 2018. Approval can be found in the annexure.

RESULTS

PATIENT CHARACTERISTICS

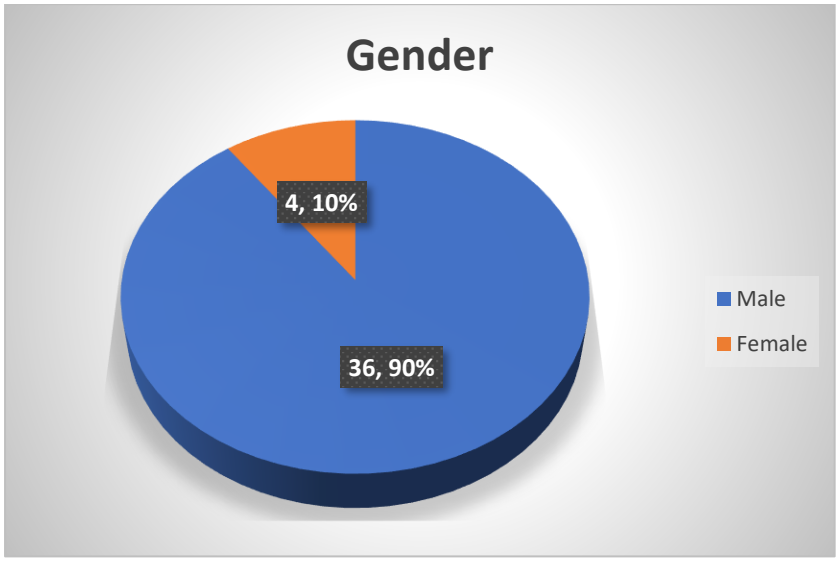
Patients having Ankylosing spondylitis and other related disorders who underwent Total Hip Arthroplasty between 01/01/2012 to 31/12/2018 were included in this study. Based on the inclusion criteria, 168 patients fulfilled the criteria for this study. Out of which only 62 patients came to the hospital for review during the study period and of which 22 patients data could not be collected. Thus they were excluded from the study. 40 patients underwent follow-up evaluation during this study after obtaining informed consent.

DEMOGRAPHICS

GENDER DISTRIBUTION

Among 40 patients, 36 were males and 4 were females.

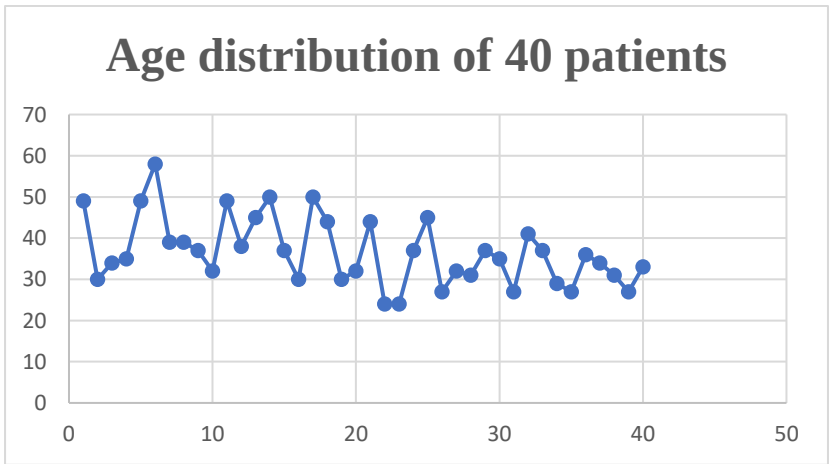
Figure 12: Gender distribution of patients enrolled in this study.



AGE DISTRIBUTION

The oldest patient in the study was 58 years and the youngest was 24 years of age at the time of assessment. The mean age was 36.63 with a standard deviation of 8.16.

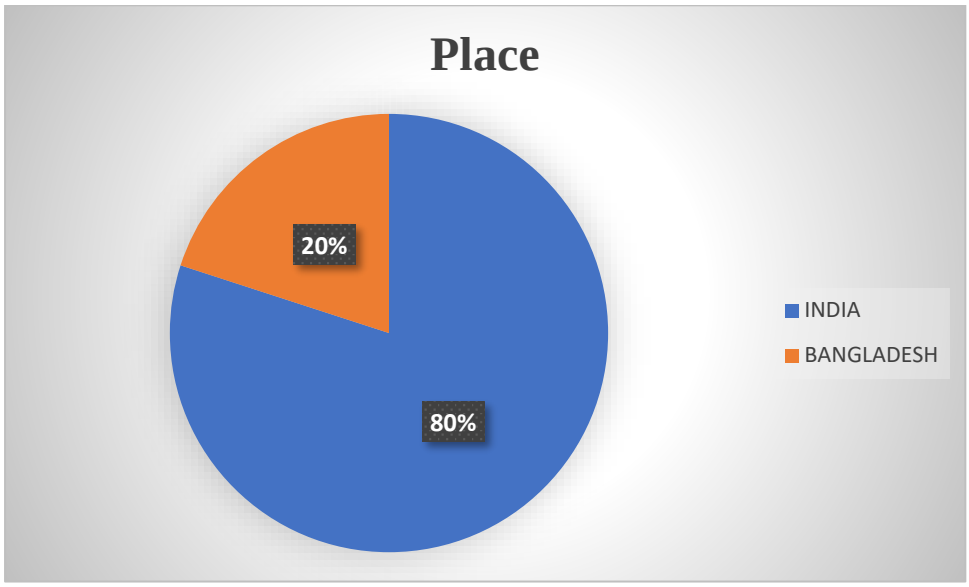
Figure 13: Age distribution of 40 patients

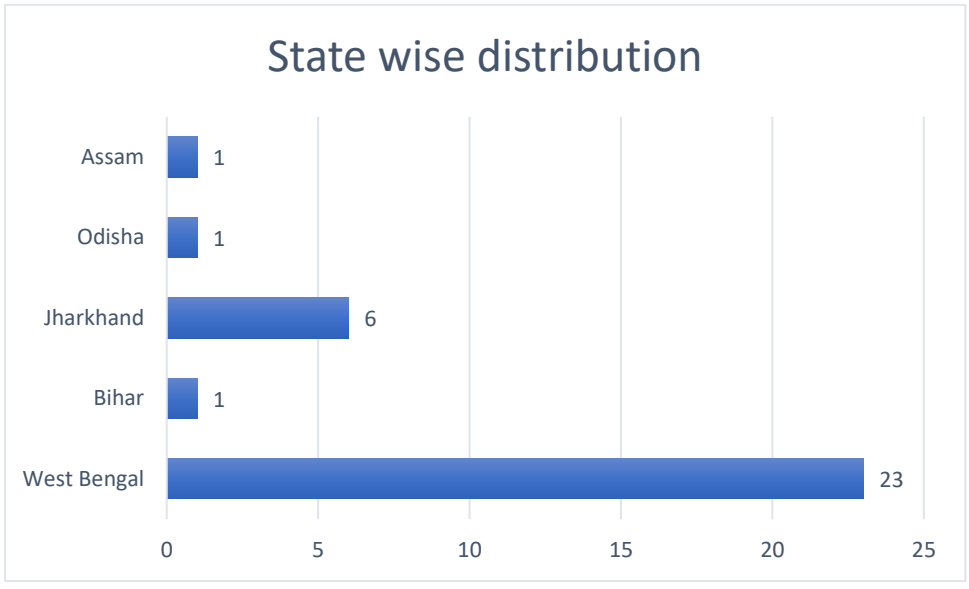


GEOGRAPHICAL DISTRIBUTION

Out of the 40 patients, 32 were from various states of India and 8 were from Bangladesh.

Figure 14: Geographical Distribution of Patients in this study





HOSPITAL STAY AND FOLLOW UP

The average number of days 40 patients spend in our hospital was 15 days and an average follow up of these patients was 38 months post-surgery.

Table 3: Showing Days of Hospital Stay and Patient follow up

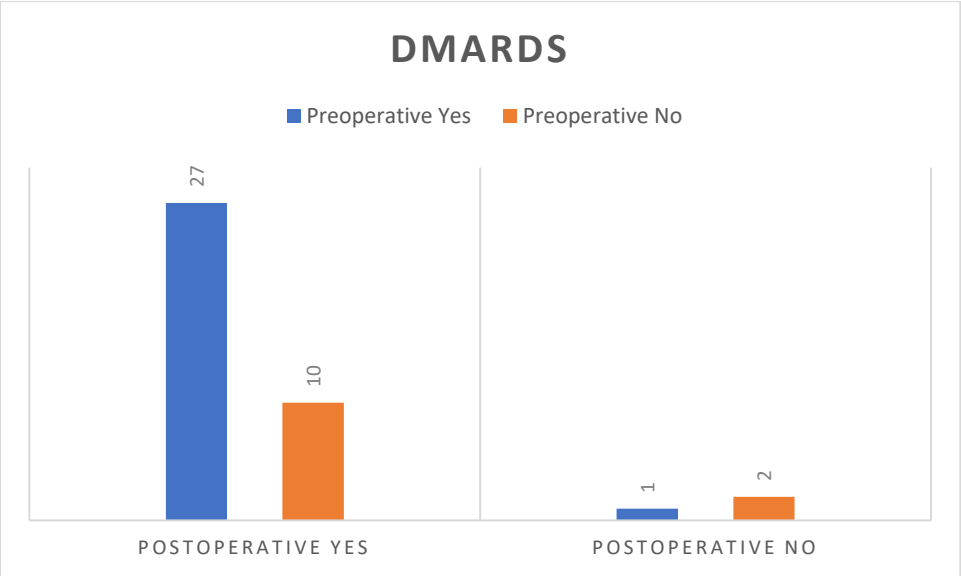
	N	Minimum	Maximum	Mean	Std. Deviation
Total Days Of hospital Stay	40	06	17	12.89	1.856
Follow up of patients (Months)	40	06	83	38.33	22.943

USE OF DISEASE – MODIFYING ANTIRHEUMATIC DRUG (DMARDs)

We also looked into whether these patients had taken DMARDs preoperatively and postoperatively. It was found that 28 patients took DMARDs preoperatively and 37 patients took DMARDs postoperatively. We also found that 27 patients had taken the medications preoperatively as well as postoperatively, 10 patients had taken

postoperatively. one patient did not take DMARDs post-operatively and 2 patients did not take DMARDs pre or postoperatively.

Figure 15: Distribution of Intake of DMARDs Pre and Postoperatively



OUTCOME WITH DMARDs

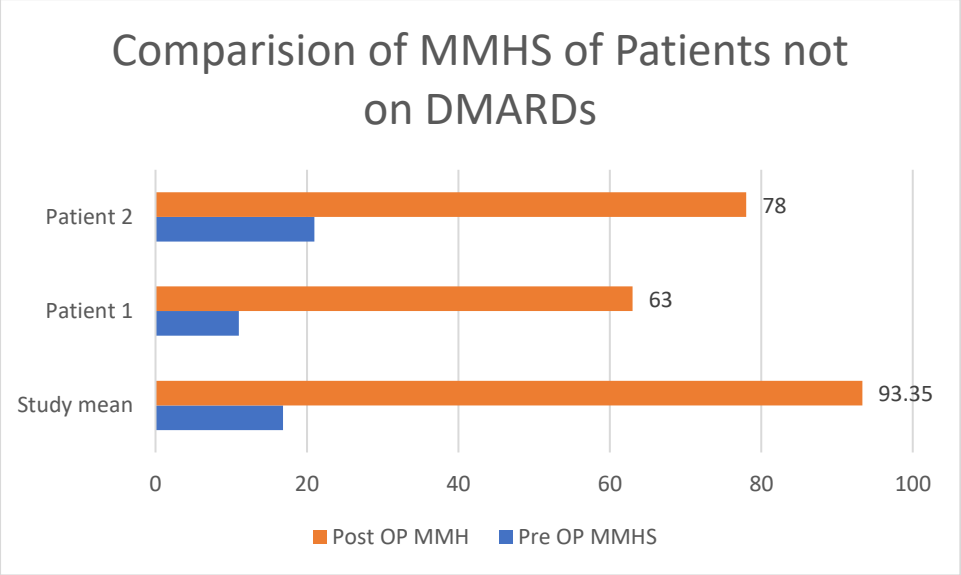
Even though there was no statistical significance, there was a difference in mean modified harris hip score in patients who were taking DMARDs and Not on DMARDs. (Table 4)

Also, it was also noted that 2 patients who never took DMARDs Pre-operatively and postoperatively had a very less postoperative MHHS compared to patients who to DMARDs. (Figure 16)

Table 4: Comparison of MHHS on DMARDs

	Mean ± SD	**Mean diff (95 % CI)**	**P value**
Post OP MHHS			
DMARDs taken pre and postoperatively (n=27)	95.81 ± 5.08	5.21 (-3.65 , 14.08)	0.220
DMARDs not taken preoperatively but taken postoperatively (n=10)	90.60 ± 12.22		
Pre OP MHHS			
DMARDs taken pre and postoperatively (n=27)	17.11 ± 6.07	1.51 (-3.16 , 6.18)	0.515
DMARDs not taken preoperatively but taken postoperatively (n=10)	15.60 ± 6.59		

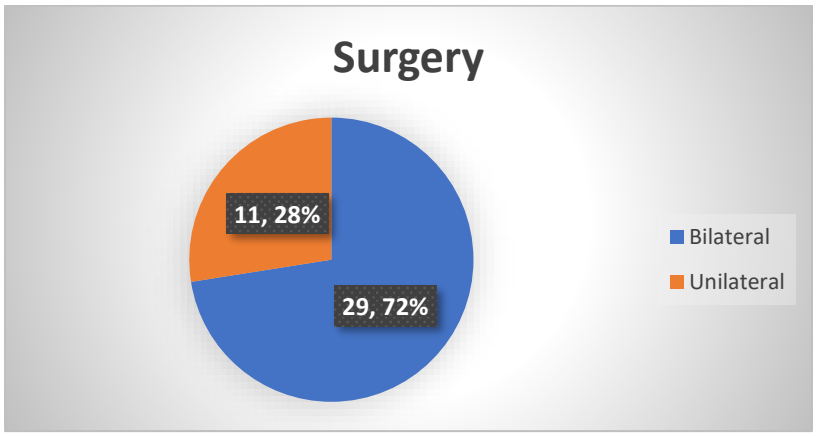
Figure 16: Comparision of MMHS of Patients not on DMARDs



TYPE OF SURGERY

Out of the 40 patients enrolled in this study, 72.5% (29) of patients underwent bilateral total hip replacement and 27.5% (11) of patients underwent a unilateral total hip replacement. Totally 69 hips were included in this study.

Figure 17. Type of surgery patients underwent in this study.



FUNCTIONAL OUTCOME

MODIFIED HARRIS HIP SCORE

On analyzing the modified Harris hip score, the mean preoperative modified Harris hip score improved from **16.85** (Standard Deviation of 6.14) to **93.35** (Standard Deviation of 9.41) at the time of follow up. This improvement was found to be statistically significant ($p<0.001$).

An MHHS of 90-100 was considered Excellent, 80-89 as Very good, 70-79 as good, 60 -69 as average and <60 as Poor.

We had 30 out of 40 patients with postoperative MMHS more that 90.

Table 5: Comparison of MHHS in pre and post (n=40)

	Mean ± SD	**Mean diff (95 % CI)**	**P value**
Post THA MHHS	**93.35 ± 9.41**	76.50 (73.22 , 79.78)	<0.001
Pre THA MHHS	**16.85 ± 6.14**		

Table 6: Total Patients divided on their MHHS and Compared Pre and Postop

Harris Hip Score	**Number of patients**	**Number of Patients**
	Preoperative	**Postoperative**
Excellent	0	30
Very Good	0	5
Good	0	3
Average	0	2
Poor	40	0
Total	40	40

RANGE OF MOTION SCORE

The mean preoperative Range of Motion (ROM) Score improved from **1.06**/5 (SD of 1.28) to **4.54**/5 (SD of 0.63) in the 69 hips we measured. This improvement was found to be statistically significant ($p<0.001$).

Table 7: Overall Comparison of ROM (n=69 hips, Right and Left)

	Mean ± SD	**Mean diff (95 % CI)**	**P value**
Post THA ROM	4.54 ± 0.63	3.48 (3.12 , 3.83)	<0.001
Pre THA ROM	1.06 ± 1.28		

A total of 69 hips of 40 patients was divided into two groups based on ROM scores of the Hip. The first group consisted of Hips with ROM scores of 0 and 1 and the second group consisted of ROM scores of 2,3,4 and 5. There were a total of 48 patients in group 1 and 21 patients in group 2.

Table 8: Division of 69 hips based on the Pre OP ROM score.

Pre ROM	Number	Percentage
0 – 1 : No Movement	48	69.6
2 – 5: Movement	21	30.4

It was also noted that 31 out of 48 patients in ROM group 1 (0-1) had a postoperative ROM score of 5. Also, 64 out of 69 patients had a postoperative ROM score of 4 or 5.

Table 9: Cross-tabulation of pre-ROM (0-1 and 2-5) with post-ROM categories

	Post ROM		
Pre ROM	3	4	5
0 – 1 : No Movement (n=48)	2 (4.2)	15 (31.13)	31 (64.6)
2 – 5: Movement (n=21)	3 (14.3)	7 (33.3)	11 (52.4)

FLEXION PRE OPERATIVE VS POSTOPERATIVE

The comparison of mean preoperative flexion and mean postoperative flexion showed statistically significant improvement ($p<0.001$). The mean preoperative flexion was **29.49°** (SD of 33.22) which improved to **102.03°** (SD of 10.51).

Table 10: Comparison of Flexion in pre and post (n=69 hips)

	Mean ± SD	**Mean diff (95 % CI)**	**P value**
Post THA Flexion	102.03 ± 10.51	72.54 (64.57 , 80.51)	<0.001
Pre THA Flexion	29.49 ± 33.22		

The comparison of Preoperative and Postoperative flexion between ROM groups 1 and 2 showed to be statistically significant (Table 11 and Table 12).

Table 11: Comparison of flexion score (post-pre) in 0-1 and 2-5 group.

Groups	**Pre Flexion**	**Post flexion**	**Mean diff (95 % CI)**	**P value**
0 – 1 : No Movement (n=48)	13.96 ± 17.83	101.38 ± 8.42	87.92 (82.75 , 93.08)	<0.001
2 – 5: Movement (n=21)	65.00 ±33.20	102.38 ± 14.46	37.38 (22.07 , 52.69)	<0.001

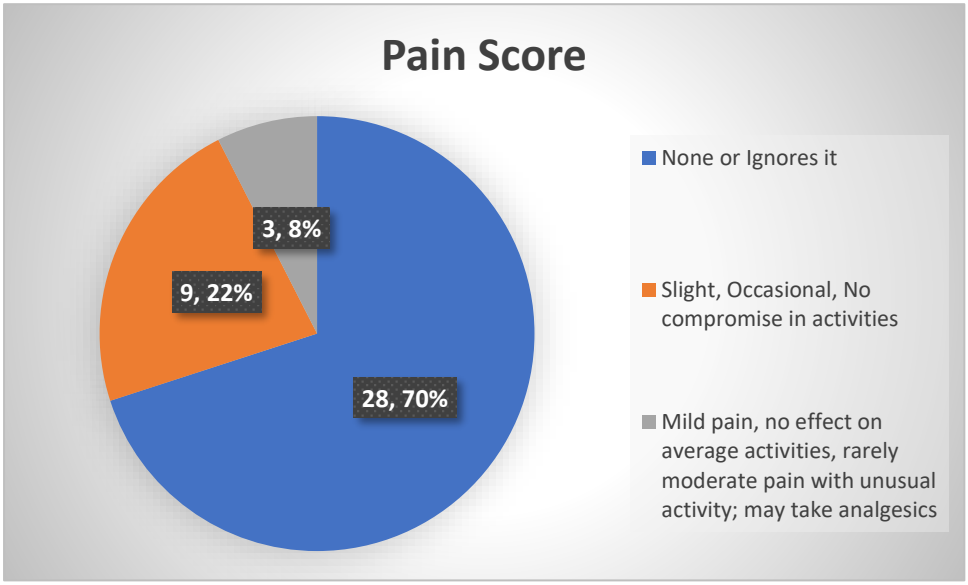
Table 12: Comparison of median flexion score (post-pre) in 0-1 and 2-5 group.

Group	**Pre Flexion**	**Post flexion**	**P value**
0 – 1 : No Movement (n=48)	0 (0 , 30)	100 (100 , 110)	<0.001
2 – 5: Movement (n=21)	70 (32.50 , 90)	100 (100 , 110)	<0.001

PAIN SCORE

It was also found that, among the 40 respondents, the pain relief was excellent. 37 out of 40 (92%) patients did not require any analgesics for pain relief and the remaining 3 patients rarely had moderate pain with unusual activity.

Figure 18: Pain component of MMHS



QUALITY OF LIFE-SF 36 SCORE AND GENERAL HEALTH

It was also noted that out of 40 patients 11 patients found their general health status to be excellent and 20 of them found their general health to be very good (Table 13). The SF 36 questionnaire scores were collected and calculated and the results are given in Table 14.

Table 13: Distribution of general health status among 40 patients

General Health Status	Poor	1	2.5
	Fair	3	7.5
	Good	5	12.5
	Very Good	20	50.0
	Excellent	11	27.5

Table 14: SF-36 Scores

SF-36 Scores		
Mental Health (MH)	(n=40)	84.10 ±11.58
Role limitations due to emotional problems (RE)	(n=40)	94.17 ± 19.81
Social functioning (SF)	(n=40)	86.25 ± 16.70
Energy fatigue/Vitality (VT)	(n=40)	71.87 ± 16.63
General Health (GH)	(n=40)	63.12 ± 24.22
Bodily Pain (BP)	(n=40)	80.00 ± 19.23
Physical Functioning (PF)	(n=40)	69.63 ± 18.58
Role limitations due to Physical Health (RP)	(n=40)	85.00 ± 33.87

DISCUSSION

Ankylosing spondylitis (AS), is a chronic systemic rheumatic disorder, also known as Von Becheterew's disease or Marie – Strumpell disease. Previous studies have shown and established that this disease has a higher male to female ratio of about 2:1 to 3:1 and it was evident in our study also as 90% of our patients were males.

Hip involvement in AS patients is common and the recorded prevalence of clinical hip involvement in AS ranges from 24% to 36% and the prevalence of radiographic hip arthritis ranges from 9% to 22%. (95,96)

Five percent of AS patients have been reported to need hip replacement surgery. (95) In a recent study, the overall rate of joint replacement surgery in RA patients decreased by 40% with the widespread use of anti-tumor necrosis factor (anti-TNF) agents, while the overall rate of joint replacement surgery in spondyloarthritis increased by 40%. (144)

A severe hip deformity can have a huge impact on the quality of life of patients involved, and total hip arthroplasty is the most common treatment of choice. (118,145) Nevertheless, in the context of AS and subsequent surgical outcomes, successful THA procedures are poorly defined. The purpose of this study was to

perform a retrospective analysis of the surgical techniques and results of THA for AS patients.

Several researchers originally suggested that after total hip arthroplasty for AS there would be relatively modest improvements in motion range. (130,133,146) These arose from joint contractures, excessively limited movements, and preoperative ankylosis. Moreover, when the findings were evaluated, and an almost consistently significant increase in the range of movement tends to be maintained.

The most known indication of THA is disabling pain. Patients with stiff hips or bony ankylosis have significant, functional disabilities. THA brings about dramatic changes in function and quality of life in these young patients. The increased hip ROM and subsequent functional improvement in these individuals support THA in this condition.

For long-term fixation and hip function as well as for the longevity of the implants in this young and active group of patients the choice of implant is particularly important in order to improve hip joint strength. (130)

The choice of the femoral implant at THA is dependent on the proximal femur morphology, especially in ankylosing spondylitis. The sizing and the fixation of the

femur in THA should be done according to the proximal femur anatomy to ensure implant longevity

Significant debate has centered on the superiority of cementless and cemented components in AS patients. (134,139,147–149) Several researchers have proposed that cemented prostheses may be beneficial in AS patients, as extreme osteoporosis usually found in affected patients makes it difficult to achieve enough osseointegration between bone and prosthesis. (2,139) By comparison, advocates of a cementless component argue that bone ingrowth would increase the implant's lifetime and minimize the complexity of the young AS population's future revisions. (137,147,148)

Cemented THA was preferred and was performed in patients with AS with Dorr type C femurs. Cemented femoral components may achieve favorable long-term results with high-quality cementing based on the Barrack et al (150) cement classification. Regardless of the type of femoral implant (cemented or cementless), Dorr's type C patients had higher femoral component loosening. (121)

In general, a decrease in physical activity and weight loss with the progression of the disease can reduce physiological stress in patients with AS (151), good component fixation should be achieved for total hip arthroplasty. The soft tissue and bony changes are responsible for the progressive stiffness. The restoration of the normal range of movement is not possible after THA due to the soft tissue changes. This leads

to increased forces at the implant-bone interface. The survivorship of the total hip arthroplasty in these patients has improved significantly but the THA revision rates may be slightly higher than the overall revision rates. (121,152)

After Charnley low-friction arthroplasty with cement in 43 cases, Sochart and Porter (135) obtained better surgical outcomes in long-term follow-up. Initially, the authors of this study favored cemented femoral implants and obtained satisfactory results using components of cemented stem form. Saglam et al. (121) identified the possibility of using both cemented and uncemented components.

The findings of 76 Charnley low-friction arthroplasties were analyzed by Lehtimaki et al. (153) with a follow-up of 8 to 28 years. The patients averaged 40 years (16-67). The survival of both original components was 80% at age 10, 66% at age 15 and 62% at age 20.

Joshi et al. (2) analyzed the findings of 181 low-friction Charnley arthroplasties in 103 patients with an average 10-year follow-up (range: 2-27 years) and average 47-year age (17-77 years). The survival of both original components was 87% at 10 years, 81% at 15 years and 72% at 27 years. Due to mechanical loosening, seventeen hips were revised.

Shih et al. (148) reported in 46 patients (74 hips) with AS on the long-term outcome of THA. Both cemented (52 hips) and cementless (22 hips) prostheses were used in their studies. According to the Kaplan-Meyer survival curve, 78% of the prosthesis remained functioning after 10 years. During follow-up, 15 cemented implants (28 percent) were found to be loose, while only one cementless (5 percent) was found to have femoral stem loosening. While they were unable to conclude definitively on the superiority of cementless fixation, the development of good bony growth in follow-up radiographs suggested that there might be a more important role for cementless fixation in young patients with AS.

95 THAs were examined by Tang and Chiu (139), of which 46 were cemented and 49 were cementless. The likelihood of survival was 100 percent at 5 years, 97.7 percent at 10 years, and 66.5 percent at 15 years for cemented prostheses, which were mainly Charnley prostheses. At both 5 and 10 years, the survival rate for the uncemented components was 95.5 percent. At 11 years, however, it fell sharply to just 66%. They were unable to comment on whether one form of the prosthesis was superior to the other because patients with cemented prosthesis were significantly younger than patients with a cementless prosthesis, so the two patient groups were not comparable.

With a mean follow-up of 8.5 years, Bhan et al. (137) evaluated 92 cementless arthroplasties in AS patients. Analysis of Kaplan-Meier survival with revision as endpoint showed 98.82% survival at 5 years and 85.8% survival at 8.5 years of

follow-up. 13 hips(14%) were revised due to aseptic loosening, the revision period averaged 8.5 years (range, 5-12 years).

Cementless total hip arthroplasty was used in 83 hips (79%) and cemented TKA in 22 hips (21%) in the study by Saglam et al (121). At an average follow-up of 5.4 years, the overall rate of aseptic loosening was 7.6 percent. Femoral loosening in cemented and cementless femoral components was statistically comparable (14% vs. 8%; p= 0.089).

In our study, we used the cementless prosthesis for all our 40 patients and 69 hips. The average follow up of patients was 38.33 months and the maximum was 84 months of follow up. At the point of last follow up there was no evidence of clinical or radiological signs of implant loosening.

In this study, the MHHS, the ROM Score and the SF-36 Score were analyzed for the quality of life and joint functions of patients. The Harris Hip Score has three parts. The first part is as follows: questions related to pain, distance covered while walking, limping, wearing socks and shoes, climbing stairs, sitting and using public transportation. Two elements from the original Harris hip score relating to socks/shoes and sitting are replaced respectively by squatting and sitting cross-legged. This was done as patients do not wear shoes and socks in the Indian rural setting which was also used by Vishwanathan et al. (154)) in their study and they concluded that MHHS has

sufficient construct validity, internal validity, and sensitivity to determine the functional outcome of hips in the Indian population. In the second part, differences in limb length and joint movement are assessed. In the third part, flexion, abduction, adduction and external rotation of the hip joint are examined. The final score is the sum of the scores allocated for each part, However, published data found the physical examination aspect of HHS to be of minimal significance. (124) So we used only the first part to calculate our MHHS and the maximum range of scores was 0 to 91. The range of scores was rescaled to 0 to 100 for ease of presentation. (125) In this study, the third part was analyzed separately as the ROM score.

The HHS test of post-operative patients compared to pre-operative patients in this study showed significant progress in hip joint function so that the mean HHS was observed preoperatively was 16.79 which improved to 93.35 postoperatively at the time of review for this study.

The ROM survey in patients at the time of review for this study compared with before surgery in this study showed considerable progress has been made in the hip joint function so that the Preoperative mean ROM score increased from 1.06 to 4.54 postoperatively at the time of review for this study. We also looked at the flexion movement of the 69 hips we analyzed and it was found there was a significant improvement in flexion from preoperative to the postoperative period for the patient at

the time of review for this study. The preoperative and postoperative mean flexion was 29.49 and 102.03 respectively.

We also looked into the pain relief component of the MHHS separately as one of the aims of total hip arthroplasty is pain relief. We found that 92% of our patients in this study have no pain or ignorable pain that did not compromise in any activities. In the remaining 8% of the patients, they had only rarely moderate pain with unusual activity that may or may not require analgesics for pain relief.

Bhan et al (137) and Saglam et al (121) recorded changes in their respective case series of 33.1 and 34.1. One possible reason for the change seen in our study is that the patient group began at a much lower functional baseline.

Kilgus et al (147) evaluated the range of motion of patients in the flexion position and their findings were largely in line with our study in terms of improvement.

It is important to note that the surgical approach that we used in our orthopedic unit was the Mallory Modification of Hardinge approach (113) and there is a lack of literature that looks into the functional outcome following THA with this approach, especially in ankylosing spondylitis. The posterior approach has been used in the majority of published literature. (97,134,137–142)

While various surgeons have modified the anterior lateral approach, all modifications to this procedure for THA have a common element. In the technique suggested for mobilizing the abductors from the greater trochanter, differ in the various anterolateral approaches. (113)

In a 1954 study, McFarland and Osborne (155) highlighted the gluteus medius and minimus and the vastus lateralis muscles as being in direct functional cohesion through a thick periosteum covering the greater trochanter's anterolateral border. In 1982, Hardinge (114) introduced the hip-the direct lateral approach as a modern surgical technique and stressed McFarland and Osborne's observation. Hardinge's major change was to leave the posterior portion of the gluteus medius, with its thickest attachment point, undisturbed from the greater trochanter.

The abductor splint in the translateral approach by Mallory is more anterior compared to the technique described by Hardinge, thus leaving the lateral 2/3rd of the attachment of gluteus medius intact.

The translateral approach as described by Mallory offers predictable and easy access to the hip joint. It prevents the sciatic nerve from being endangered, eliminates the need for trochanteric osteotomy, provides excellent exposure to both acetabular and proximal femoral regions, and provides rapid postoperative rehabilitation. A dislocation happens rarely and the development of heterotopic bone is not a significant

complication. The abductor muscle "split" is a simple method that respects the anatomy involved, given the different techniques for mobilizing the abductor musculature. Ultimately, this particular surgical technique did not affect the hip function as measured by Mallory et al in their study. (156)

Our method followed the principles outlined below. The TFL is divided, the gluteus medius is clearly defined and the fibers split at the junction of the anterior one third and posterior two-thirds. The anterior 1/3 is detached at the musculotendinous junction to facilitate good resuturing at closure. The gluteus minimus and capsule are then divided together towards the 12 0 clock position of the acetabulum and the hip dislocated after adequate release.

The various studies which have been done in this field have been summarised in table 15.

Table 15: Summary of Other studies and Comparison with our series

Study (Year)	Patients (and Hips)	Follow up in Months	Pain Relief(%)	Final MHHS	ROM Score/ Mean Flexion	Approach	Complications (%)
Bisla(130) (1976)	23 (34)	42.5	91	NS	ROM-3	NS	5.88
Resnick (146) (1976)	11 (21)	36	NS	NS	NS	NS	0
Williams (157) (1977)	56 (99)	36	NS	NS	NS	NS	10
Baldurson (131) (1977)	10 (18)	45.6	94	NS	Flexion-90	NS	0
Shanahan (158) (1982)	12 (16)	89	94	NS	NS	NS	6.25
Finsterbush (132) (1988)	23 (35)	90	NS	NS	Flexion-86	NS	14.28
Walker (133) (1991)	19 (29)	58	97	NS	ROM-4	NS	0
Gualtieri (159) (1992)	39 (73)	90	89	NS	NS	NS	0
Brinker (134) (1996)	12 (20)	75	90	89.1	ROM-4	Posterior, Lateral	0
Sochart (135) (1997)	24 (43)	276	100	NS	ROM-4	NS	27.9
Lehtimaki (153) (2001)	54 (76)	240	NS	NS	NS	NS	3.94
Joshi (2) (2002)	103 (181)	120	96	NS	NS	Lateral, Hardinge	10.5
Kim (136) *2007*	12 (24)	132	NS	82.3	NS	Lateral	12.5
Bhan (137) (2008)	54 (92)	102	62	82.6	ROM-4	Posterior	14
Li (138) (2009)	24 (39)	36	NS	91	ROM-4	Posterolateral	2.5
Tang (139) (2000)	58 (95)	135.4	94	88.8	ROM-4.2	Posterior	20
Bangjian (140) (2012)	12 (24)	50.4	100	86.25	Flexion-84	Posterolateral	0
Malhotra (141) (2012)	23 (32)	42	NS	87.1	ROM-4	Posterior	4.7
Siavashi (97) 2014	77 (NA)	12	NS	88.22	ROM-5	Posterior, Lateral	20.8
Xu (142) 2017	54 (81)	42	NS	86.1	Flexion-82.5	Posterolateral	0
Our Series	**40 (69)**	**38.33**	**92**	**93.35**	**Flexion-102.03, ROM-4.54**	**Mallory Modification of Hardinge**	**1.4**

Many studies have shown that the use of DMARDs and Biologicals in Ankylosing spondylitis has mixed results (160,161), few studies have shown improvement and few have shown no benefit. In our study, we looked into the harris hip score of patients who were on any of the medications for AS preoperatively and postoperatively Vs Patients who started taking these medications postoperatively. We found that even though there was no statistical significance between the two groups, the pre and post MHHS of patients who were on medication pre and post-operatively we slightly higher (Refer Table 4). We also noted that Post Operative MHHS of two patients who did not take any DMARDs or Biologicals pre or postoperatively showed significantly lower Postoperative MHHS scores compared to the study mean value of MHHS (Refer Figure 16).

Based on the Range of Motion Scale, which is the sum of Flexion, Abduction, Adduction, External and Internal Rotation, the ROM score was calculated. There are totally six scores starting from 0 (0-30°), 1 (31°-60°), 2 (61°-100°), 3 (101°-160°), 4 (161°-210°) and 5 (211°-300°). We divided the 69 hips based on ROM scores into two groups, Group 1 with ROM score of 0-1 and Group 2 with ROM score of 2-5 (Refer Table 8). Patients in group 1 had little or no movements in their hips and their mean preoperative flexion was 14° and Patients in group 2 had some movements across their hip Joint and their preoperative flexion was 65° (Refer Table 11). We found that Postoperative flexion was similar in both the groups (101.38° in group 1 and 102.38° in group 2). This shows that surgical intervention in a fused or stiff hip with a grossly reduced range of movement also provided results that were comparable to patients

who had some movements across their hip joint. This was found to be statistically significant in our study. We also noted that out 69 hips we studied totally 64 (93%) patients had a ROM score of 4 and 42 (61%) patients had a ROM score of 5 postoperatively. This shows the improvement in the functional aspect of a patient with ankylosing spondylitis.

Short Form 36 or also known as SF-36 is to date, the most commonly used health-related quality-of-life measure in research. SF-36 focuses on eight domains, each of which consists of several questions. For example, questions in the physical domain attempt to determine the degree of limitation caused by the individual's health to activities such as walking and climbing stairs, using three answers: ‘not limited at all,’ ‘a little limited’ and ‘a lot limited.’ For the more general components, five responses are offered: 'excellent', 'very good', 'good', 'fair,' and 'poor' Responses to all questions within a domain are used to generate a construct score, 0–100, higher scores indicate better health.

The SF-36 scores we calculated in our study we compared it with other studies which looked into the quality of life among patients with ankylosing spondylitis. We also looked into studies that showed. A case-control study in the Iranian population done by bahardoust et al. (162) showed that Patients who underwent THA, irrespective of the condition leading towards THA, had remarkable reduced Health-related quality of life in the Iranian population.

In a study by Dagfinrud et al. (163), which looked into the comparison between the health status of the general population and patients with ankylosing spondylitis using SF-36 scores. They found patients with AS on all SF-36 scales showed significantly impaired health. They concluded that AS affects all crucial health dimensions and that the physical aspects seem to be most severely affected.

In a study by van Tubergen et al (164), which investigated the relationship between exhaustion and quality of life in AS in all its aspects, found the quality of life using SF-36 scores, found that AS patients with fatigue has relatively low SF-36 Scores.

Our findings are summarised and compared with other studies and given in table 16.

In 2016, Yang et al. (143) did a systematic review and meta-analysis on The health-related quality of life of ankylosing spondylitis patients assessed by SF-36. Thirty-eight studies were included in this study, all of which were consistent in summarizing the SF-36 scores The combined mean physical health domain scores ranged from 45.93 to 58.17, with the RP and PF domains being the lowest and the highest respectively. The combined mean scores for mental health domains ranged from 47.49 to 62.52, with the VT and SF domains being the lowest and the highest respectively. They concluded that Patients with AS had a substantially impaired quality of life in comparison with the general population.

Table 16: Comparision of SF 36 scores with other studies

SF-36 Scores	Our Series	Bahardoust et al (162) 2012	Dagfinrud et al (163) 2004	van Tubergen et al (164) 2002
Mental Health (MH)	**84.10 (11.58)**	39.9(28.2)	70 (19)	65.5 (18.1)
Role limitations due to emotional problems (RE)	**94.17 (19.81)**	79.1 (19.2)	66 (42)	68.5 (41.3)
Social functioning (SF)	**86.25 (16.70)**	28.5 (29.2)	70 (27)	64.6 (24.6)
Energy fatigue/Vitality (VT)	**71.87 (16.63)**	56.2 (21.4)	43 (23)	42.6 (16.5)
General Health (GH)	**63.12 (24.22)**	42.1 (26.3)	51 (24)	42.8 (20.2)
Bodily Pain (BP)	**80.00 (19.23)**	48.2 (28.4)	44 (22)	48.3 (19.2)
Physical Functioning (PF)	**69.63 (18.58)**	28.3 (11.1)	71 (23)	55.8 (23.4)
Role limitations due to Physical Health (RP)	**85.00 (33.87)**	31.2 (12.6)	44 (41)	35.6 (38.1)

Comparing the SF-36 scores with other studies showed that each component of SF-36 scores of our patients showed that values were comparable and even more than some of the studies. Even though the studies compared here gives SF-36 scores among the patients with ankylosing spondylitis and our study looks the quality of life after an ankylosing spondylitis patient undergoes total hip replacement, It may very well indicate that total hip replacement in ankylosing spondylitis patient definitely improves their quality of life both physically and emotionally.

Complications

We had only one patient who developed a complication in our study. This patient had undergone bilateral THR in 2012 and presented with left side pain 73 months after his surgery. He has been on immunosuppression with DMARDs (Methotrexate, Sulfasalazine and Hydroxychloroquine) in varying doses Preoperatively and as well as postoperatively. There was also a history of receiving alternate medicine.

On taking detailed history it was found that In 2015, he developed hyperpigmentation over the lower 1/3rd of both legs and he was diagnosed to be having chronic venous insufficiency secondary to perforator incompetence. He was managed conservatively with Daflon and compression stockings.

He was evaluated and diagnosed to be having chronic osteomyelitis of the left proximal femur and he first underwent implant exit and cement spacer insertion his intraoperative cultures grew coagulase-negative Staphylococcus species resistant to oxacillin. He was initiated on Inj. Teicoplanin and received 6 weeks course. Postoperatively after the second surgery, he developed left superficial femoral vein thrombosis which was managed non surgically.

Six months later he underwent Left Hip Spacer Exit and Total Hip Replacement, Intraoperative cultures did not have any growth. Postoperatively his condition and wound were stable.

This is a delayed presentation of periprosthetic infection that was seen 73 mths from surgery. The cause for infection in this patient could have been precipitated due to chronic venous insufficiency secondary to perforator incompetence. In a study by Jenkins et al. (165), he has mentioned about the patient being at risk of infection due to chronic venous insufficiency. Fritz et al. (166) in his study also highlighted the relationship between chronic osteomyelitis with chronic venous insufficiency. National Organization for Rare Disorders (NORD) in their database mentions about osteomyelitis due to diminished blood supply to bones.

Chronic Venous insufficiency along with immunosuppression with DMARDs could have been the reason for complications in this patient.

LIMITATIONS

The key limitations of this research are as follows:

A large number of patients 106 out of 162 (65.43%) did not come back for follow up. Our data was collected retrospectively with clinical follow-up.

Our study's average follow up was 38.33 months (range 6–83 months). An average 5 year follow up with radiological and clinical outcomes would have been ideal to study the various outcomes.

THAs at our unit are performed with the Malory modification of the Hardinge approach. Analysis of the THA outcomes for AS patients compared to the other non-inflammatory arthritis group would have added value with two groups for comparison. although researching the short-and mid-term effects of THA in AS patients is acceptable; the number of cases may have been too small (69 THAs), although the completeness of all clinical and functional evidence supports our study findings.

We will continue to follow up on these patients to analyze the long term outcome and results in AS.

CONCLUSION

In summary, AS typically presents with varying degrees of hip involvement associated with a significant impairment of function. THA in ankylosing spondylitis brings about definite functional improvement as well as pain relief. The increased range of movement results in good functional improvement especially in these patients with stiff spines.

Component survival is an important issue considering these patient's young age. Good long-term survival with cemented THA has been documented. In this subgroup, studies on cementless THA have a relatively shorter follow-up time and therefore no definitive conclusion can be drawn regarding their superiority.

Our studies suggest that Mallory modification of the Hardinge approach with cementless implants for THA achieves significant functional improvement in ankylosing spondylitis.

Also, we were able to conclude that our surgical intervention on these subsets of patients showed satisfactory results in all the eight health dimensions of the SF 36 score, indicating an improvement in the quality of life in these patients.

We will continue to follow up on these patients to understand the long term results and outcomes for these patients who have undergone THA with ankylosing spondylitis.

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ANNEXURES

ANNEXURE 1: CLINICAL PICTURES

Figure 17: AS Patient Sitting in a chair

Figure 18: AS Patient Lying in bed

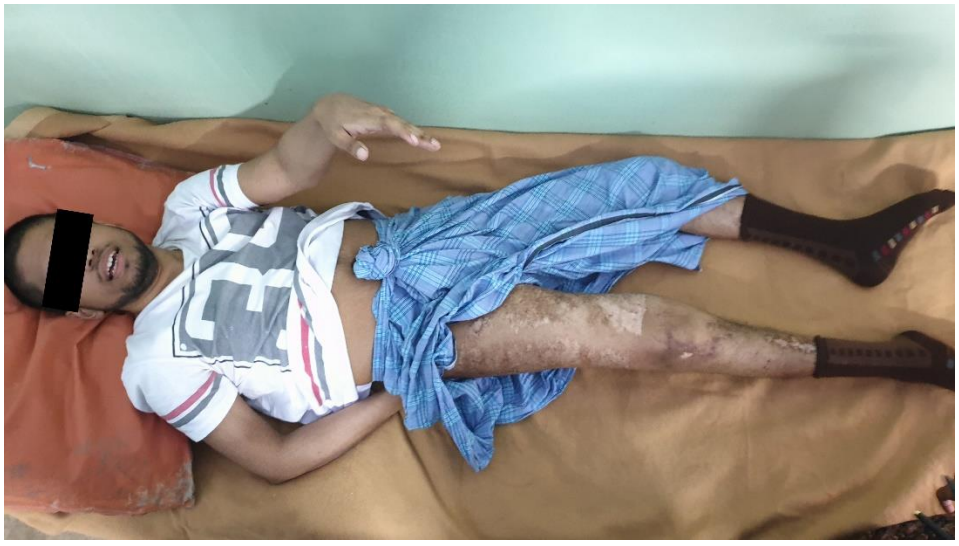
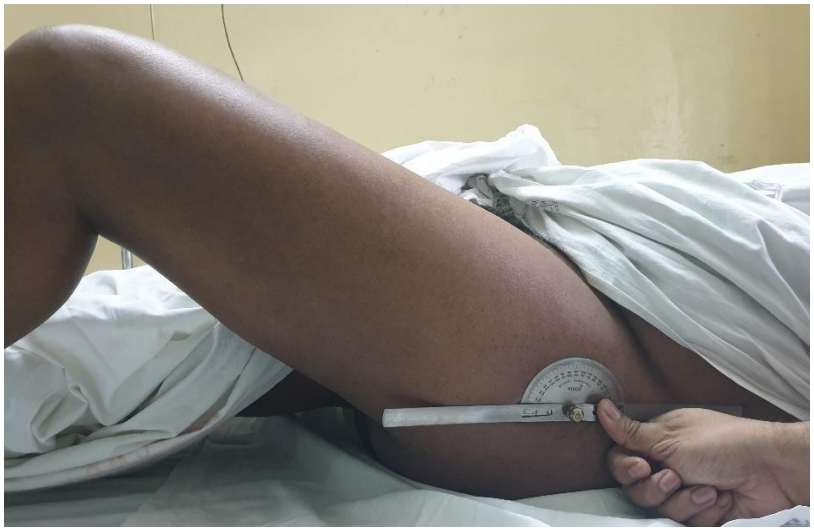
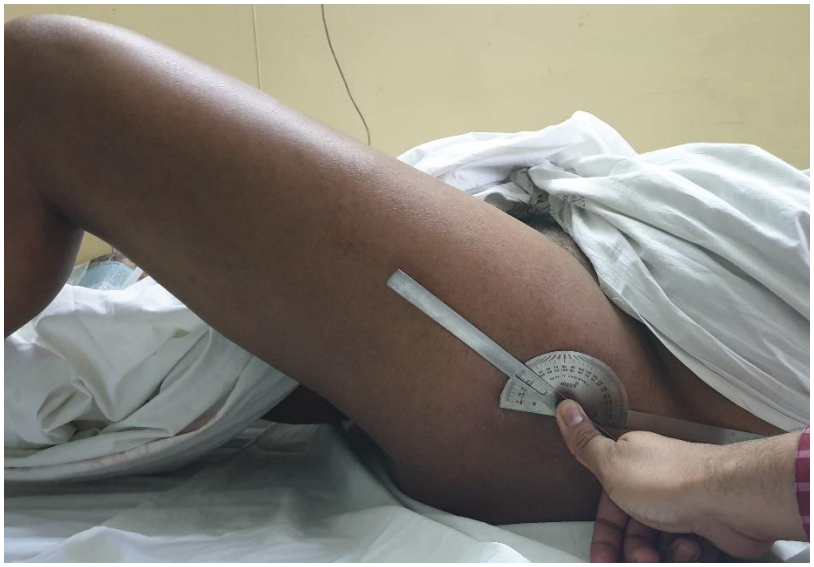


Figure 19: Measuring Flexion





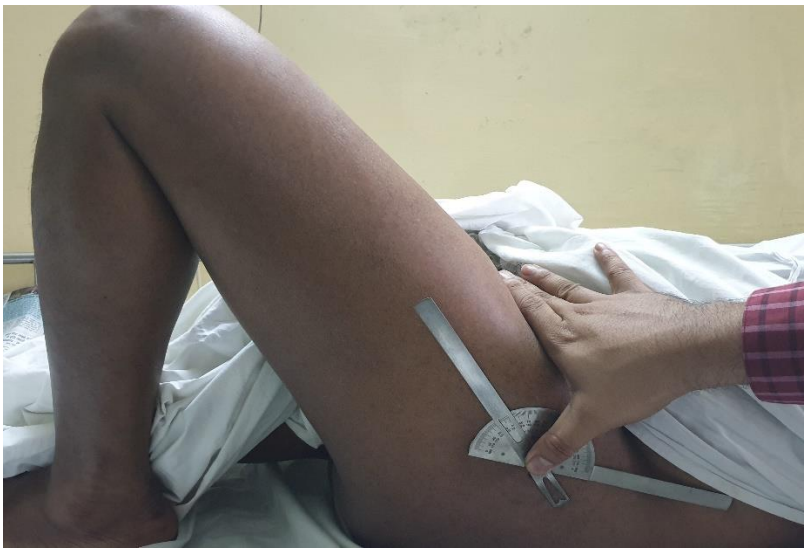


Figure 20: Measuring Abduction and Adduction

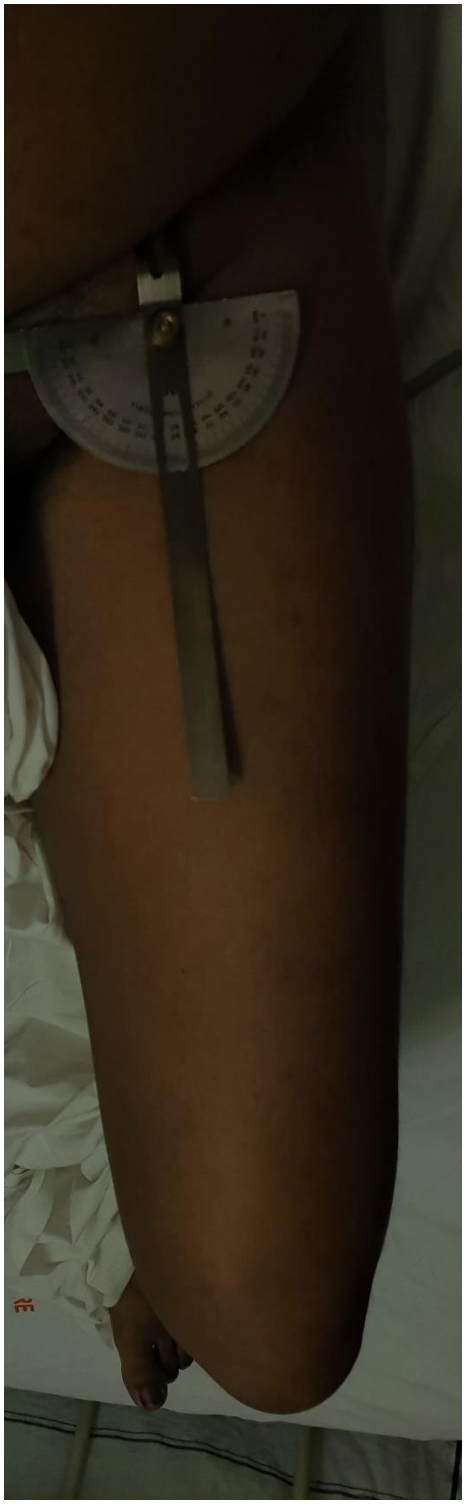
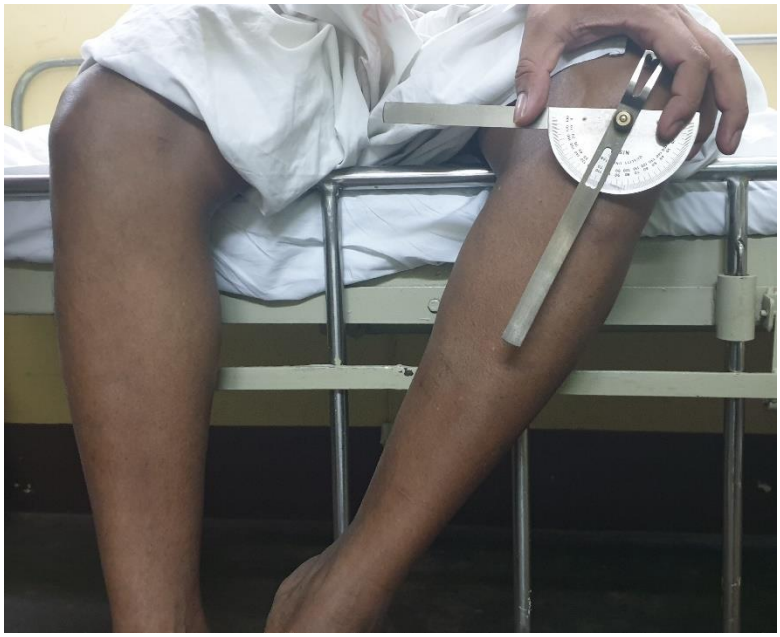
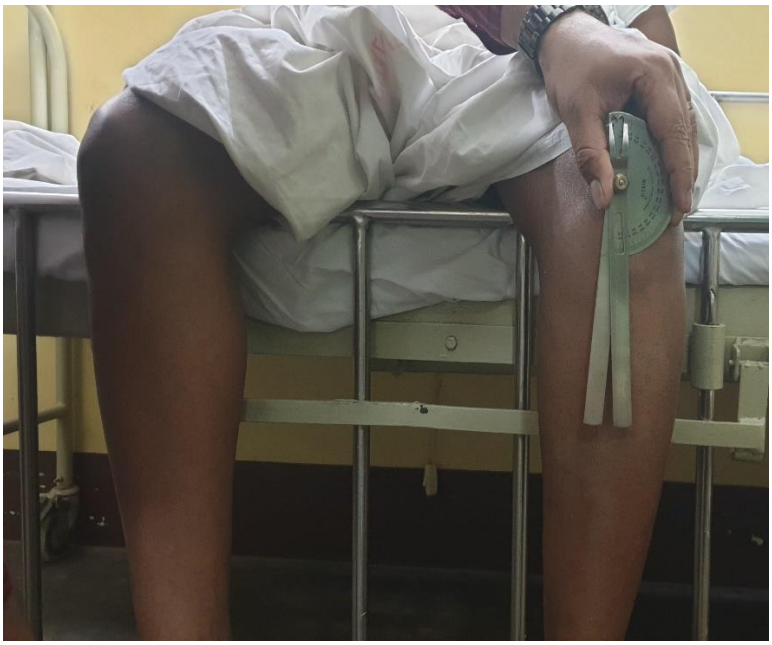


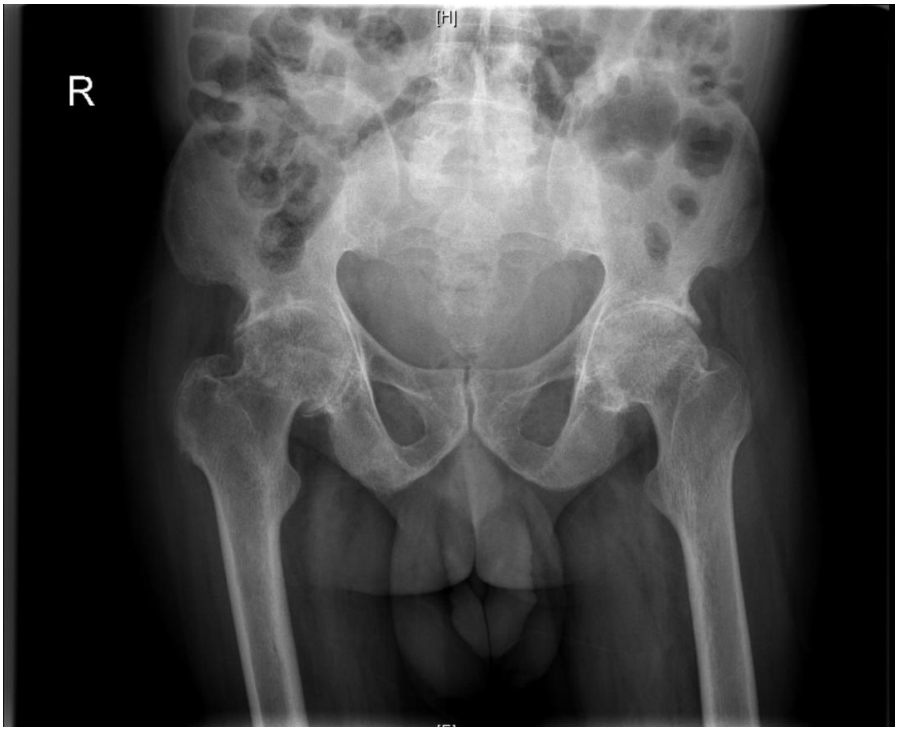
Figure 21: Measuring Internal and External Rotation





ANNEXURE 2: X-RAYS

Figure 22: Patient 1



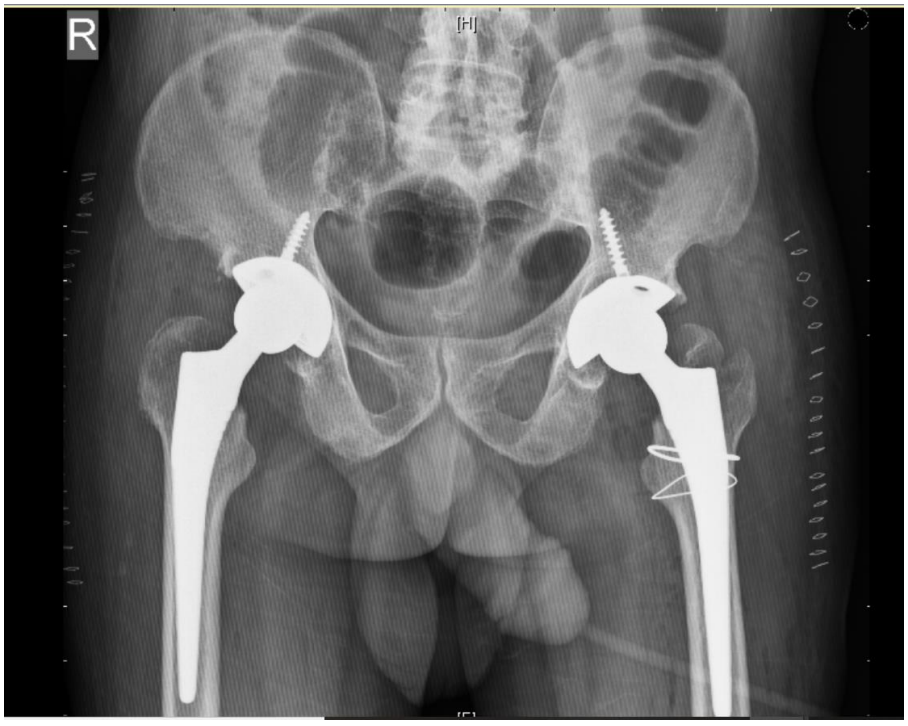
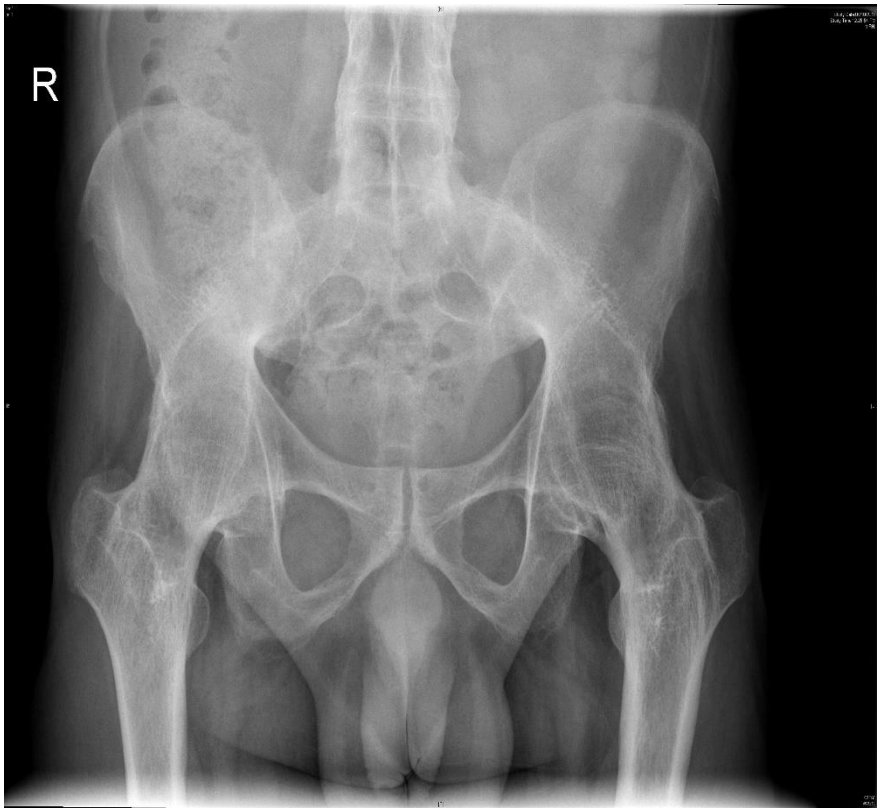


Figure 23: Patient 2



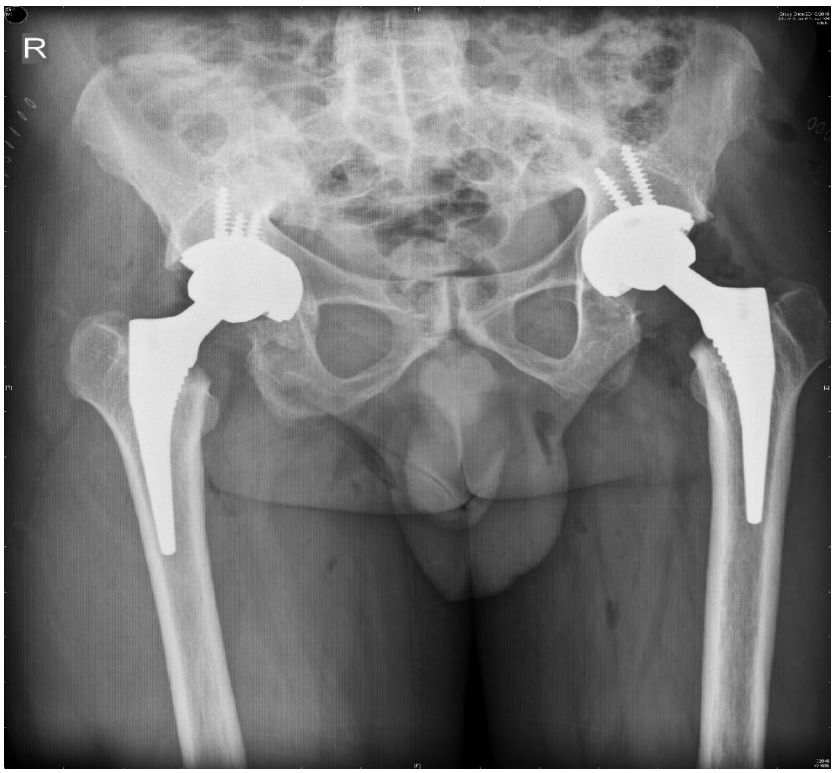


Figure 24: Patient 3

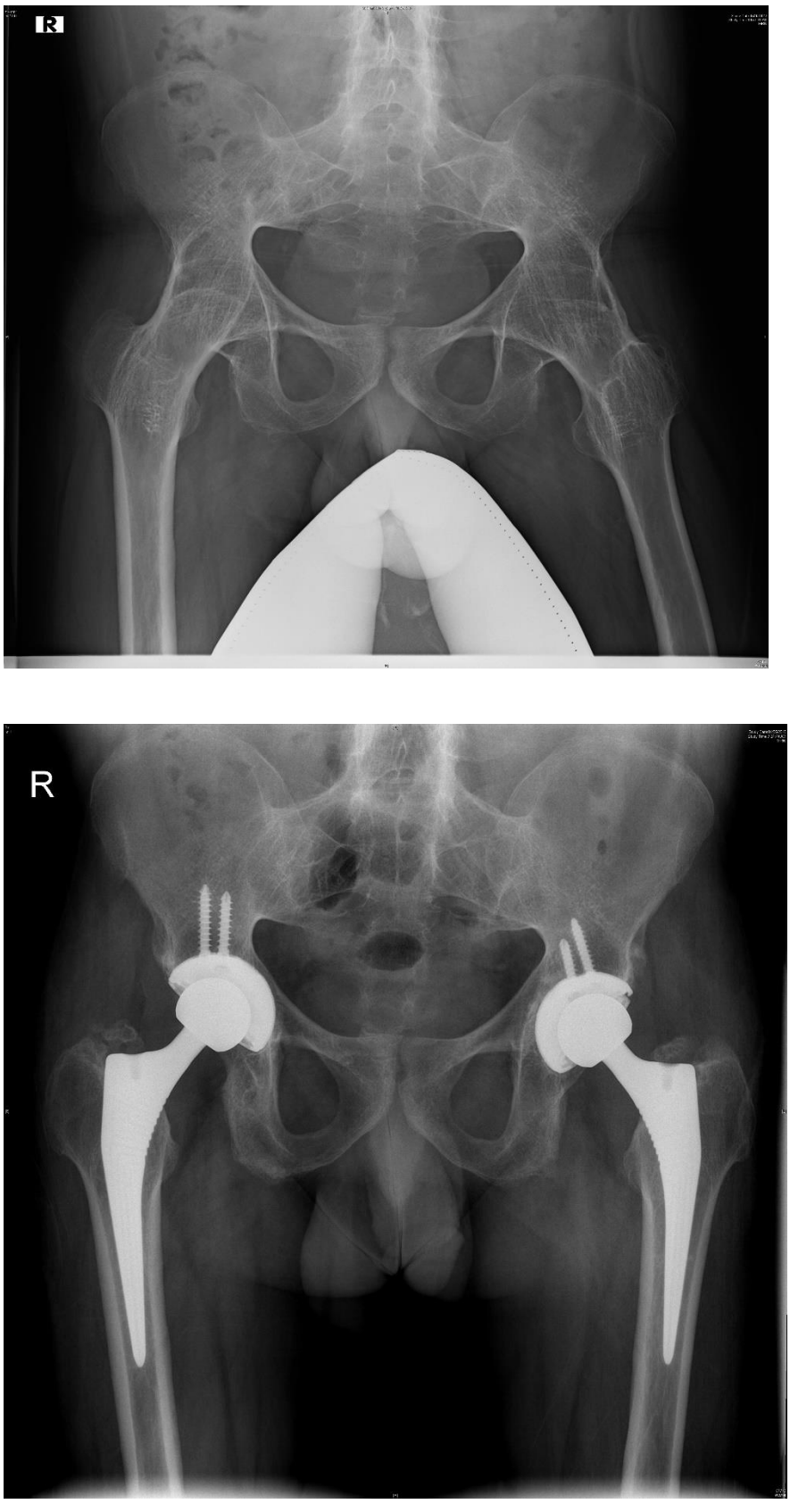
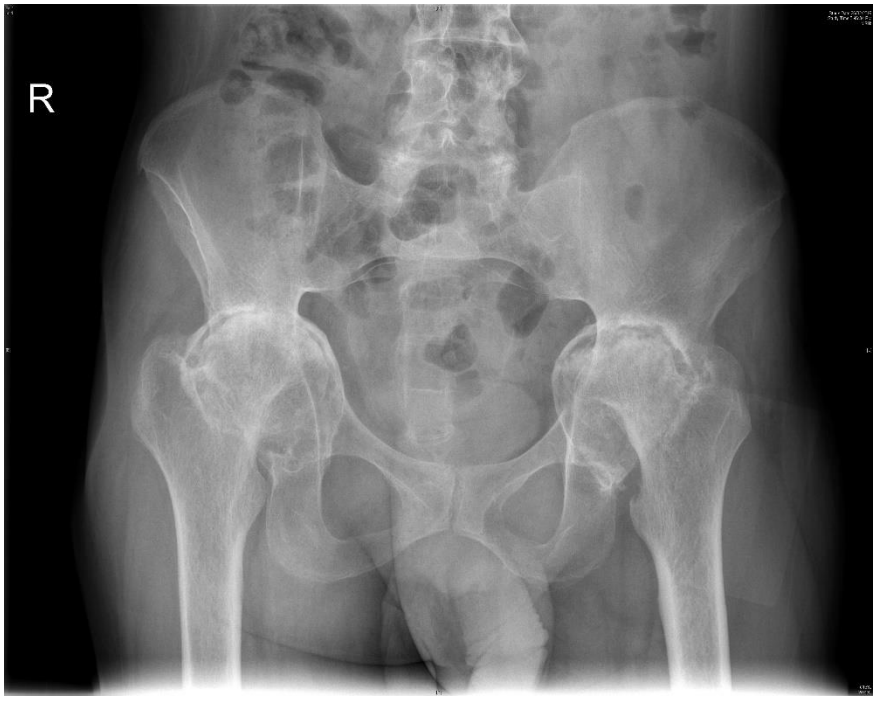


Figure 25: Patient 4



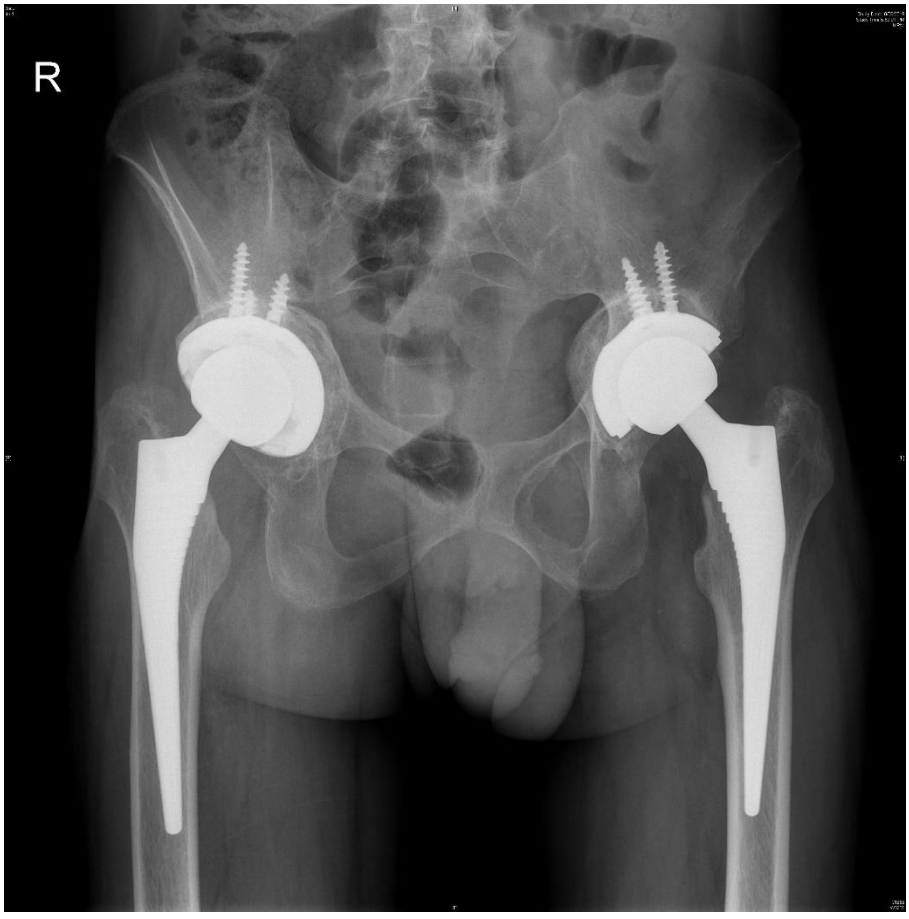
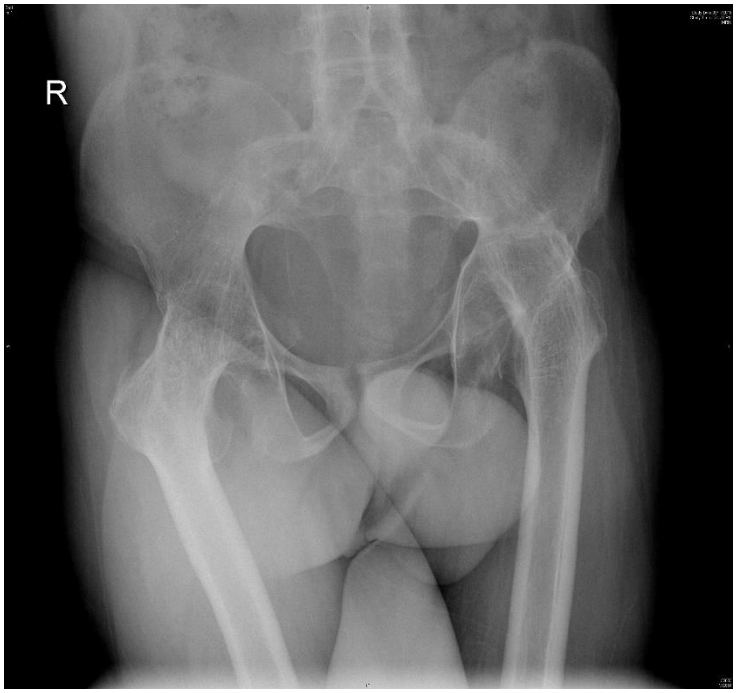
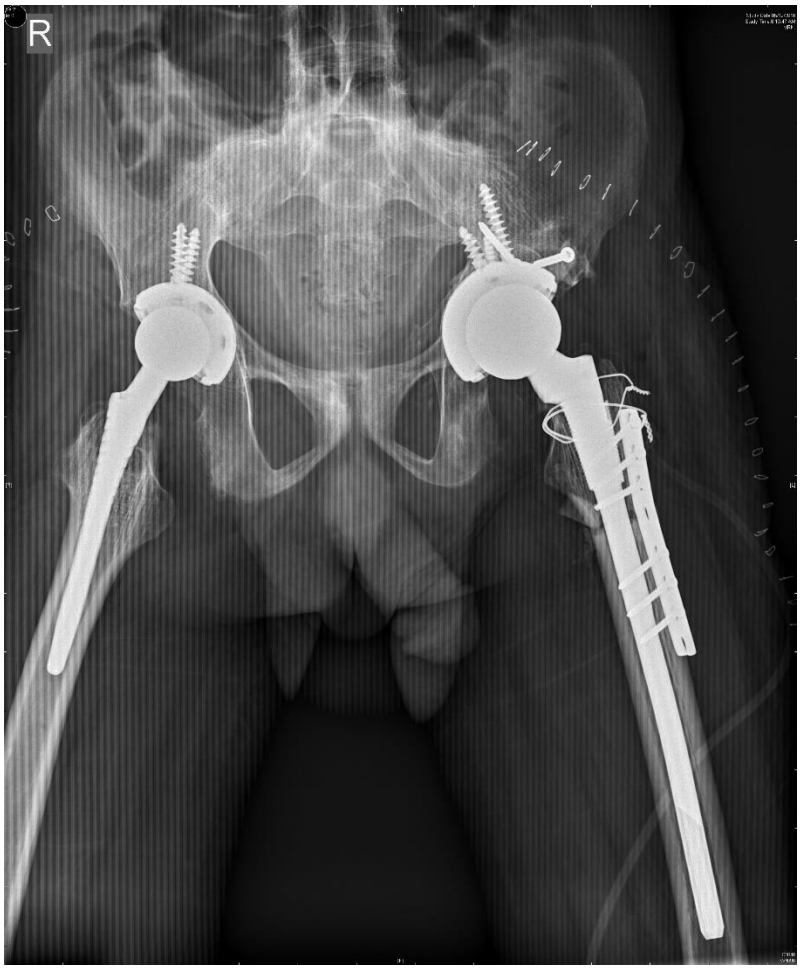


Figure 26: Patient 5





ANNEXURE 3: PROFORMA

Total Hip Arthroplasty in Patients With Ankylosing Spondylitis and SSA

PERFORMA

Subject Initials ☐☐☐ Subject ID ☐☐☐☐☐ Date: ☐☐ / ☐☐ / ☐☐
Month Day Year

Demographics

Medical Record Number: ☐☐☐☐☐☐☐

First Name:
Middle Name (or initial):
Last Name:

Birthdate: ☐☐ / ☐☐ / ☐☐☐☐
Month Day Year

Gender: (check one)
☐ Male
☐ Female

Marital Status: (check one)
☐ Married
☐ Single
☐ Separated

Contact Information:

Address:		City:
State:	Pin:	Country:
Phone Number: ☐ Home ☐ Work ☐ Cell ☐ Other	Alternate Phone Number: ☐ Home ☐ Work ☐ Cell ☐ Other	Email address:
Preferred method of contact:		

Emergency Contact:

Name:		
Address:		
City:	State:	Pin:
Phone Number: ☐ Home ☐ Work ☐ Cell ☐ Other	Alternate Phone Number: ☐ Home ☐ Work ☐ Cell ☐ Other	Email address:
Preferred method of contact:		

Eligibility Criteria

Inclusion Criteria

Patients who meet *all* of the following criteria are eligible for enrollment as study participants:

	Yes	No
1. Patients with Ankylosing Spondylitis and other SSA		
2. Underwent Total Hip Arthroplasty (Unilateral/Bilateral), under Orthopaedics unit –II, Since January 2012		
3. Age more than 18 years		
4. At least Six Months Post Surgery		

Exclusion Criteria

Patients who meet of these criteria are eligible for enrollment as study participants:

	Yes	No
5. Patient Not a diagnosed case of Ankylosing spondylitis or other related disorders.		
6. Operated elsewhere		
7. Chronic Hip arthritis due to avascular necrosis		
8. Chronic hip arthritis due to trauma		
9. Revision Arthroplasty		
10. <18 years age		
11.		
12.		

Medical History (General)

Body System	Diagnosed condition?	Diagnosis/Condition/Surgery	Onset Date Or Year	Current Problem
Diabetes Mellitus	☐ Yes ☐ No			☐ Yes ☐ No
Hypertension	☐ Yes ☐ No			☐ Yes ☐ No
Thyroid Dysfunction	☐ Yes ☐ No			☐ Yes ☐ No
Dyslipidemia	☐ Yes ☐ No			☐ Yes ☐ No
Cardio Vascular Disorders	☐ Yes ☐ No			☐ Yes ☐ No
Respiratory Disorders	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No
	☐ Yes ☐ No			☐ Yes ☐ No

Medication History

List of DMARDs

Pre Operatively (If Any)	Post Operatively (If Any)

Details Of Surgery

Surgery:

Date Of Surgery:

Number Of days in Hospital:

Post-operative complications: ☐ Yes ☐ No

If Yes,

Complications:

1. Haematoma ☐ Yes ☐ No
2. Wound break down ☐ Yes ☐ No
3. Infection ☐ Yes ☐ No
4. Deep vein thrombosis ☐ Yes ☐ No
5. Pulmonary embolism ☐ Yes ☐ No
6. Myocardial Infarction ☐ Yes ☐ No
7. Pneumonia ☐ Yes ☐ No
8. Peri-prosthetic fractures ☐ Yes ☐ No
9. Dislocations ☐ Yes ☐ No
10. ICU admissions ☐ Yes ☐ No
11. If Yes, Reason: _____
12. Any Other Complications _____

Harris Hip Score

Pain

- None or ignores it (44)
- Slight, occasional, no compromise in activities (40)
- Mild pain, no effect on average activities, rarely moderate pain with unusual activity; may take aspirin (30)
- Moderate Pain, tolerable but makes concession to pain. Some limitation of ordinary activity or work. May require Occasional pain medication stronger than aspirin (20)
- Marked pain, serious limitation of activities (10)
- Totally disabled, crippled, pain in bed, bedridden (0)

Limp

- None (11)
- Slight (8)
- Moderate (5)
- Severe (0)

Support

- None (11)
- Cane for long walks (7)
- Cane most of time (5)
- One crutch (3)
- Two canes (2)
- Two crutches or not able to walk (0)

Distance Walked

- Unlimited (11)
- Six blocks (8)
- Two or three blocks (5)
- Indoors only (2)
- Bed and chair only (0)

Sitting

- Comfortably in ordinary chair for one hour (5)
- On a high chair for 30 minutes (3)
- Unable to sit comfortably in any chair (0)

Enter public transportation

- Yes (1)
- No (0)

Stairs

- Normally without using a railing (4)
- Normally using a railing (2)
- In any manner (1)
- Unable to do stairs (0)

Put on Shoes and Socks

- With ease (4)
- With difficulty (2)
- Unable (0)

Absence of Deformity (All yes = 4; Less than 4 =0)

- Less than 30° fixed flexion contracture _ Yes _ No
- Less than 10° fixed abduction _ Yes _ No
- Less than 10° fixed internal rotation in extension _ Yes _ No
- Limb length discrepancy less than 3.2 cm _ Yes _ No

Range of Motion (

- Flexion (*140°) _____
- Abduction (*40°) _____
- Adduction (*40°) _____
- External Rotation (*40°) _____
- Internal Rotation (*40°) _____

Range of Motion Scale

211° - 300° (5)	61° - 100 (2)
161° - 210° (4)	31° - 60° (1)
101° - 160° (3)	0° - 30° (0)

Range of Motion Score _____

Total Harris Hip Score _____

SF-36 QUESTIONNAIRE

Please answer the 36 questions of the **Health Survey** completely, honestly, and without interruptions.

GENERAL HEALTH:
In general, would you say your health is:

◯ Excellent ◯ Very Good ◯ Good ◯ Fair ◯ Poor

Compared to one year ago, how would you rate your health in general now?

◯ Much better now than one year ago
◯ Somewhat better now than one year ago
◯ About the same
◯ Somewhat worse now than one year ago
◯ Much worse than one year ago

LIMITATIONS OF ACTIVITIES:
The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?

Vigorous activities, such as running, lifting heavy objects, participating in strenuous sports.

◯ Yes, Limited a lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Moderate activities, such as moving a table, pushing a vacuum cleaner, bowling, or playing golf

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Lifting or carrying groceries

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Climbing several flights of stairs

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Climbing one flight of stairs

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Bending, kneeling, or stooping

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Walking more than a mile

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Walking several blocks

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Walking one block

◯ Yes, Limited a Lot ◯ Yes, Limited a Little ◯ No, Not Limited at all

Bathing or dressing yourself

○ Yes, Limited a Lot ○ Yes, Limited a Little ○ No, Not Limited at all

PHYSICAL HEALTH PROBLEMS:
During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of your physical health?

Cut down the amount of time you spent on work or other activities

○ Yes ○ No

Accomplished less than you would like

○ Yes ○ No

Were limited in the kind of work or other activities

○ Yes ○ No

Had difficulty performing the work or other activities (for example, it took extra effort)

○ Yes ○ No

EMOTIONAL HEALTH PROBLEMS:
During the past 4 weeks, have you had any of the following problems with your work or other regular daily activities as a result of any emotional problems (such as feeling depressed or anxious)?

Cut down the amount of time you spent on work or other activities

○ Yes ○ No

Accomplished less than you would like

○ Yes ○ No

Didn't do work or other activities as carefully as usual

○ Yes ○ No

SOCIAL ACTIVITIES:
Emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

○ Not at all ○ Slightly ○ Moderately ○ Severe ○ Very Severe

PAIN:
How much bodily pain have you had during the past 4 weeks?

○ None ○ Very Mild ○ Mild ○ Moderate ○ Severe ○ Very Severe

During the past 4 weeks, how much did pain interfere with your normal work (including both work outside the home and housework)?

○ Not at all ○ A little bit ○ Moderately ○ Quite a bit ○ Extremely

ENERGY AND EMOTIONS:

These questions are about how you feel and how things have been with you during the last 4 weeks. For each question, please give the answer that comes closest to the way you have been feeling.

Did you feel full of pep?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Have you been a very nervous person?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Have you felt so down in the dumps that nothing could cheer you up?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Have you felt calm and peaceful?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Did you have a lot of energy?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Have you felt downhearted and blue?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Did you feel worn out?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Have you been a happy person?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

Did you feel tired?

- ◯ All of the time
- ◯ Most of the time
- ◯ A good Bit of the Time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

SOCIAL ACTIVITIES:
During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?

- ◯ All of the time
- ◯ Most of the time
- ◯ Some of the time
- ◯ A little bit of the time
- ◯ None of the Time

GENERAL HEALTH:
How true or false is each of the following statements for you?

I seem to get sick a little easier than other people

○ Definitely true ○ Mostly true ○ Don't know ○ Mostly false ○ Definitely false

I am as healthy as anybody I know

○ Definitely true ○ Mostly true ○ Don't know ○ Mostly false ○ Definitely false

I expect my health to get worse

○ Definitely true ○ Mostly true ○ Don't know ○ Mostly false ○ Definitely false

My health is excellent

○ Definitely true ○ Mostly true ○ Don't know ○ Mostly false ○ Definitely false

ANNEXURE 4: PATIENT INFORMATION SHEET

Christian Medical College, Vellore
Department of Orthopaedics

Study on the improvement of quality of life and improvement of activities in patients with Ankylosing spondylitis who underwent Total Hip arthroplasty.

Information sheet

If you take part what will you have to do?
If you agree to participate in this study, your base line data will be collected.
You will be asked questions on your current health status.
Your hip range of movements will be examined.
All the other treatments that you are already on will be continued and your regular treatment will not be changed during this study.
Routine X-rays taken during your follow up may be used for this study.
No additional procedures or blood tests will be conducted routinely for this study.

If at any time you experience any problems, you can report this to the doctor.

Can you withdraw from this study after it starts?
Your participation in this study is entirely voluntary and you are also free to decide to withdraw permission to participate in this study. If you do so, this will not affect your usual treatment at this hospital in any way.

What will happen if you develop any study related injury?
We do not expect any injury to happen to you because of taking part in this study.

Will you have to pay anything extra to take part in the study?
You will not incur any extra charges for taking part in this study

Any other treatment that you usually take will continue but the usual arrangements that you have with the hospital will decide how much you pay for this.

What happens after the study is over?
You may or may not benefit from the study that you are a part of. However, the conclusions drawn from this study will be useful to manage similar patients in future.

Will your personal details be kept confidential?
The results of this study may be published in a medical journal but you will not be identified by name in any publication or presentation of results. However, your medical notes may be reviewed by people associated with the study, without your additional permission, should you decide to participate in this study.
You are urged to communicate the health condition to the best of your knowledge

If you have any further questions, please ask
Dr. Mathew Kiran Jacob
Department of Orthopaedics Unit 2
Christian Medical College Hospital
Vellore, Tamilnadu
632004
Tel: 0416 2282081
Mobile No. 7025747999
email: mathewkiranjacob@yahoo.co.in

ANNEXURE 5: CONSENT FORM

Christian Medical College, Vellore Department of Orthopaedics

Informed Consent form to participate in a research study

Study Title: Study on the improvement of quality of life and improvement of activities in patients with Ankylosing spondylitis who underwent Total Hip arthroplasty.

Study Number: _____

Subject's Name: _____

Date of Birth / Age: _____

(Subject)

(i) I confirm that I have read and understood the information sheet dated _____ for the above study and have had the opportunity to ask questions. [ ]

(ii) I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected. [ ]

(iii) I understand that the Ethics Committee and the regulatory authorities will not need my permission to look at my health records both in respect of the current study and any further research that may be conducted in relation to it, even if I withdraw from the trial. I agree with this access. However, I understand that my identity will not be revealed in any information released to third parties or published. [ ]

(iv) I agree not to restrict the use of any data or results that arise from this study provided such use is only for the scientific purpose(s). [ ]

(v) I agree to take part in the above study. [ ]

Signature (or Thumb impression) of the Subject/Legally Acceptable

Date: _____/_____/_____

Signatory's Name: _____ Signature:

Or

Representative: _____

Date: _____/_____/_____

Signatory's Name: _____

Signature of the Investigator: _____

Date: _____/_____/_____

Study Investigator's Name: _____

Signature or thumb impression of the Witness: _____

Date: _____/_____/_____

Name & Address of the Witness:

ANNEXURE 6: ETHICS COMMITTEE (IRB) APPROVAL

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

Dr. B.J. Prashantham, M.A., M.A., Dr. Min (Clinical)
Director, Christian Counseling Center,
Chairperson, Ethics Committee.

Dr. Anna Benjamin Pulimood, M.B.B.S., MD., Ph.D.,
Chairperson, Research Committee & Principal

Dr. Biju George, M.B.B.S., MD., DM.,
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

May 14, 2018

Dr. Mathew Kiran Jacob,
PG Registrar,
Department of Orthopaedics - 2,
Christian Medical College,
Vellore – 632 002.

Sub: **Fluid Research Grant: New Proposal:**
Clinical and Functional Outcomes in Patients with Spondyloarthropathy who have Undergone a Total Hip Arthroplasty.
Dr. Mathew Kiran Jacob , Employment Number: 29609, Post Graduate Registrar, Orthopaedics, Dr. Anil Thomas Oommen, Employment Number: 31228, Orthopaedics – Unit II, Dr. Pradeep Punnoose, Employment Number: 13033, Orthopaedics – Unit II, Dr. V.J Chandy, Employment Number: 29191, Orthopaedics – Unit II.

Ref: IRB Min. No. 11164 [OBSERVE] dated 06.02.2018

Dear Dr. Mathew Kiran Jacob,

I enclose the following documents:-

1. Institutional Review Board approval 2. Agreement

Could you please sign the agreement and send it to Dr. Biju George, Addl. Vice Principal (Research), so that the grant money can be released.

With best wishes,

Dr. Biju George
Secretary (Ethics Committee)
Institutional Review Board

Dr. BIJU GEORGE
MBBS., MD., DM.
SECRETARY - (ETHICS COMMITTEE)
Institutional Review Board,
Christian Medical College, Vellore - 632 002.

Cc: Dr. Anil Thomas Oommen, Dept. of Ortho - 2, CMC, Vellore

Ethics Committee Blue, Office of Research, 1st Floor, Carman Block, Christian Medical College, Vellore, Tamil Nadu 632 002
Tel: 0416 – 2284294, 2284202 Fax: 0416 – 2262788, 2284481 E-mail: research@cmcvellore.ac.in

OFFICE OF RESEARCH
INSTITUTIONAL REVIEW BOARD (IRB)
CHRISTIAN MEDICAL COLLEGE, VELLORE, INDIA

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Ref: IRB Min. No. 11164 [OBSERVE] dated 06.02.2018

Dear Dr. Mathew Kiran Jacob,

The Institutional Review Board **(Blue**, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project titled "Clinical and Functional Outcomes in Patients with Spondyloarthropathy who have Undergone a Total Hip Arthroplasty" on February 06th 2018.

The Committee reviewed the following documents:

1. IRB Application format
2. Questionnaire
3. Patient information sheet and Informed Consent Form (English, Tamil, Hindi, Telugu, Bengali)
4. Cvs of Drs. Chandy, Pradeep Ponnoose, Anil Oommen, Mathew Kiran
5. No. of documents 1- 4.

The following Institutional Review Board (Blue, Research & Ethics Committee) members were present at the meeting held on February 06th 2018 in the Jacob Chandy Hall, Paul brand Building, Christian Medical College, Vellore 632 004.

Ethics Committee Blue, Office of Research, 1st Floor, Carman Block, Christian Medical College, Vellore, Tamil Nadu 632 002
Tel: 0416 – 2284294, 2284202 Fax: 0416 – 2262788, 2284481 E-mail: research@cmcvellore.ac.in

Dr. B.J. Prashantham, M.A., M.A., Dr. Min (Clinical)
Director, Christian Counseling Center,
Chairperson, Ethics Committee.

Dr. Anna Benjamin Pulimood, M.B.B.S., MD., Ph.D.,
Chairperson, Research Committee & Principal

Dr. Biju George, M.B.B.S., MD., DM.,
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Name	Qualification	Designation	Affiliation
Dr. Biju George	MBBS, MD, DM	Professor, Haematology, Research), Additional Vice Principal , Deputy Chairperson (Research Committee), Member Secretary (Ethics Committee), IRB, CMC, Vellore	Internal, Clinician
Dr. Anna B. Pulimood	MBBS, MD, PhD	Principal, Chairperson-Research Committee, IRB, CMC, Vellore	Internal, Clinician
Dr. Thomas V Paul	MBBS, MD, DNB, PhD	Professor, Endocrinology, CMC, Vellore	Internal, Clinician
Dr. RekhaPai	BSc, MSc, PhD	Associate Professor, Pathology, CMC, Vellore	Internal, Basic Medical Scientist
Rev. Joseph Devaraj	BSc, BD	Chaplaincy Department, CMC, Vellore	Internal, Social Scientist
Mr. C. Sampath	BSc, BL	Advocate, Vellore	External, Legal Expert
Dr. Jayaprakash Muliyil	BSc, MBBS, MD, MPH, Dr PH (Epid), DMHC	Retired Professor, CMC, Vellore	External, Scientist &Epidemiologist
Ms. Grace Rebekha	M.Sc., (Biostatistics)	Lecturer, Biostatistics, CMC, Vellore	Internal, Statistician
Dr. Vivek Mathew	MD (Gen. Med.) DM (Neuro) Dip. NB (Neuro)	Professor, Neurology, CMC, Vellore	Internal, Clinician
Dr. Inian Samarasam	MS, FRCS, FRACS	Professor, Surgery, CMC, Vellore	Internal, Clinician
Dr. Asha Solomon	MSc Nursing	Associate Professor, Medical Surgical Nursing, CMC, Vellore	Internal, Nurse

Ethics Committee Blue, Office of Research, 1st Floor, Carman Block, Christian Medical College, Vellore, Tamil Nadu 632 002
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Chairperson, Research Committee & Principal

Dr. Biju George, M.B.B.S., MD., DM.,
Deputy Chairperson,
Secretary, Ethics Committee, IRB
Additional Vice-Principal (Research)

Dr. Sowmya Sathyendra	MBBS, MD (Gen. Medicine)	Professor, Medicine III, CMC, Vellore	Internal, Clinician
Dr. Mathew Joseph	MBBS, MCH	Professor, Neurosurgery, CMC, Vellore	Internal, Clinician
Mrs. Pattabiraman	BSc, DSSA	Social Worker, Vellore	External, Lay Person
Mrs. Sheela Durai	MSc Nursing	Professor, Medical Surgical Nursing, CMC, Vellore	Internal, Nurse
Dr. John Antony Jude Prakash	MBBS, MD	Professor, Clinical Microbiology, CMC, Vellore.	Internal, Clinician.

We approve the project to be conducted as presented.

Kindly provide the total number of patients enrolled in your study and the total number of Withdrawals for the study entitled: "Clinical and Functional Outcomes in Patients with Spondyloarthropathy who have Undergone a Total Hip Arthroplasty" on a monthly basis. Please send copies of this to the Research Office (research@cmcvellore.ac.in).

Fluid Grant Allocation:

A sum of 17,500/- INR (Rupees Seventeen Thousand Five Hundred Only) will be granted for24 Months

Yours sincerely,

Dr. Biju George
Secretary (Ethics Committee)
Institutional Review Board

Dr. BIJU GEORGE
MBBS., MD., DM.
SECRETARY - (ETHICS COMMITTEE)
Institutional Review Board,
Christian Medical College, Vellore - 632 002.

IRB Min. No. 11164 [OBSERVE] dated 06.02.2018 4 of 4

ANNEXURE 7: MASTER SHEET

slno	age	gender	country	ifindia	DMAR	DMAR	surgery	dayshos	hosps	hosps	posto	pocha	pocwo	pocinf	pocde	pocpu	pocmy	pocpn	pocpe	pocdis
1	49	Male	India	West Bengal	Yes	No	Bilateral	13			No									
2	30	Male	Bangladesh		No	Yes	Unilateral	13			No									
3	34	Male	Bangladesh		Yes	Yes	Bilateral	10			No									
4	35	Male	India	West Bengal	No	No	Unilateral	13			No									
5	49	Male	India	Assam	Yes	Yes	Unilateral	15			No									
6	58	Male	India	West Bengal	Yes	Yes	Unilateral	17			No									
7	39	Male	India	Jharkhand	No	Yes	Unilateral	12			No									
8	39	Male	India	Jharkhand	Yes	Yes	Unilateral	11			No									
9	37	Male	India	Jharkhand	No	Yes	Unilateral	12			No									
10	32	Male	India	West Bengal	Yes	Yes	Unilateral	13			No									
11	49	Male	India	West Bengal	Yes	Yes	Unilateral	12			No									
12	38	Female	India	Jharkhand	Yes	Yes	Unilateral	13			No									
13	45	Male	India	West Bengal	Yes	Yes	Unilateral	12			No									
14	50	Male	India	West Bengal	Yes	Yes	Bilateral	13			No									
15	37	Male	India	West Bengal	No	Yes	Bilateral	12			No									
16	30	Male	India	Jharkhand	Yes	Yes	Bilateral	13			No									
17	50	Male	India	West Bengal	Yes	Yes	Bilateral	12			No									
18	44	Male	Bangladesh		Yes	Yes	Bilateral	27	13	14	No									
19	30	Male	India	Bihar	Yes	Yes	Bilateral	17			No									
20	32	Male	India	West Bengal	No	Yes	Bilateral	16			Yes	No	No	Yes	No	No	No	No	No	No
21	44	Male	India	West Bengal	Yes	Yes	Bilateral	12			No									
22	24	Male	India	West Bengal	No	Yes	Bilateral	16			No									
23	24	Male	India	Odisha	No	Yes	Bilateral	13			No									
24	37	Male	India	West Bengal	Yes	Yes	Bilateral	24	12	12	No									
25	45	Male	India	West Bengal	No	Yes	Bilateral	13			No									
26	27	Male	India	West Bengal	Yes	Yes	Bilateral	13			No									
27	32	Female	India	West Bengal	Yes	Yes	Bilateral	12			No									
28	31	Male	India	West Bengal	Yes	Yes	Bilateral	26	13	13	No									
29	37	Male	Bangladesh		No	No	Bilateral	13			No									
30	35	Male	India	West Bengal	Yes	Yes	Bilateral	13			No									
31	27	Male	Bangladesh		Yes	Yes	Bilateral	25	13	12	No									
32	41	Male	India	Jharkhand	Yes	Yes	Bilateral	17			No									
33	37	Male	India	West Bengal	No	Yes	Bilateral	13			No									
34	29	Male	Bangladesh		Yes	Yes	Bilateral	25	12	13	No									
35	27	Male	India	West Bengal	Yes	Yes	Bilateral	24	11	13	No									
36	36	Male	Bangladesh		Yes	Yes	Bilateral	12			No									
37	34	Female	India	West Bengal	No	Yes	Bilateral	19	6	13	No									
38	31	Male	India	West Bengal	Yes	Yes	Bilateral	11			No									
39	27	Male	Bangladesh		Yes	Yes	Bilateral	14			No									
40	33	Female	India	West Bengal	Yes	Yes	Bilateral	15			No									

pocicu	pocicu	pocan	PRE OP	POST C	PRE OP	PRE OP	POST OI	POST OI	ROM SC	ROM SC	ROM SC	ROM SC	Physica	physica	emotio	Energy/	Emotion	Social fu	Pain	General
			24	100	20	0	120	100	5	5	0	0	60	100	100	70	92	100	57.5	40
			20	79		10		100		5		0	60	50	100	60	76	62.5	45	65
			21	100	70	70	100	100	5	5	2	2	85	100	100	100	100	100	100	95
			11	63		0		90		4		0	10	0	66.67	25	52	50	45	0
			15	97		0		100		5		0	90	100	100	65	92	87.5	77.5	50
			20	90	40		100		5		1		65	100	100	55	72	75	77.5	50
			21	100		90		100		5		2	85	100	100	70	84	100	90	70
			21	97	20		100		4			1	70	100	100	70	84	87.5	90	35
			13	77		90		100		5		3	40	0	100	50	64	62.5	32.5	10
			10	90		35		110		5		1	65	100	100	85	92	100	90	55
			20	100		35		110		5		1	50	100	100	60	84	100	77.5	75
			30	100		120		120		5		5	85	100	100	100	100	100	100	100
			11	88	0		110		5		0		65	0	100	70	76	87.5	67.5	60
			19	88	60	80	100	100	4	4	1	2	55	0	0	55	68	50	67.5	55
			19	100	0	0	90	90	5	5	0	0	80	100	100	80	96	100	100	85
			19	84	60	80	80	80	3	3	3	3	50	75	100	65	68	75	80	60
			16	100	50	20	100	90	5	4	1	0	80	100	100	85	76	75	100	75
			21	100	45	60	120	110	5	5	2	2	85	100	100	75	96	100	90	85
			15	100	0	90	110	110	5	5	0	4	90	100	100	70	88	100	100	95
No			21	67	10	15	100	60	4	3	2	2	35	0	66.67	40	80	62.5	32.5	40
			13	92	0	0	110	110	5	5	0	0	80	100	100	75	88	100	90	70
			19	100	0	0	110	100	5	4	0	0	95	75	100	80	88	100	90	80
			0	88	0	0	90	90	4	4	0	0	65	100	100	50	80	87.5	67.5	35
			19	100	0	30	110	100	4	5	0	1	85	100	100	75	96	100	100	95
			13	100	70	70	100	100	4	4	3	3	80	100	100	65	88	75	77.5	70
			19	100	0	70	100	110	5	5	0	3	90	100	100	75	88	75	100	95
			11	100	45	35	110	100	4	4	1	1	50	100	33.33	60	68	50	45	30
			20	100	30	20	120	120	5	5	1	2	95	100	100	85	92	100	90	100
			21	78	30	20	100	90	3	3	1	0	50	100	100	55	68	62.5	55	45
			13	97	0	0	100	100	5	5	0	0	70	100	100	90	88	75	90	80
			14	97	110	40	110	110	5	5	5	1	80	100	100	85	92	100	77.5	75
			15	88	15	20	110	110	4	4	2	2	85	100	100	95	100	100	90	85
			11	95	0	0	100	100	4	4	0	0	75	100	100	75	88	87.5	90	65
			21	95	0	0	100	100	5	5	0	0	65	100	100	70	84	75	77.5	30
			10	100	0	40	110	110	5	5	0	1	90	100	100	100	100	100	90	70
			0	93	110	0	110	90	4	4	3	0	65	100	100	80	84	100	90	70
			19	100	0	0	110	110	5	5	0	0	55	100	100	60	68	100	100	55
			29	100	30	20	100	90	5	5	1	1	70	100	100	80	84	100	90	80
			18	100	0	0	90	90	4	4	0	0	85	100	100	100	100	100	80	55
			22	91	40	20	110	110	5	5	1	0	50	100	100	70	80	87.5	90	40