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Comprehensive Management of Ankylosing Spondylitis: Pharmacotherapeutic Approaches and Surgical Correction of Kyphotic Deformity

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Abstract

Ankylosing spondylitis (AS) is a chronic inflammatory disease that primarily affects the axial skeleton, often leading to significant functional impairment and spinal deformities. This case report highlights the diagnostic challenges and the necessity of a multidisciplinary management approach for advanced AS. To evaluate the effectiveness of a comprehensive treatment approach combining pharmacological and surgical interventions in improving clinical outcomes and quality of life in patients with severe ankylosing spondylitis (AS) and thoracolumbar kyphotic deformity (TLKD), a 26-year-old male presented with a four-year history of worsening inflammatory back pain that improved with activity but worsened at rest. Radiographic imaging revealed characteristic "bamboo spine" and "dagger spine" appearances, while laboratory tests showed elevated inflammatory markers (CRP and ESR). The patient was diagnosed with radiographic ankylosing spondylitis with very high disease activity (ASDAS-CRP 3.98) and a severe thoracolumbar kyphotic deformity (TLKD). The patient received a comprehensive treatment regimen consisting of meloxicam (7.5 mg twice daily) and the TNF-α inhibitor etanercept (50 mg weekly) to control systemic inflammation. To address the structural deformity, the orthopedic team performed a pedicle subtraction osteotomy (PSO). At the four-month follow-up, the patient demonstrated significant clinical improvement. The ASDAS-CRP score decreased from 3.98 to 2.9, indicating reduced disease activity. Surgical correction resulted in a substantial improvement in the chin-brow-to-vertical angle (CBVA) from 31.1° to 20.2°, restoring the patient's horizontal gaze and improving overall postural balance and quality of life.

INTRODUCTION

Ankylosing spondylitis (AS), now commonly discussed within the broader spectrum of axial spondyloarthritis, is a chronic immune-mediated inflammatory disease that primarily affects the sacroiliac joints and spine, progressively impairing mobility, posture, function, and quality of life. Its burden is especially significant because the disease often begins in young adulthood, meaning that patients may live for decades with pain, stiffness, fatigue, work limitations, and structural damage if timely diagnosis and appropriate treatment are not achieved. Contemporary reviews and guidelines consistently emphasize that AS is not merely

a musculoskeletal disorder but a lifelong systemic condition requiring early recognition, regular monitoring, and integrated long-term management.

At the global level, epidemiological evidence shows that AS remains relatively uncommon but clinically important because of its early onset and cumulative disability. A large review cited in recent epidemiological work reported marked geographic variation, with prevalence estimates of approximately 23.8 per 10,000 in Europe, 16.7 per 10,000 in Asia, 31.9 per 10,000 in North America, 10.2 per 10,000 in Latin America, and 7.4 per 10,000 in Africa. In Thailand, a recent national database study identified 13,292 patients in 2017, with a prevalence of 20.4 per 100,000 and incidence rates of approximately 10.4 per 100,000 person-years during 2018–2020. These figures confirm that although AS is not among the most prevalent rheumatic diseases, its distribution across populations is substantial enough to require stronger diagnostic pathways and more responsive health services.

The clinical challenge becomes more serious because AS frequently involves diagnostic delay. A systematic review found a pooled mean delay of 6.7 years, while global patient-reported data from 27 countries showed a mean delay of 7.4 years and a median of 4.0 years before diagnosis. Such delays are not trivial; they allow ongoing inflammation to drive irreversible structural progression, functional decline, and psychosocial burden, while also increasing healthcare utilization and costs. This is highly relevant to the present manuscript, in which the patient experienced inflammatory back pain for four years before receiving a definitive diagnosis and comprehensive treatment.

A key issue in AS management is that disease control must address two interconnected but distinct problems: active systemic inflammation and established structural deformity. In many patients, pharmacologic therapy can suppress inflammation and reduce symptoms; however, once marked thoracolumbar kyphotic deformity has developed, medication alone is insufficient to restore sagittal alignment, horizontal gaze, or biomechanical balance. The presented case illustrates this problem clearly: the patient had very severe disease activity, radiographic features of a bamboo spine and dagger spine, and severe thoracolumbar kyphotic deformity, indicating that both medical and surgical strategies were necessary rather than either approach in isolation.

Previous studies have demonstrated the importance of modern pharmacologic therapy in AS. The 2022 ASAS–EULAR recommendations support nonsteroidal anti-inflammatory drugs (NSAIDs) as first-line treatment and recommend biologic or targeted synthetic disease-modifying antirheumatic drugs (DMARDs) for persistently active disease. Supporting this direction, a systematic literature review informing the guideline update confirmed the efficacy and safety of biologic DMARDs in axial spondyloarthritis, while a 2023 network meta-analysis reported that tumor necrosis factor-alpha (TNF-α) inhibitors were significantly superior to several alternative advanced therapies in limiting disease progression and severe functional restriction. These findings provide strong evidence base for the use of etanercept in patients with high inflammatory activity, such as in the present case.

Other recent studies have focused on the surgical management of advanced deformity. Pedicle subtraction osteotomy (PSO) continues to be regarded as an effective corrective option for severe kyphosis in AS because it can restore sagittal alignment and horizontal vision, although it also carries technical complexity and perioperative risk. A 2024 case series reported favorable long-term outcomes for one-stage, single-level PSO augmented with Ponte

osteotomy in high-angle thoracolumbar kyphotic deformity, while newer biomechanical research has examined vascular stress and aortic changes during osteotomy to better understand surgical safety. This body of evidence confirms that corrective surgery is not only cosmetically relevant but also functionally transformative for selected patients with advanced deformity.

Despite these advances, an important research gap remains. Much of the literature discusses either pharmacologic control of disease activity or surgical correction of kyphosis as separate domains, whereas fewer reports describe how both modalities can be integrated into a single comprehensive management pathway for patients with severe AS who present with both high inflammatory burden and major structural deformity. In addition, outcome reporting is often fragmented, with some studies emphasizing laboratory or disease activity scores and others focusing mainly on radiographic or technical correction. This creates a need for clinically grounded, case-based evidence demonstrating how multidimensional improvement can be assessed through inflammatory, functional, and postural outcomes collectively.

The urgency of this study lies in the fact that delayed or incomplete management of severe AS can lead to permanent disability during the most productive years of life, reduced health-related quality of life, and persistent work impairment, even among patients receiving advanced therapy. Recent research on biologic-treated patients has still found meaningful associations between poorer quality of life and diagnostic delay, functional limitation, and disease activity. Therefore, documenting a management strategy that combines inflammation control, deformity correction, and follow-up outcome evaluation is important not only for academic completeness but also for clinical decision-making in real-world multidisciplinary care.

The novelty of this research lies in its integrative perspective. Rather than presenting AS solely as a rheumatologic inflammatory disorder or solely as an orthopedic deformity problem, this manuscript frames severe radiographic AS as a condition requiring comprehensive and sequential management involving anti-inflammatory pharmacotherapy, biologic therapy, surgical correction, and functional outcome reassessment. The case becomes even more valuable because it documents measurable improvement after combined treatment, including a reduction of ASDAS-CRP from 3.98 to 2.9 and improvement of CBVA from 31.1° to 20.2°, thereby demonstrating how clinical, inflammatory, and postural domains may improve concurrently following interdisciplinary intervention.

Based on this context, this study aims to analyze and describe the comprehensive management of severe ankylosing spondylitis with thoracolumbar kyphotic deformity through a combination of pharmacotherapeutic intervention and surgical correction, as well as to evaluate the resulting clinical outcomes. The research is expected to contribute practical evidence for clinicians regarding the importance of early recognition, timely escalation to biologic therapy, careful selection of corrective surgery, and multidimensional postoperative assessment. In this sense, the study offers benefits at both scientific and clinical levels: enriching the case-based literature on advanced AS, supporting multidisciplinary treatment strategies, and providing a reference for improving function, alignment, and quality of life in patients with aggressive disease presentations.

RESEARCH METHOD

A 26-year-old man (referred to as ANI) a villa guard, Balinese, from Gianyar, came with complaints of back pain that had been getting worse for four years, especially in the morning and at night. Low back pain feels very painful like being pierced by a sharp object that appears especially in the morning and night so that it interferes with the patient's sleep quality. The pain does not improve with rest but decreases with physical activity, bending forward and lying down. The pain increases by changing positions, sitting for a long time, standing up and sleeping on your back. Patients also complain of Stiffness of the lower back joints that is felt especially in the morning which lasts about 10-15 minutes but can improve with physical activity. The patient denied swelling, pain, and redness in the joints of the fingers of both hands and feet, wrists, elbows and shoulders, both knees and heels. Complaints of redness in the eyes, itching, rashes or spots, redness of the skin are denied by the patient. Defecation and urination are said as usual.

Physical examination of the eyes found no redness in the conjunctiva, neck movements were found to be flexion capable but difficult to extend, limited lateral bending, right and left rotation can still be done. Physical examination of the heart found no murmurs, in the lungs, the sound of vesicular breath, normal vocal phremetrophic in both lung fields, no ronchi or wheezing were found. On examination of the extremities, the manus joint dextra sinistra, the genu joint dekstra et sinistra, the ankle dekstra et sinistra, the patella dekstra et sinistra, the malleolus lateral dekstra et sinistra, the carpal, metacarpal, the phalangs dekstra et sinistra, on inspection there was no redness and swelling, there was no complaint of pressure on the palapati, and *the range of movement* was within normal limits.

Physical examination of the lumbosacral region on inspection showed kyphotic deformity of the spine, while at touch, *midline tenderness* was found in the L5-S1 region. On the patient's motor examination, motor strength of 5 was found in all four extremities, with *a limited range of movement*. An *occiput to wall distance test* was carried out with a result of 20 cm, in addition to that *a schoeber test was also carried* out with a positive result of 3 cm. Laboratory results showed an increase in inflammatory markers, namely *c-reactive protein* (CRP)) (Table 1). Other parameters that experience an increase are the rate of blood precipitation, platelets, and potassium.

Radiographic findings (Figure 1), including thoracic, lumbar and pelvic X-rays, showed images of the bamboo *spine* and dagger *spine* reinforcing the diagnosis of ankylosing spondylitis (AS). *The dagger spine* (calcification of the spinosum ligament) in CV L2-S1, while *the bamboo spine* is marginally syndesmophyte in the Th4-L1 vertebrae. Subchondral sclerosis was found in the acetabulum, but there was no disorder in the Shenton line. A full-spine MRI also confirmed the condition of ankylosing spondylitis (Figure 2). The findings on the MRI showed the presence of kyphosis deformity accompanied by *bridging syndesmophyte paravertebrae CV* Th1-Th12, romanus lesions on *the anterior-inferior endplate CV L1,* bilateral sacroilitis, and sclerotis on CV Th11.

Table 1. Results of the patient's laboratory examination

Parameter	Date 1/3/2023	Reference Value
WBC	7.24	4.10-11.00

HGB	13.2	13.5-17.5
HCT	42.0	41.0-53.0
MCV	84.8	80.0-100.0
MCH	26.7	26.0-34.0
PLT	413	150-440
LED	**48.0**	<20
Kuantitative CRP	**31.2**	<5
RF	Negatives	Negatives
HbsAg	Non-Reactive	Non-Reactive
Anti HCV	Non-Reactive	Non-Reactive
INR	0.9	0.9-1.1
PPT	10.3	10.0-12.7
APTT	34.0	23.0-34.7
AST/SGOT	17.1	5.0-34.0
ALT/SGPT	11.7	11.0-50.0
GDS	95	70-140
GOOD	15.2	8.0-23.0
Creatinine	0.89	0.72-1.25
e-LFG	118.84	≥90
K	**5.29**	3.50-5.10
On	139	136-145
PITC	Non-Reactive	Non-Reactive

Source: Primary data from patient laboratory examination results

The patient was diagnosed with Radiographic Ankylosing Spondylitis with *Very Severe Diseases Activity* (ASDAS CRP 3.98) and *Thoracolumbar Kyphotic deformity*. Patients start treatment with meloxicam 2x7.5mg to relieve symptoms. Considering the severity and progressive nature of the disease, treatment plans involve etanercept, which is *a tumor necrosis factor* (TNF) inhibitor. By Orthopedic patients are scheduled to undergo *deformity correction* with Pedicle subtraction osteotomies (PSO) *procedures.*Patients are scheduled for regular follow-up to monitor response to treatment and assess disease progression. A comprehensive approach, including pharmacological interventions, biological therapies and deformity correction aims to improve patients' quality of life and reduce complications associated with AS.

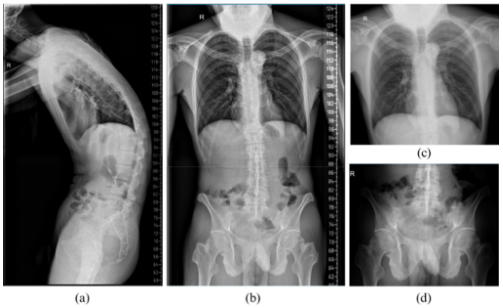

Figure 1. X-ray photo of the patient (a)(b) *streatching spine* AP/Lateral (c) thorax AP (d) pelvis AP.

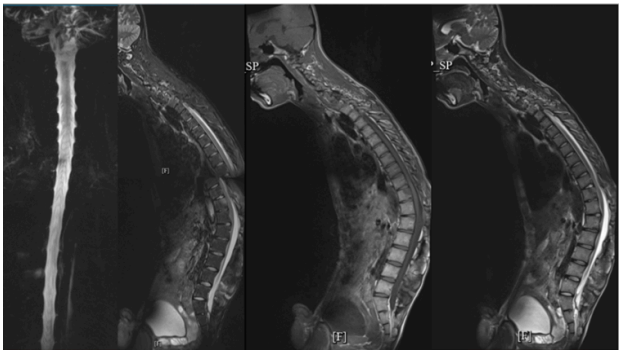

Figure 2. Results of MRI examination of Whole Spine (*Thoracic Center)* axial T1WI, T2WI; sagittal T1WI, T2WI, T1 FS + Myelography, without and with contrast.

RESULTS AND DISCUSSION

Ankylotic spondylitis (AS) is a subtype of axial spondylitis, which is a chronic inflammatory disease that affects the axial spine. (Indonesia, 2020) About 0.1-0.2% of the world's population suffers from this disease, and it is often found in early adulthood or late adolescence. The prevalence of this disease is higher in male patients than in women, with a ratio of 3:1. Genetic and nongenetic factors play a role in the development of ankylosing spondylitis. (Hwang et al., 2021)

HLA-B27 gene findings are generally found in 90-95% of US patients. (McCormack & Wellington, 2004) The HLA-B27 gene that is often found in ankylotic spondylitis patients has 231 protein subtypes and a high genetic polymorphism (328 alleles). There are six mechanisms of the HLA-B27 gene in US pathogenesis, namely (1) it can alter the intracellular arrangement and fertilize arthriisogenic bacteria, (2) it is recognized by T cell receptors on CD4+ T lymphocytes as antigens and thus provokes an autoimmune response, (3) it alters the normal microbiome of the body, (4) it forms homodimers recognized by *leukocyte immunoglobulin-like receptors* (LILRs) dan *killer-cell immunoglobulin-like receptors* (KIR), (5) seen as peptides *"arthritogenic*", and (6) have a tendency to misfold on the endoplasmic reticulum.(Hwang et al., 2021)

Risk factors outside of genetics can also affect the development of ankylosing spondylitis (AS). Protection from the gut microbiome induced by breastfeeding is said to prevent the occurrence of the disease. In addition, it is said that a history of childhood infections, namely tonsillitis and upper respiratory tract infections, is also associated with the

incidence of AS. Several other factors such as stress, social factors, and lifestyle also have an effect. These factors include having siblings, vitamin D deficiency, and smoking (both tobacco cigarettes and e-cigarettes).(Hwang et al., 2021)

The clinical manifestation of this disease is chronic low back pain for more than three months, where the pain does not subside with rest but improves with activity, limitation of lumbar vertebral movement in the sagittal and frontal directions, Decrease in the expansion of the chest cavity relatively compared to normal values, according to age and sex, kjoint that lasted more than 30 minutes in the morning, and a positive response to the administration of nonsteroidal anti-inflammatory drugs (NCBs).(Indonesia, 2021) This finding was also found in our patients who had low back pain accompanied by stiffness for four years. Pain improves with physical activity and is more felt, especially in the morning and evening.

Physical examination is aimed at looking at other clinical manifestations commonly found in ankylosing spondylitis (AS). The findings were in the form of peripheral joint involvement which is generally asymmetrical and <5 joints, and is acute. Findings of dactitis (sausage finger) and entheticism can also be found. Extraarticular findings to note include uveitis, ulcerative colitis, crohn's disease, aortic insufficiency, atrioventicular block, restrictive lung disease, pulmonary fibrosis, amyloidosis, osteoporosis, occipital pain, and neurological deficits.(Indonesia, 2020, 2021) The results of the systematic review showed that gait (*gait*) US patients were significantly different from normal controls, but there is no regulation or consensus governing this as a criterion for US diagnosis.(Soulard et al., 2021) In our patients physical examinations of the eyes, skin, abdomen, heart lungs, and extremities were found within normal limits. While examination of the lumbosacral region on inspection showed kyphotic deformity of the spine, while on touch it was found *midline tenderness* in the L5-S1 region, with *range of movement* limited (sagittal and frontal). Tests are carried out *occiput to wall distance* with a result of 20 cm, in addition to that it is also carried out *schoeber test* with a positive result of 3 cm.

An HLA-B27 test can help establish a diagnosis if it is feasible. However, a negative HLA-B27 test result cannot rule out the possibility of a SpA diagnosis Laboratory tests, namely blood tests, and immunology can also be done to help establish the diagnosis in addition to HLA-B27 genetic testing.[1] Increased blood deposit rate (LED) and *c-reactive protein* (CRP) indicates inflammation associated with ankylosing spondylose. Research says that high CRP concentrations are an indication of a systemic inflammatory response to inflammation in the sacroiliac joints and can be an indicator of inflammation in spondyloarthritis.(Liu et al., 2018) Improved kidney function may occur in some cases of AS.[6] In addition, a complete blood test also provides information related to other disorders that may be the trigger or whether there is an underlying infection that can exclude peripheral spondyloarthritis or other diseases.(Indonesia, 2020, 2021) Our patients experienced an increase in LED, CRP, platelets, and potassium, while the HLAB27 examination had not been performed.

Radiographic support should be done to establish the diagnosis. A conventional radiological picture of the US and its explanation can be seen in Table 2. Conventional radiological examination of *the Sacro Iliac Joint* (SIJ) is the first recommended modality for ax-SpA diagnosis and remains the primary choice for the assessment of structural changes in the spine and SIJ. The US assessment uses degrees of sacroiliitis based on radiology ranging

from 0-4, where 0 is normal or no change to 4 indicates the presence of severe abnormalities or total ankylosis. In addition to inflammation, sclerosis and erosive images can also be found.

Table 2. Conventional radiological findings in ankylosa spondylitis(Indonesia, 2021)

Conventional radiological findings	Explanation
ankylosing	Total fusion, especially in the sacroiliac joint
Bamboo spine	The findings of syndesmophyte, which is annular recurrence of fibrosis, which connects each vertebral vertebrae
Dagger sign	Ossification of the supraspinosus and interspinosus ligaments, creating a thin radio-opaque line from the vertical center downwards
Railroad track sign	Fusion of the capsular ligament in the posterior joint creates a bilateral radio-opaque image in the antero-posterior
Trolley track sign	There is *a dagger sign* and *a railroad track singing.*

Sumber: Data sekunder hasil pemeriksaan radiologi dan literatur terkait

MRI of the pelvic, veterbra, and sacroiliac regions should also be performed to see if there are structural (inflammatory) lesions for early stage diagnosis. If no inflammation is found on MRI, an HLA-B27 gene test or repeat MRI may be performed. MRI examinations can also be used to assess disease progression and therapeutic response in addition to using *ankylosing spondylitis disease activity score* (ASDAS) and *bath ankylosing spondylitis disease activity index* (BASDAI).[1,8] Other radiological examinations, such as *CT scan* It is not recommended to do so because there can be extensive radiation in the spinal area.[8] However, there are meta-analyses that suggest that ultrasound, as an alternative to non-invasive examination, can be used for the evaluation of inflammation in AS in clinical practice although its accuracy is not ideal. Ultrasound examinations have a lower cost than MRIs in the US examination.[9] The results of the radiographic examination on our patients showed a picture of '*bamboo spine*' and '*dagger spine*' as well as subchondral sclerosis of the acetabulum. On MRI, in addition to the findings showing ankylotic spondylitis, our patient also developed kyphosis deformities in the thoracolumbar region.

The diagnosis of AS was established with low back pain ≥ 3 months (with or without peripheral manifestations) with the onset of patient age < 45 years plus sacroilitis, bilateral sacro≥ilitis, grade 3-4 unilateral sacroilitis) conventional radiography with ≥1 description of spondyloarthritis (Inflammatory low back pain, arthritis, enthesitis, uveitis, daktilitis, psoriasis, *chron's disease/ulcerative* colitis, good response to OAINS, family history with SpA, HLAB27, increased CRP. The patient was a 26-year-old male with complaints of low back pain for the past 4 years that improved with activity, with grade 3 bilateral sacroiliis on pelvic radiography. It was also found that calcification of the spinosum ligament of the lumbar vertebrae 2 to sacrum 1 formed the image of the dagger spine in the thoracolumbar photo, and the appearance of marginal syndesmophyte in the thoracic vertebrae which formed the image of *the bamboo spine*. Patients were diagnosed with Radiographic Ankylosing

Spondylitis with *Very Severe Diseases Activity* (ASDAS CRP 3.98) and *Thoracolumbar Kyphotic deformity* where the diagnosis of radiographic axial spondylitis or ankylosing spondylitis was established with the ASAS 2010 criteria or the modified 1984 New York criteria specific to the USA.

The management of ankylosing spondylosis (AS) is divided into pharmacological and nonpharmacological therapies. Pharmacological therapies include OAINS, conventional DMARDs (Metrotreksate, Sulfasalazine), local glucocorticoids, Anti TNF α, Anti IL-17A (Secukinumab, Ixxekizumab). Non-pharmacological therapies from the US include physical therapies such as *back exercise* and *stretching*, as well as Operational actions such as *total hip replacement* and *vertebral osteotomy*. OAINS therapy is the first choice of SpA management that is given continuously, there is no specific choice of OAINS that is more recommended so that any OAINS option can be used. While conventional DMARDs such as methotrexate and sulfasalazine can be administered for the treatment of peripheral joint manifestations (when the joints involved > 2 joints). Local injections of glucocorticoids may be given if arthritis occurs in ≤2 joints. The combination of OAINS and anti-TNF α is the second line if axial spondyloarthritis remains active. Anti-TNF drugs can α be replaced with anti-IL-17A if there are comorbidities or no response to anti-TNF α. The algorithm of therapy options can be seen in **Image** 3. Evaluation of the use of OAINS was carried out after 1 month of therapy, anti-TNF α after 3 months, and anti-IL-17A after 4 months.(Indonesia, 2020, 2021) Other therapies for AS, such as the administration of janus kinase inhibitors (JAKs), are being studied in depth. Meta-analysis said that the administration of tofaitinib 5 mg produced a better therapeutic response than the administration of IL-17A.[10] Nonetheless, the results of another meta-analysis say that anti-TNF α remains a more ideal option to address US progressivity.[11] Surgery *total hip arthroplasty* (THA) is recommended for patients with advanced pelvic arthritis.(Indonesia, 2021) Meta-analysis showed that THA can improve the mobility and function of the patient's pelvis. Although this procedure has complications such as, fractures, dislocations, ossification, and temporary nerve paralysis, it is considered safe and effective because the complications are well managed and there is no reported remission of ankylotic spondylitis.

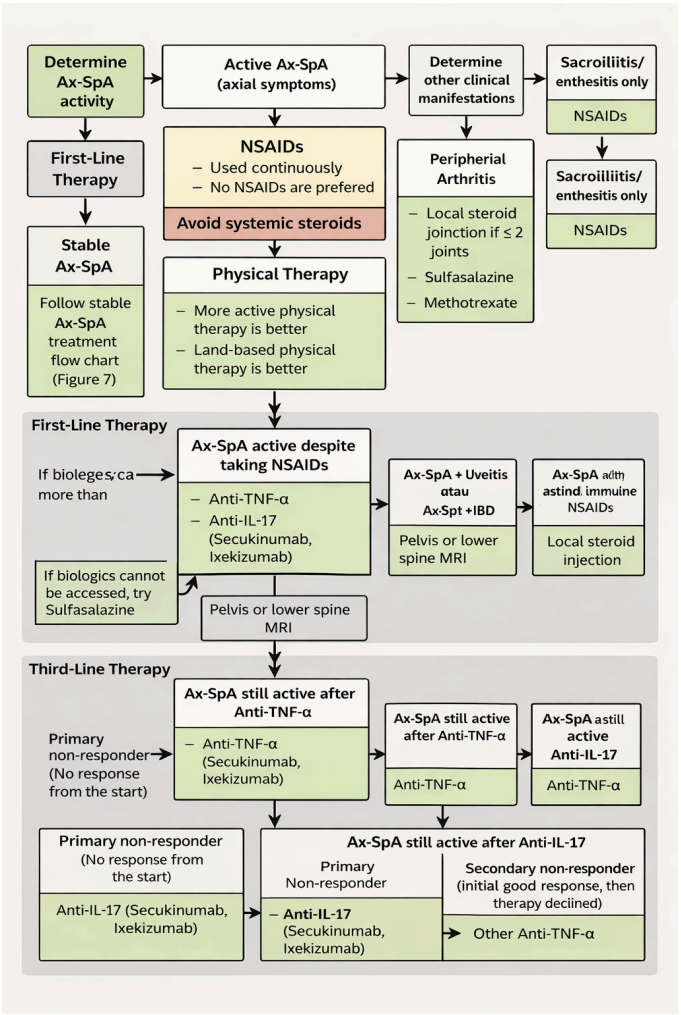

Figure 3. Algorithm of therapies for spondylosis ankylosis.(Indonesia, 2021)

Tumor Necrosis Factors (TNF) - alpha is a protein produced by the body during the inflammatory response process. *Tumor Necrosis Factors (TNF) – alpha* produces inflammation which further causes pain, tenderness, swelling and fever in several inflammatory conditions, one of which is ankylosing spondylitis.[13] Anti TNF- α binds to TNF- α and lymphotoxin- α (TNFβ), stopping their interaction with TNF receptors on the cell surface, thereby inhibiting the biological activity of both proteins. There are four types of anti-TNF-α, namely adalimumab, etarnecept, golimumab, and infliximab.[13,14] The use of anti-TNF-α correlates with the emergence of opportunistic infections so that before the administration of anti-TNF-α therapy, screening for opportunistic infectious diseases such as Tuberculosis (TB), Human Papilloma Virus (HPV) infection, Hepatitis B and C, Varicella Zoster Virus (VZV), Herpes Simplex virus (HSV), Cytomegalovirus (CMV), Epstein Barr Virus (EBV), Human Immunodeficiency Virus (HIV), other infections (bacteria, parasites, and fungi). Other conditions that need to be screened before the administration of anti-TNF-α. Among others, such as pregnancy, previous history of cancer and heart failure.[15] The patient's *chest x-ray* examination showed no signs of pneumonia or tuberculosis, HbsAg and anti-HCV were found to be non-reactive, anti-HIV was found to be non-reactive, there was no family history of cancer and no history of heart failure in the patient.

Anti TNF- α is able to provide a high condition improvement effect with use for 6-24 weeks. In a study conducted by McCormack and Wellington, etarnecept showed its superiority over placebo. *The PRINCIPLE 20 Improvement criteria* were used as a benchmark for improving the condition of patients using etarnecept, where the group of users who injected 25 mg of subcutaneous etanercept every 2 times a week, for 12 weeks ($p < 0.0001$) was 59%, higher than the placebo group which was only 28%. At 24 weeks of use ($p < 0.0001$) the response of etarnecept therapy compared to placebo was 57% and 27%, respectively. Even in the second week after initiation therapy, a significantly higher therapeutic response for etanercept than placebo ($p < 0.01$) was observed.[14] patients were treated with a subcutaneous injection of etarnecept 50 mg once a week for 12-24 weeks, accompanied by meloxicam 7.5 mg every 12 hours orally. The patient's condition will be evaluated monthly with ASDAS (Ankylosing Spondylitis Disease Activity Score) CRP or LED with parameters of low back pain, peripheral pain/swelling, morning stiffness and CRP/LED with a target of remission (ASDAS < 1.3) or minimal low disease activity (ASDAS < 2.1), a decrease in VAS of at least 2 points and improvement of functional impairments.

US patients experience spinal pain and stiffness from occipital to sacrum, postural changes including loss of lumbar lordosis, buttock atrophy, *thoracic kyphosis* is becoming more pronounced, forward flexion of the neck, waist flexion with flexion of both knees as compensation. These postural changes will cause *severe thoracolumbar kyphotic deformity* (TLKD) and *flexion-contracture deformities* of the spine. Complications that can be experienced by patients with *severe thoracolumbar kyphotic deformity* (TLKD) include back pain, *horizon vision loss*, neurological deficits, difficulty walking, *abdominal viscera compression*, lung dysfunction, and *psychosocial difficulties. Corrective osteotomies* are the only therapy for US patients with thoracolumbar Kifosis, where there are 4 types of osteotomies, namely *Smith-Peterson osteotomies (SPO), Ponte osteotomies (PO), pedicle subtraction osteotomies (PSO), and vertebral column resections (VCR)*.[16,17] The purpose of Osteotomy is to reduce the CBVA *angle* (*Chin-brow to vertical angle*) so that it can restore the ability to see horizontally and restore the balance of the patient's *sagittal vertical axis*.[17] Indications of osteotomy include the patient's inability to stand upright and balanced, inability to see horizontally, compression of the visceral organs due to kyphosis, pain due to *muscle strain,* and unattractive cosmetic appearance.[17] In this case, it can be seen that the thoracolumbal kyphosis deformity experienced by the patient has caused the patient's inability to stand upright and balanced, the patient also has difficulty seeing horizontally, the chronic pain that the patient has experienced for 4 years that has not improved, and the patient's posture is hunchback. The patient does not experience lung dysfunction, eating disorders and compression of the visceral organs. In this case, the operative nonpharmacological management carried out was the correction of the patient's deformity carried out by orthopedics in the form of *vertebral osteotomies* with *the Pedicle substraction osteotomies* (PSO) procedure. Patients also receive physical therapy and back stretching as many as 2 sessions by physiotherapists.

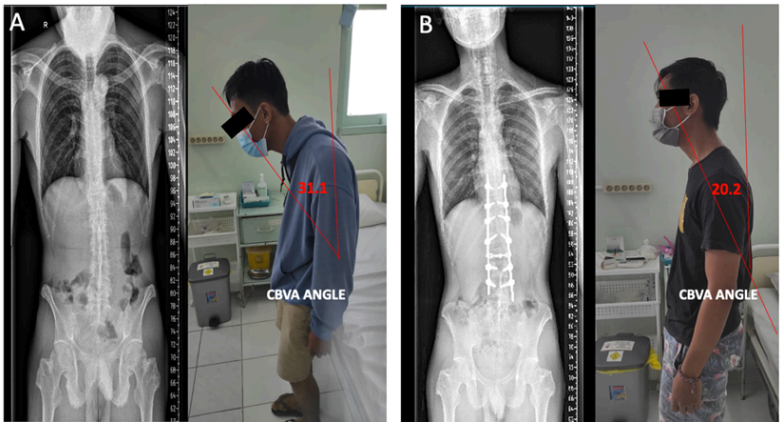

Figure 3. Comparison of preoperative and postoperative conditions: (A) X-ray steaching spine and clinical photo of the patient with preoperative CBVA angle, (B) X-ray steaching spine and clinical photo of the patient with postoperative CBVA angle.
Catatan: CBVA (Chin brow vertical angle).

At the 4-month postoperative follow-up, the patient's complaints of low back pain had been greatly reduced, the hunched posture had improved and was quite balanced, horizontal vision had improved, neck stiffness had improved, the patient was able to sleep in a prone position and the stiffness in the *hip joint* had decreased. There was an improvement in the CBVA angle from 31.1° to 20.2° (**Figure 3**). The ASDAS CRP score improved from 3.98 points to 2.9 points, but the CRP was still quite high, at 26.3 mg/L. BASFI (*Bath Ankylosing Spondilytis Functional Index*) scoring also improved from 7.7 points to 4.5 points. Patients fitted with rod and interpedicle screw internal fixation as high as CV Th10-L4, were given 50 mg of oral sodium diclofenac when necessary for pain management and planned for the administration of a sixth etarnecept at the next control.

Table 3. Clinical Picture and Inflammatory Parameters of Preoperative and Postoperative Patients

Parameter	Pre-Operation	Post-Operative
Main Complaints	Back pain, *horizon vision loss,* hunched posture, balance disorders, neck stiffness, and stiffness in the *hip joint.*	Low back pain improves, horizontal vision improves, neck stiffness improves, patients are able to sleep in a prone position and stiffness in the *hip joint* joints has decreased.
BASFI	7,5	4,5
ASDAS-CRP	3.98 points	2.9 points
CRP	31.2 mg/L	26.3 mg/L
Sudut CBVA	31,1°	20.2°

In this case report, patients with radiographic ankylotic spondylitis accompanied by severe thoracolumbar kyphosis deformity and very high disease activity (ASDAS-CRP 3.98) showed significant clinical and radiological improvement after deformity correction using ***the*** *pedicle subtraction osteotomy* (PSO) technique. However, CRP levels remained high (26.3 mg/L) at the 4-month postoperative evaluation. This condition can be explained by a

prolonged postoperative inflammatory response, given that PSO is a major spine surgery procedure with extensive bone resection and significant soft tissue manipulation. The process of bone healing and tissue remodeling can maintain the activation of pro-inflammatory cytokines so that CRP levels do not immediately return to normal. In addition, surgical corrective measures only correct structural deformities and do not directly control the systemic inflammatory processes underlying ankylosing spondylitis, especially in patients with high disease activity prior to surgery.

The persistence of elevated CRP also indicates the possibility of ongoing disease activity or an inoptimal response to biologic therapy. Although patients have received subcutaneous 50 mg etanercept once weekly for 12–24 weeks with NSAIDs, some patients with ankylosing spondylitis are known to experience partial or non-response to TNF-α inhibitors. Therefore, re-evaluation of therapy adherence, medication administration techniques, as well as the exclusion of other inflammatory causes such as postoperative infections need to be carried out. As per the ASAS–EULAR recommendations, in patients with high disease activity despite having received adequate biologic therapy, therapeutic escalation may be considered in the form of replacement to another TNF-α inhibitor or switch to biologics with different mechanisms of action, such as IL-17 inhibitors, within the framework of a *treat-to-target approach*.

The long-term success of correction of thoracolumbar kyphosis deformity in ankylosing spondylitis using *pedicle subtraction osteotomy* (PSO) is not only determined by the technical success of the surgery, but also highly dependent on a structured and aggressive postoperative rehabilitation program. Rehabilitation aims to maintain sagittal correction, prevent postoperative complications, improve respiratory function and mobility, and optimize the patient's quality of life. In patients with ankylosing spondylitis, chronic spinal stiffness and involvement of the axial and peripheral joints make rehabilitation an essential component of postoperative management.

In the initial postoperative phase (0–6 weeks), rehabilitation is focused on gradual early mobilization, deep breathing exercises, and prevention of immobilization complications such as atelectasis and thromboembolism. Isometric exercises of the extremities and light paraspinal muscles, as well as correct posture education, need to be done from an early age while still paying attention to the stability of internal fixation. The use of a thoracolumbar brace can be considered to maintain the correction of deformities during the bone healing process, especially in the early postoperative period.

In the advanced phase (6 weeks to 6 months), the physiotherapy program is directed at increasing the range of motion of the peripheral joints, strengthening the extensor muscles of the back and ***core muscles***, as well as balance exercises and gait training. Postural exercises that emphasize the position of extension and sagittal alignment are essential to maintain PSO correction results and prevent recurrence of deformity. In addition, low-impact aerobic exercise, such as walking or swimming, is recommended to increase functional capacity and control overall disease activity.

A multidisciplinary and continuous approach to rehabilitation, with the involvement of medical rehabilitation doctors, physiotherapists, and surgical teams, has been shown to improve long-term functional outcomes in postoperative ankylotic spondylitis patients. Patient adherence to rehabilitation programs is also a key factor in maintaining deformity

correction, lowering disability, and improving quality of life. Therefore, post-PSO rehabilitation should be seen as an integral part of the overall management strategy for ankylosing spondylitis patients.

CONCLUSION

This paper describes a 26-year-old man with ankylosing spondylitis (AS) presenting with high disease activity (ASDAS-CRP 3.98) and severe thoracolumbar kyphotic deformity (TLKD), diagnosed based on a four-year history of inflammatory back pain, elevated inflammatory markers (ESR and CRP), and characteristic radiological findings including bamboo spine and the dagger sign. A multidisciplinary management strategy combining anti–tumor necrosis factor therapy (etanercept) and surgical correction via pedicle subtraction osteotomy (PSO) resulted in reduced disease activity (ASDAS-CRP 3.98 to 2.9), significant postural correction (CBVA 31.1° to 20.2°), and marked improvement in horizontal gaze, spinal mobility, and overall quality of life. This case underscores the importance of early diagnosis and the integration of biologic therapy with corrective surgery to prevent long-term disability and restore function in young patients with severe AS. Future research should focus on longitudinal, multicenter studies to evaluate optimal timing, sequencing, and long-term outcomes of combined pharmacologic and surgical interventions, as well as standardized multidimensional outcome measures integrating inflammatory, functional, and radiographic domains.

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