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Editorial

Doctor, will my sleep improve after the rotator cuff surgery?

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A rotator cuff tear (RCT) is one of the most common causes of disability and shoulder pain, especially in older individuals due to age-related degeneration. It is not uncommon for patients to experience sleep disturbances due to aggravated pain at night. However, only around 15% of people may have an asymptomatic RCT.[1]

Sleep disturbance is a common finding in patients with RCT. A systematic review showed that only 11% of symptomatic rotator cuff patients were without sleep disturbances.[2] The quality of sleep has become an important component of our health that requires attention in patients with a rotator cuff tear. Unfortunately, in the field of orthopedics, sleep disturbances were considered trivial and under-appreciated, perhaps due to many related conditions that may contribute to sleep disturbances.

Horneff et al. reported that the prevalence of sleep disorders before rotator cuff repair may reach 89%, and 38% of patients may still experience sleep disturbances six months after the rotator repair.[3] Following arthroscopic rotator cuff repair, sleep quality is reported to consistently improve to 47%.[2] This improvement is usually seen within six months after surgical repair of the RCT. However, residual sleep disorders after surgery were also reported to persist for as long as two years in 41% of patients who complained of sleep disturbances.[3] Most patients undergoing rotator cuff repair experience sleep disturbances at night due to increased cytokine inflammation, which may persist even after two years.[2]

Recently, orthopedic surgeons have been trying to determine the cause, but it seems that sleep impairment is multifactorial. Night pain plays a significant role in sleep disturbances, but other associated factors such as female sex, depression, the presence of low back pain, diabetes mellitus, cervical involvement, and a BMI >25 kg/m^2 significantly affect sleep quality.[4] Surgical factors may also be correlated with worse sleep quality, such as preoperative and prolonged postoperative narcotic pain medication (e.g., oxycodone) for more than six weeks, which decreases rapid eye movement and increases wakefulness.[3,5]

Sleep disturbances may affect the circadian rhythm, the biological rhythm of the body with a near-24-hour period, which affects the behavior and physiology of most organisms.[6] This would influence patient emotions, social interactions, and physical well-being, impairing the patient's quality of life. Furthermore, this would have a negative impact on postoperative outcomes and patient satisfaction.[7]

It is important for the surgeon to counsel the patient regarding the healing timeline so that the patient can have appropriate expectations following a rotator cuff repair procedure.

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Review Article

Total Knee Replacement in Valgus Knee

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Abstract

Total knee replacement (TKR) in valgus knee patients presents unique challenges and requires careful consideration of various factors to ensure optimal outcomes. Valgus knee deformity can be associated with various underlying conditions, including autoimmune diseases like rheumatoid arthritis. Nearly 10% of patients undergoing total knee replacement have valgus knee deformity, which is associated with poorer functional outcomes than varus knees. When planning TKR procedures for patients with valgus knee deformity, it is crucial to identify the underlying reason, as the surgical strategy and implant selection may vary according to the individual etiology and patient factor. Proper alignment and stability of the knee joint need precise bone cuts, soft tissue balance, and implant design. Soft tissue balance ensures optimal joint function and range of motion. A comprehensive pre-operative planning process that takes into account these factors is essential for achieving the best possible outcomes and patient satisfaction in TKR for valgus knee patients. Different surgical approaches, such as the medial parapatellar and lateral parapatellar approaches, offer distinct advantages and disadvantages in treating valgus knee patients, and the choice of approach should be based on the surgeon's expertise and the patient's specific anatomy and deformity. For a successful output, the coronal, sagittal, and rotational alignment must be in proper proportion. Therefore, before performing a total knee replacement on a valgus knee, it is necessary to have a thorough understanding of the problem and the treatment options available.

Introduction

A valgus knee is a type of knee deformity characterized by an outward angulation of the lower leg about the thigh.[1] Osseus malalignment in the valgus knee is defined by medial proximal tibial angle (MPTA) >90º, lateral distal femur angle (LDFA) <85º, or a combination of them.[2] Valgus knee deformity can result from various causes, including osteoarthritis, rheumatoid arthritis, rickets, and renal osteodystrophy. Valgus deformity with total knee replacement is less prevalent than varus deformity. Nearly 10 percent of individuals receiving total knee replacement (TKR) exhibit valgus knee deformity and are associated with less favorable functional results than varus knees.

Anatomical Differences

There are anatomical differences to consider while performing total knee replacement on a valgus knee that can be caused by a bony or ligamentous pathology. Bone abnormalities such as hypoplastic lateral condyle, lateral tibial plateau bone loss, external rotation deformity of the tibia, femoral and tibial metaphyseal valgus remodeling, and patellar malalignment often add difficulties to doing TKR. In contrast, soft tissue pathologies such as a tight iliotibial band (ITB), lateral collateral ligament (LCL), lateral retinaculum and capsule tightness, posterior cruciate ligament tightness, and the laxity the of medial ligament may also worsen the valgus deformity.[4] The anatconsiderationseration and clinical implications are presented in Table 1.

No	Anatomical considerations	Clinical Implications
1	Lateral femoral condyle hypoplasia	The posterior femoral condyle is often deficient and may result in malrotation of the femoral component. Therefore, the anteroposterior (AP) axis and the trans epicondylar axis should be used as reference to achieve correct femoral component rotation.[5]
2	Tibial plateau remodeling	This may lead to under-correction of the deformity if the distal tibia valgus there is unrecognized. Lateral side tibial components augments may be necessary.[5]
3	Tightness of the ITB	The pie crusting technique is conducted to lengthen the ITB and maintain its continuity.[5]
4	Tightness of the LCL	Released in the case of tightness in flexion.[6]
5	Lateral retinaculum and capsule tightness	Released in the case of tightness in extension.[6]
6	Tightness of the PCL	Released in the case of pathological laxity of the medial compartment with the release of the lateral side, followed by PCL balancing.[6]
7	Medial ligament laxity	Advancement of the medial structure.[6]

Table 1. Anatomical consideration and clinical implication for TKR in valgus knee

The diagnostic procedure for total knee replacement (TKR) in valgus knees is similar to that of normal knees, with some additional considerations such as evaluating the valgus deformity using CT-Scan or MRI to measure joint anatomy and alignment. Soft tissue evaluation such as medial and lateral collateral ligaments, the posterolateral capsule, the popliteus tendon, the hamstring tendons, the lateral head of the gastrocnemius, and the iliotibial band also need to be carefully evaluated to determine whether soft tissue releases are necessary to perform.[4] The surgical procedure for total knee replacement in valgus knees also has some different considerations compared to normal knees such as approaches, soft tissue release, bone resection, and implant selection since there are changes in the anatomy of the landmark that is usually used for bony cut in total knee replacement. This condition can lead to malalignment of the implant and may cause instability or post-operative pain. To manage bone abnormalities or soft tissue disease or both in valgus deformity, thorough pre-operative planning, clinical assessment, implant backup, and good operation skill are needed.[7]

Classification

Several classifications of the valgus malaligned knee have been recorded, with the severity of the deformity and the extent of soft-tissue involvement often being considered. Ranawat classifies valgus knee into three types, Type I: Valgus <10°; Type II: 10°< Valgus <20°; Type III: Valgus >20°. (Figure 1).

Mullaji and Shetty[8] amended the initial Ranawat classification[9] to incorporate multi-planar and/or extra-articular abnormalities, and they categorized valgus deformity as follows:

- Type I: correctible valgus deformity with no fixed deformity and an intact MCL
- Type II: fixed valgus deformity with an intact MCL
- Type III: valgus and hyperextension deformity with an intact MCL
- Type IV: valgus and a fixed flexion deformity with an intact MCL
- Type V: severe valgus deformity with an incompetent MCL
- Type VI: valgus secondary to extra-articular deformity

Pre-operative Planning

Total knee replacement (TKR) is an elective surgery that is not typically considered an emergency procedure. It is essential to carefully evaluate the degree of valgus deformity, the underlying cause, and the extent of bone and soft tissue abnormalities before proceeding with surgery. Pre-operative planning, alignment assessment, soft tissue balancing, and implant selection are crucial for achieving optimal outcomes in TKR for valgus knees. Rushing into surgery without proper evaluation and planning can increase the risk of complications and lead to suboptimal outcomes. Pre-operative planning is crucial when performing total knee replacement in a valgus knee. Obtaining an accurate axis restoration, component orientation, and joint stability in a valgus knee with combined bony and ligamentous pathology may be challenging. Therefore, it is vital to take the time to carefully evaluate the patient's condition and plan the surgery accordingly.[5]

An important aspect of pre-operative planning for valgus knee deformity patients undergoing total knee replacement is determining the patency of the ligament via physical examination (TKA). To discover dynamic instabilities, the general alignment should be evaluated both in the supine and weight-bearing position, and the gait should be watched. The knee must be assessed for anteroposterior laxity, range of motion (ROM), coronal and sagittal deformities, and mediolateral instability. The surgeon must evaluate the medial and lateral collateral ligaments, along with the posterolateral capsule, popliteus tendon, hamstring tendons, lateral head of the gastrocnemius, and iliotibial band. The integrity of these ligaments is essential for excellent outcomes in TKA procedures for valgus knees. In fixed valgus deformity, the lateral collateral ligament is contracted and added varus force in physical

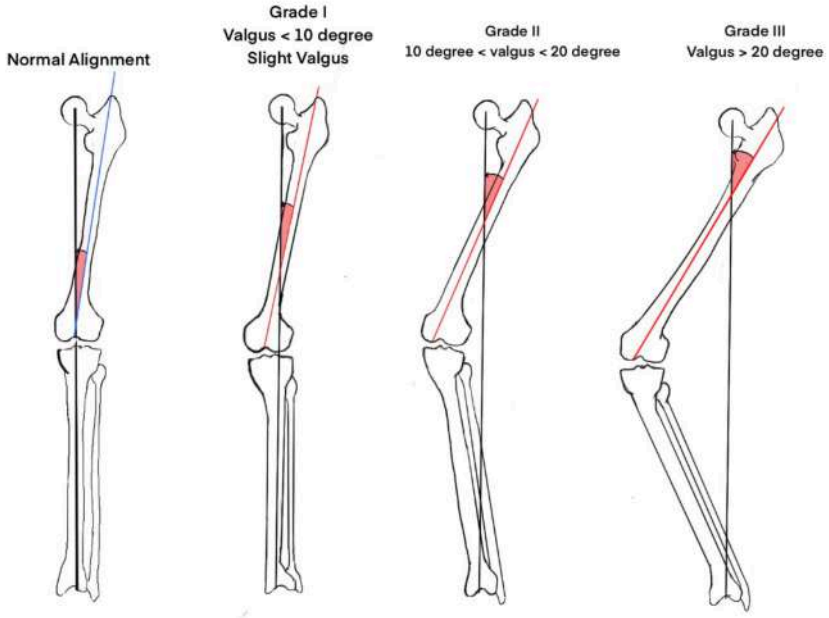

Figure 1. Ranawat classification based onthe degree of valgus deformity

examination will not correct the deformity. In dynamic valgus deformity, the deformity will be corrected if the varus force is added in physical examination. It is easier to do TKR in Dynamic valgus deformity because lateral soft tissue is not contracted and only a little release is needed to balance the medial and lateral soft tissue. The surgeon can prepare for suitable soft tissue releases or changes during TKA to promote optimal joint stability and range of motion by carefully analyzing the integrity of the ligaments during pre-operative planning.[10]

When performing total knee replacement in a valgus knee, pre-operative planning such as radiographic planning, templating, component positioning, balancing, and implant selection should be considered carefully. Radiographic planning is essential to determine the degree of valgus deformity and the extent of bone defects. A template of bone cuts must be performed in the anteroposterior radiographic view of the knee. On the tibial anatomical axis, a line is drawn, followed by a perpendicular line at the level of the tibial plateau. The femoral anatomical axis is drawn, followed by a second line at the level of the intercondylar notch with the desired amount of valgus. Metaphyseal remodeling at the distal femur often makes the entry point of the intramedullary guide for distal femoral resection more medial than normal. The anatomical femoral axis have to be drawn with the center of the shaft as the guidance and the point where anatomical axis at the most distal part of the femur should be marked as the entry the point of intramedullary guide for distal femoral resection.[9] Incorrect entry point of intramedullary guide will make the distal resection inaccurate and usually will lead to more valgus resection of distal femur.[11]

The distal femoral resection angle is a crucial aspect of pre-operative planning for total knee replacement (TKR) in valgus knee patients. It refers to the angle at which the distal femur is cut during the surgery to accommodate the implant. This angle is determined based on the degree of valgus deformity and the degree of tibia and femur bowing. Proper evaluation of the distal femoral resection angle is essential for achieving optimal alignment and stability of the knee joint during TKR. Precise distal femoral resection with an accurate valgus cutting angle (VCA) is important while correcting valgus deformity in total knee replacement. SA study by Song et al[12] showed that a fixed distal femoral resection with a valgus cutting angle of 3° is more appropriate in intra-articular valgus deformity than exta-articular valgus deformity in TKA. By carefully evaluating the distal femoral resection angle during pre-operative planning, surgeons can develop a comprehensive surgical strategy to address the deformity and optimize the results of TKR in valgus knee patients.[13]

In valgus knee patients, pre-operative planning for total knee replacement (TKR) should include an examination of the tibia and femur bowing condition. In valgus knee, lateral femoral bowing refers to a deformity where the femur bone curves outward on the lateral side, which can pose challenges in achieving optimal outcomes and longevity of total knee replacement. In addition, the tibia bone may bow medially in the valgus knee, which can lead to misplacement of the tibial component during TKA. This misplacement can result in instability, pain, and premature wear of the implant. Therefore, these are important to be considered in the pre-operative phase to plan the corrective techniques to address the tibia

and femur bowing during the surgery. This may involve adjusting the bone cuts and implant positioning to achieve proper alignment and stability.[14]

Approach

When approaching total knee replacement in a valgus knee, several considerations should be taken into account including the approaches, soft tissue release, osteotomy, implant selection, and balancing. The medial parapatellar approach is the most commonly used approach for total knee replacement (TKR), including in patients with valgus knee deformity. However, in valgus knee patients, the medial parapatellar approach may present some challenges in achieving proper soft tissue balance and joint alignment. One advantage of the medial parapatellar approach is its familiarity with most surgeons, providing satisfactory exposure for the procedure. On the other hand, this approach has a disadvantage in that it requires additional release of lateral soft tissue structures, which can jeopardize patellar blood supply and compromise patellar tracking. When a medial approach is employed to treat a valgus knee, the surgeon must be highly cautious when detaching the MCL. In valgus abnormalities, the release of the medial structures should be limited to the overhanging osteophytes.[15]

Alternative methods, such as the lateral parapatellar approach, can provide direct access to the tight lateral ligamentous structures, allowing for easier release and proper knee balancing while preserving the medial structures. This approach also optimizes patellar tracking and maintains the medial blood supply to the patella.[16] Study by Cheng et al[17] also showed that the lateral parapatellar approach improved pain and function post-operative significantly without deviation of the lower limb mechanical axis of the prosthesis position, good knee stability, and simplifying the complex soft tissue balance technique of the valgus deformity. However, the lateral parapatellar technique may bring certain disadvantages, such as technical issues with patella eversion and surgeon unfamiliarity.[18] In addition, there is a possibility of soft tissue closure and wound healing difficulties. Despite these obstacles, the lateral parapatellar approach is a viable option for treating patients with valgus knee deformity, as it has been demonstrated to result in higher post-operative Knee Society Scores, shorter surgery times, and comparable complication rates compared to the medial parapatellar approach.[19]

Technical Consideration

When performing total knee replacement in a valgus knee, achieving proper balance and correction of limb alignment by utilizing appropriate sizing and type of implant is crucial for long-term success. Accurate bone cuts are crucial for achieving proper alignment and stability of the knee joint, while soft tissue balance ensures optimal joint function and range of motion.

Tibial Resection

When performing a total knee replacement on a valgus knee, a shallower resection of the tibia is preferred. A significant correlation exists between the needed tibial resection and the pre-operative leg axis. In valgus deformities, the required resection depth-averaged 5.1 mm and was significantly reduced compared to knees with a neutral leg axis (6.8 mm) and varus deformities (8.0 mm). Manufacturers recommend undercutting the high side of the tibial plateau to the depth of the thinnest insert available. However, the study demonstrates that in valgus deformities, unnecessary bone loss can be avoided by reducing the tibial resection depth. The optimal tibial

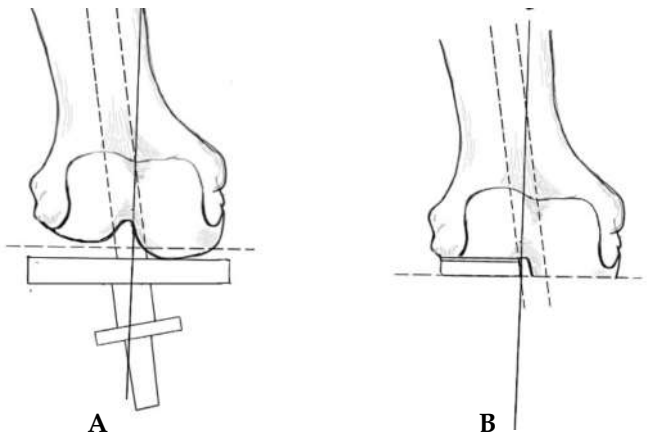

Figure 2. Lateral condyle hypoplasia; 2.a note the resection doesn't involve lateral condyle that is smaller than usual; 2.b block augment can be used to compensate for lack of bone stock in lateral condyle

resection depth in valgus deformities corresponded to the smallest insert thickness minus 3 mm.[20] The tibial cut should be performed perpendicular to the anatomical axis, removing the smallest possible bone amount, especially from the lateral side. In cases of severe bony deformities of the tibial plateau, it may be necessary to remove nearly no bone from the lateral side to prevent medial over-resection or mal-aligned cuts.

Distal Femoral Resection

Distal femoral excision in total knee replacement (TKR) for valgus knees requires alignment correction, joint line restoration, anatomical considerations, and surgical technique. The objective of distal femoral excision for the valgus knee is to achieve appropriate alignment and restore the joint line. When the distal femoral cut is performed, the surgeon should pay attention to the distal femoral angle of the cut and also how much bony cut will be performed.

The amount of bone resected during distal femoral resection should be based on the medial condyle. With lateral femoral condyle hypoplasia, sometimes there is no lateral femoral condyle bone that was resected in severe valgus deformity of the distal femur (Figure 2). It is not recommended to add more distal femoral resection to compensate for lateral condyle hypoplasia as it will alter the joint line and make balancing more difficult. The unresected lateral condyle should be managed with a distal femoral augment device or with a screw to fill the gap between the unresected bone and the implant.[10,12]

Femoral Rotation

Achieving proper femoral rotation is essential for restoring natural joint mechanics, patellar tracking, optimizing implant longevity, and ensuring functional outcomes. However, the complexity of femoral rotation in valgus knees poses unique challenges that necessitate a thorough understanding and precise surgical techniques. Due to lateral condylar hypoplasia and lateral cartilage erosion, it is difficult to achieve correct rotational alignment of the femoral component during total knee replacement (TKR) for the valgus knee. An available landmark that is usually used in TKR to determine the rotation is the posterior condyle, but in the valgus knee, the lateral condyle is often hypoplastic making the posterior condyle axis more internal rotation (more than 3 degrees) about trans epicondylar and anteroposterior axis (Figure 3).

The gap technique involves resecting the tibia in advance and performing anterior and posterior cuts of the femur parallel to the tibial cut when the knee is at 90° of flexion. This permits free rotation of the femoral component while limiting soft tissue release. The gap technique-based navigation system allows surgeons to quantify femoral component rotation based on the

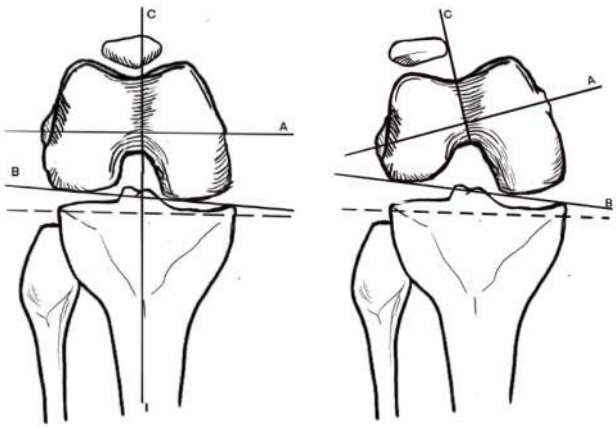

Figure 3. The left is a normal knee and the right is a valgus knee with lateral femoral condyle hypoplasia. Note that in the valgus knee, the posterior condyle axis is often unreliable due to hypoplasia. A = trans epicondylar axis, B = posterior condyle axis, C = Anteroposterior axis (whiteside line)

posterior condylar axis, which can help achieve proper rotational alignment of the femoral component in TKR for valgus knee deformity.[21]

Arime et al.[22] identified the anteroposterior axis, the posterior condylar axis, and the trans epicondylar axis in thirty cadaveric femora to determine the reliability of using each axis in the operative setting to achieve correct rotational alignment of the femoral component in total knee replacement in a valgus knee. In addition to obtaining radiographs of the distal side of each femur, creating the axes, and calculating the angles to compare with the visual measurements, radiographs were also taken for this investigation. The article demonstrates that the anteroposterior axis is a reliable reference point for rotational alignment of the femoral component in a valgus knee. Utilizing the anteroposterior axis as a trustworthy landmark, surgeons can lessen the likelihood of malalignment and enhance the knee joint's overall performance.

All landmarks available such as the trans epicondylar axis, anteroposterior axis, medial and lateral flexion gap balance, and posterior condyle axis should be considered to determine the correct rotation of the femoral component.

Soft Tissue Balancing

The soft tissue balance in the valgus knee is more difficult due to the specific collection of bone and soft tissue anomalies that must be addressed during the procedure.[7] Proper soft tissue balance can help in the optimization of alignment, stability, and functional outcomes. In valgus knees, lateral soft tissue release is frequently performed during TKR. To correct the valgus deformity and achieve normal alignment, tight lateral collateral ligaments (LCL), posterolateral capsule (PLC), popliteus tendon (POP), hamstring tendons, the lateral head of the gastrocnemius (LHG),

and iliotibial band (ITB) are released. Gap balancing is a technique used in TKR to improve soft tissue balance and joint stability. This involves correcting the bone cuts and soft tissue releases so that the gaps in flexion and extension are equal and symmetric. Gap balance in valgus knees can be difficult due to the specific mix of bone and soft tissue anomalies that must be addressed after surgery.[23]

The sequence of lateral soft tissue release is still debated in the literature. The overall alignment should be assessed both in the supine and weight-bearing positions, and the gait should be observed to identify any dynamic instabilities. It is also very important to determine whether the valgus deformity is fixed or reducible, as this will determine the level of constraint needed for the prosthesis. If the deformity is fixed, a semi-constrained or higher-constrained prosthesis may be necessary.[9,24]

Although numerous soft tissue techniques and procedures have been promoted over the past three decades, there is no consensus regarding the structures that must be targeted during TKR and the order of their release.[1] However, a sufficient lateral soft tissue release must be undertaken to prevent residual valgus deformity and patellofemoral alignment issues, while avoiding excessive releases that may increase the risk of complications.[25] In a lateral parapatellar approach, the lateral retinaculum and vastus lateralis muscle are separated to expose the lateral portion of the knee joint. It permits improved sight and access to the lateral components of the knee joint, which can be advantageous in cases of severe valgus deformity.[26] In addition, selective soft tissue release involves releasing particular soft tissues, such as the iliotibial band, lateral capsule, and lateral collateral ligament, to equalize the stress on both sides of the knee joint. It has been determined to be effective without restricting prosthetic mobility. Importantly, poor soft tissue balancing can result in consequences such as late-onset joint instability, and the choice of approach should be determined by the degree of deformity and joint instability. It is essential to highlight that the literature lacks sufficient information to determine the best strategy for lateral soft tissue release.[1]

Ranawat introduced an inside-out technique to release lateral soft tissue in the valgus knee. The technique has several steps: (1) Remove peripheral osteophytes. (2) Extend the knee and distract with a lamina spreader. (3) Irrigate and dry the joint. (4) Palpate the posterior cruciate ligament, posterolateral corner, and iliotibial band to determine tight structures. (5) Release any remnant of the posterior cruciate ligament. (6) Release the posterolateral capsule intra-articularly with the use of electrocautery at the level of the tibial cut surface from the posterior cruciate ligament to the posterior border of the iliotibial band. (7) Preserve the popliteus if possible, unless it is too tight. (8) The iliotibial band is lengthened as necessary from the inside with multiple transverse stab incisions a few centimeters proximal to the joint line with the use of the so-called pie-crusting technique. (9) Repeat these steps after manual stress testing if necessary.

Implant Design

When considering implant design for total knee replacement (TKR) in valgus knees, posteriorly stabilized (PS) implants are commonly used. In valgus knees, PS implants are favored over cruciate-retaining (CR) implants due to the greater risk of instability associated with CR implants.[27] The size of the implant should be carefully selected based on the individual patient's anatomy and the degree of valgus deformity. Undersizing the femoral component can lead to increased rates of aseptic loosening and revision surgery.[4] It is important to avoid overcorrecting the Hip-Knee-Ankle (HKA) angle, particularly the tibial mechanical angle, in the event of a fixed severe valgus knee. Maintaining a severe valgus knee in a mild residual valgus to use a less limited implant or to avoid substantial ligament releasing should not hurt the 5-10-year implant survival and the functional scores.[28]

In valgus knee replacement, there is still no consensus on the degree of implant restraint that should be applied. With satisfactory clinical outcomes, both cruciate-retaining (CR) and cruciate-sacrificing (CS) TKR implants have been utilized.[1] On the other hand, a previous study by Lombardi et al[29] proposes PCL-substituting implant designs to circumvent PCL balancing problems and deal with a potentially abnormal native ligament. Other studies, on the other hand, argue that cruciate-retaining designs should be preferred to protect condylar bone in the event of additional revision surgery, particularly in younger patients. In addition, some authors used primary constrained components with and without stem extensions.[30–32]

Varus Valgus Constraint or Constrained condylar knee (CCK) prosthesis is commonly used for revision surgery, but it can also help surgeons improve implant stability in primary knee replacement, particularly in cases of severe knee arthrosis with severe deformity and significant instability where a more constrained articulation is required.[33]

This technique is intended to give a more confined articulation, hence decreasing the chance of implant dislocation and enhancing knee function overall. The device consists of a semi-restricted prosthesis designed to offer stability in the coronal and sagittal planes while allowing for some rotational movement. Ren et al.[34] studied the midterm results of CCK implants in primary total knee replacement for severe valgus deformity involving 47 patients who received primary TKR. According to the findings, in primary TKR for severe valgus deformity, CCK implants can yield satisfactory midterm outcomes.

Mancino et al.[35] evaluated the clinical and radiological results of CCK with posterior stabilized (PS) implants in 52 patients who had undergone primary TKR for valgus knee. The study concluded that there were no significant differences between the two groups in terms of clinical and radiological outcomes, and both groups had good outcomes. The constrained condylar knee (CCK) prosthesis can be utilized in primary total knee replacement (TKR) to increase implant stability, particularly in cases of severe knee arthrosis with severe deformity and considerable instability. There were no significant differences in clinical and radiological outcomes between CCK and posterior stabilized (PS) implants in primary TKR for valgus knee, as demonstrated by research.[34,35]

Other Techniques

The stability of the knee following a complete knee replacement is essential for implant survival over the long term. Extreme axial abnormalities pose a difficulty in total knee replacement (TKR) because it is technically challenging to create a satisfactory soft tissue balance. In severe valgus deformity, soft tissue release alone cannot address the imbalance of medial and lateral gap especially in extension. Several authors use sliding osteotomy of the lateral condyle to lengthen the lateral contracted soft tissue. The lateral epicondyle along with LCL and popliteus is osteotomized and moves to the distal to open the lateral gap. Shifted lateral epicondyle fixated with screw or staples after correct tension was achieved. Mullaji et al.[36] suggested using computer navigation to aid in shifting the lateral epicondyle to prevent over-release and imprecise correction of the lateral structure.

The elongated medial collateral ligament in severe valgus deformity gives severe laxity and difficulty in balance. Some authors tighten the medial collateral ligament by osteotomy of the medial femoral condyle and shift the medial femoral condyle along with the medial collateral ligament to a superior position.[37,38] This technique may help avoid excessive release, the descent of the joint line, and peroneal nerve palsy due to over-release on the lateral side of the knee.

Conclusion

Total Knee Replacement in a valgus knee is a challenging procedure that requires careful pre-operative planning and clinical examination to manage bone deformities and soft tissue contractions/ elongations. Finding the correct balance of the coronal, sagittal, and rotational alignment is necessary for a good outcome. Understanding what happens in the valgus knee and options to overcome the conditions are mandatory before performing total knee replacement in the valgus knee.

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Literature Review

An Update of Tuberculosis Spondylitis and The Holistic Management by *Subroto Sapardan* Total Treatment: Literature Review Study

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Abstract

Tuberculosis spondylitis or Pott disease is a pathological condition that is caused by infection of Mycobacterium tuberculosis and manifests a combination of osteomyelitis and arthritis that usually involves more than one vertebrae. It has recently shown a significant resurgence in developed nations secondary to global migration. Concurrent with this phenomenon, multidrug-resistant bacterial strains of tuberculosis have been increasing in developing nations over the past decades. This reality causes TB spondylitis to be a serious disease with several diagnostic and treatment challenges. One of the treatment methods for tuberculosis spondylitis that has been established in Indonesia is the Subroto Sapardan Total Treatment Protocol, by emphasizing holistic from basic to advanced treatment, this protocol is effective in treating the spondylitis.

Introduction

Tuberculosis (TB) spondylitis, also known as spinal TB or Pott disease, is a form of skeletal TB – a subclassification of extrapulmonary TB. TB spondylitis is considered to be especially dangerous as it is strongly correlated to various neurologic complaints.[1] Although there is a reduction in the number of new TB incidences worldwide, the incidence of extrapulmonary TB, including skeletal TB, remains stagnant.[2] Estimates show that skeletal TB contributes to around 10% of all extrapulmonary TB cases. Of that 10%, TB spondylitis contributes to almost 50% of the cases, making it the most common manifestation of all skeletal TB cases.[3] Additionally, TB spondylitis has a high rate of complications, reaching around 10-43%.[1] Lower-income groups are at higher risk of TB spondylitis, specifically the younger age groups.[4,5]

The persistence of TB spondylitis is highly attributed to socioeconomic factors of the community and was given the title "a disease of poverty". In lower socioeconomic status, access to healthcare amenities is relatively more limited – this similarly applies to developing countries.[4] Additionally, the commonness of TB spondylitis risk factors contributes towards its persistency. Lack of education, imbalanced nutrition, alcohol or substance abuse, several chronic diseases, and immunosuppressive drugs are all considered predisposing factors.[6,7] Lastly, an environmental factor also plays a role in the spread and persistency of the TB pathogen; being directly proportionate to socioeconomic status, this further worsens the condition.

While TB spondylitis requires urgent treatment due to it having severe consequences, there are a handful of challenges that make the current treatment regimen difficult or inefficient. One of the biggest challenges lies in the varying growth kinetics and metabolic properties of the mycobacterial population in an infected region. In extrapulmonary sites, these pathogens are harder to eliminate, and inadequate treatment risks relapse.[8] Moreover, the increasing population of drug-resistant mycobacterial strains escalates the challenge further, rendering most current treatment regimens ineffective. The diagnosis of TB spondylitis itself has its own set of controversies.[9]

In essence, TB spondylitis is a serious disease with several diagnostic and treatment challenges. In pursuance of reducing the number of cases, severity of mortality, and morbidity of TB spondylitis, as well as finding a new method of management, this paper will extensively review a treatment regimen known as *Subroto Sapardan* Total Treatment. This method of treatment is developed and used in some hospitals in Indonesia.

Discussion

The Pathogen: Mycobacteria Tuberculosis

The pathogen responsible for TB is known as *Mycobacterium tuberculosis* (MTB), it is a resilient, aerobic, bacillus bacteria that primarily infects the lungs.[2] The resilience of MTB can be credited to its thick and abundant mycothiol cell wall; this protects MTB from acid and alkaline destruction and gives it resistance to some antibiotic agents. Aside from the cell wall, MTB exhibits numerous virulence factors, namely sulfolipid compounds that suppress phagocytosis and lipoarabinomannan which increases its pathogenicity.[10,11] These reasons along with several other virulence factors make the MTB pathogen highly contagious, it transmits from host to host through aerosol; an airborne transmission.[12] Though resilient, MTB has a complex and slow process of growth and generation, one example is the requirement of Rv3671c membrane protein.[10] This notable weakness can be exploited to eliminate the pathogen from a host.

Pathophysiology and Pathogenesis of TB Spondylitis

As previously stated, MTB spreads through aerosols and infection starts in the lungs of the host. Once it enters a human host, the pathogen can exist in four different types: extracellular rapid-dividing bacilli, extracellular slow-dividing bacilli, intracellular intermittent bacilli, and dormant bacilli.[9,12] It is important to note that even though MTB is the primary causative agent of TB and all its subvariants, there are a few other mycobacterium species that are capable of infecting the host and resembling TB, such as *M. bovis*, *M. africanum,* and *M. microti* to name a few.[2,13] While the lung is the most common site of infection, these pathogens can also be typically found in lymph nodes of the mediastinum, genitourinary tracts, mesentery, gastrointestinal system, and other viscera of infected hosts.[2] Cases of TB spondylitis are predominantly secondary infections, it is the result of the progressive spread of the pathogen from a primary lesion ordinarily of pulmonary or genitourinary origin.[6] The following diseases are thought to be assistive towards the spread of MTB: diabetes, HIV, micro- and/or macro-deficiency malnutrition, and chronic renal failure.[14] Certain usage of medication can also increase the rate of MTB spread, namely usage of TNF-alpha inhibitors and corticosteroids. It has also been hypothesized that genetic susceptibility may play a role in speeding up the spread, nevertheless, this claim has yet to be confirmed.[6,13,15]

Pathogenesis of TB in a host infected with MTB is fully dependent on the outcome of bacillary growth versus the host immunity.[13] Ingestion of the pathogen by alveolar macrophages normally results in the MTB continuing its proliferation inside the macrophages leading to its rupture.[10,13] Consequently, the further immune response will be activated, and eventually tissue damage will occur, either as a granuloma containing the infection (this specific reaction will typically result in sequestration, blocking bone formation) or caesious necrosis.[16] In the soft tissue, MTB can also form a cold abscess known as a psoas abscess. Unfortunately, cases in which the immune system proves to be adequate in eliminating MTB are unexpected. In the majority of cases, the pathogen will enter a dormant phase, placing those with a history of TB at risk of various TB manifestations. Considering both incidences of primary infection and reactivation of dormant phases, approximately 5% of patients will experience a rapid progression of TB disease.[13] The aforementioned ability of MTB to persist inside macrophages creates numerous opportunities for the pathogen to initiate extrapulmonary spread, this is complemented by the pathogens adhesin which has a high affinity to mammalian cells, enabling it to latch on extrapulmonary cells.[10]

Disseminated TB in extrapulmonary regions transpires from the hematogenous or lymphatic spread of the pathogen.[10] Specifically for TB spondylitis, the pathogen enters the vertebrae through a hematogenous route, using either Batson's venous plexus or spinal arteries.[13] When using the arterial route, MTB utilizes a complex of rich vascular plexus that branches off from anterior and posterior spinal arteries. Through it, the pathogen can invade the paradisal region of the vertebrae, initiating TB spondylitis in that location.[17] Meanwhile if MTB were to spread via Batson's venous plexus, it relies on the free-flowing ability of the blood in two directions, this process is fully dependent on intra-abdominal and intrathoracic activities. Aside from veins having lower pressure in comparison to arteries, this phenomenon can ensue due to the veins of Batson's plexus being valveless; a very atypical feature. Using this route MTB typically infects the central area of the vertebrae, furthermore due to the free-flowing feature of the blood, the pathogen can exploit this to infect multiple vertebrae.[6,13]

Based on the presence of disc involvement and the form of TB spondylitis, it was divided into two distinct types: classic spondylodiscitis and atypical spondylitis without disc involvement.[1] Meanwhile there exists a classification system of TB spondylitis based on the vertebral region involved, these are:

central (seen as skipped lesions in the vertebral column), anterior (this leads to kyphotic deformity, consequently forms respiratory problems and paraplegia), and posterior (invasion of laminae, pedicles, and processes).[2,13] As previously stated, the involvement of different regions is contingent on the type of hematogenous route MTB utilizes. In classic TB spondylitis, the infection generally starts with a hyperaemic exudative reaction, it will then progress to the destruction of the intervertebral disc, epiphyseal cortex, and adjacent vertebrae. If this ailment heals before the destruction of the structures, osteoporosis typically forms after the exudate is resorbed. Whilst in destruction, adjacent vertebral bodies may fuse leading to complications or deformities.[13]

Cases of atypical spondylitis without disc involvement could occur, these cases are usually seen in central lesions or elderly patients. It has been postulated that this is most likely due to age-related avascularity; complicating the spread of MTB via hematogenous route. In these cases, clinical manifestation is highly correlated to the collapse and complete compression of the vertebral body, known as vertebra plana.[6]

The previously described pathogenesis processes were all initiated by several chemokines, in the early phases of the infection where a small tubercle is being formed, MTB was discovered to activate chaperonin (CPN) 10 and CPN60. CPN10 is a potent osteolytic cytokine that recruits numerous osteoclasts leading to bone resorption, additionally, it also exhibits an inhibitory effect towards osteoblast proliferation. The effects can be prominently seen in the anterior region of the vertebrae. Meanwhile, the role of CPN60 is more on the induction of cytokine synthesis.[18] As the human body contains numerous cytokines, some may be present to aid immunity, while others may be detected as a sign of disease progression. Typically, when macrophagic phagocytosis of MTB occurs, the white blood cell will release IFN-ɣ which increases the synthesis of pro-inflammatory cytokines such as IL-1, IL-6, TNF-α – this indicates that there is a pathogenic infection occurring in the body and also allows the utilization of IFN-ɣ as a diagnostic biomarker.[19] Recently, a study showed that IFN-ɣ has a strong synergistic effect with IL-7, an important T-cell cytokine, the study concluded that the addition of IL-7 may aid in the diagnostic performances of IFN-ɣ.[20] Once IL-1, IL-6, and TNF-α are released, a reaction cascade will then occur and activate Th1 cells which mediates protective functions against MTB; by repeating the IFN-ɣ cycle as one of its modes of action.[19] Specifically for IL-6 it will also increase the levels of C-reactive protein (CRP), which acts as an acute phase reactant in the reaction processes of cytokines during pyogenic infection, this allows CRP to act as an indicator for infection as well.[21] Despite this, some processes may instead benefit the pathogenicity of MTB, a 2012 study stated that the induction of IL-1β in some TB cases will lead to the increase of Th2 cell differentiation. Th2 cell differentiation has been observed to inhibit the protective function of Th1, consequently decreasing the levels of IFN-ɣ, suppressing inflammatory reactions which is important for the host immunity. This suppression will lead to the further proliferation of MTB in the host, progressing the disease.[22]

These forested damaging processes can be classed into 5 stages: implantation, initial destruction, progressive destruction, neurological involvement, and finally stage of deformity.[23] Eventually these processes lead to various insidious clinical manifestations of TB spondylitis. The earliest detectable signs are stiffness of the upper back during muscle contraction. Spinal rigidity may also be seen as a result of the destruction of vertebrae, though it is not considered to be a TB spondylitis-specific manifestation.[24] Backache is also a common symptom during active stages, other symptoms include rest pain, paraplegia, and spinal tenderness.[2,6] Common TB symptom of weight loss, fever, and malaise, though typically present in TB spondylitis, it is more associated with pulmonary TB. Hence, TB spondylitis has a diverse set of signs and symptoms.[2]

Diagnosis

Suspicion of TB spondylitis can arise from the identification of the common symptoms such as backache, rest pain, and paraplegia to name a few.[24] Radiological imaging can be done to aid the diagnosis, typically vertebral involvement known as Gibbs can be seen in the results, nonetheless radiological findings should be attentively differentiated from pyogenic vertebral osteomyelitis or spinal malignancy. Modalities viable for TB spondylitis include X-ray, CT scan for bone imaging, and MRI for tissue and abscess evaluation.[1] Each modality typically shows specific signs, X-rays can easily detect early erosive changes normally seen in the corner of the vertebrae.[25] However, MRI is still considered to be the method of choice in detecting early diagnosis as it has a higher sensitivity with a decent specificity, and it also allows anatomical localization of the abscess.[1,25] MRI typically shows 4 patterns of TB spondylitis: paradiskal, anterior, central, and posterior; with the majority being conforming to a paradiskal pattern. Lastly, CT scans were typically utilized to identify fragmentary bone patterns and calcification of caseating areas in later stages of the disease.[25,26] Hence, MRI and CT scans are considered to be important tools in assessing the early and later stages of the disease, respectively.[1,25,27] Laboratory examination through routine blood tests and microbial culture may help strengthen or confirm the diagnosis. Nevertheless, a histopathological assay

of samples obtained through biopsy is still considered to be a standard.[4] Confirmation can be made if the assay reveals: multinucleated giant cells, Langhans' giant cells, granuloma, or the acid-fast bacilli pathogen itself.[28]

Subroto Sapardan's Total Treatment Method

The *Subroto Sapardan's* Total Treatment is a regime for treating TB spondylitis that was developed in 1984 by Prof. Subroto Sapardan in *Cipto Mangunkusumo* Hospital, Jakarta, Indonesia.[23] Prof. Subroto Sapardan is a physician who specializes in orthopedic surgery, he is also active in the field of research and as an academic lecturer. Using his vast clinical and research experiences he arranged a treatment regimen for TB spondylitis with the following 5 points set as the goal of the regimen: to cure the infection, stabilize the spine, eliminate any pain and discomfort, correct the spine without any deformity, returning the functionality of the spine and any organ involved.[29] In total after thorough consideration and research, Prof. Subroto Sapardan made comprehensively 10 alternatives for the treatment methods.[23,29] These alternatives were all based on a few principles that rely on at least 14 different issues that stem from TB spondylitis. These problems are as follows: poor general condition, multiple lesions, instability, deformity, cold abscess, pain, infection, pathological fractures, progressive kyphosis, neurological deficits, cardiovascular complications, pulmonary disturbances, socio-economic-related and psychosocial-related problems.[29]

Prof. Subroto Sapardan formed this procedure in hopes of preventing medical practitioners from treating only the infection but also helping the patient retain their quality of life. The procedure was made very flexible and adaptable with opportunities in which the procedure itself can be improved if there were to be discoveries in the future – improvement of the original treatment method was encouraged in clinical practice [figure 1].[29]

He outlined the methodology of the treatment into 4 steps: identifying and clarifying the problem, listing the potential modalities ranging from conservative to aggressive procedures, and tailoring the stated problem with the most suitable treatment modalities. Finally, determining what treatment alternatives are used [figure 2] .[23,29]

As stated, Prof. Subroto Sapardan eventually composed 10 treatment alternatives using the 14 issues as a basis. He formulated the 1st alternative based on basic treatment (anti-tuberculous drugs, supportive treatment, plaster body jacket/spica or brace, bed rest, abscess drainage). This came about due to some patients in early cases with limited problems, refusing any type of surgery, or outright declining invasive procedures of being contraindicated from receiving such procedures.[23] The basic treatment is not only in the first alternative but also for supportive treatment of others. [23]

The 2nd alternative was targeted at stable-spine patients with good general condition, and large abscesses with minimal destruction (no instability and no deformity). [29] A guideline suggested that basic treatment with anterior debridement and evacuation of a paravertebral abscess.[23]

3rd alternative involved surgical procedures using anterior instrumentation, debridement, and fusion – this is typically reserved for cases of anterior thoracolumbar infection with minimal kyphosis and little to no pain. Prof. Subroto Sapardan was inspired by a Hong Kong method when He created this alternative, as such the two procedure shares a few similarities.[23,29]

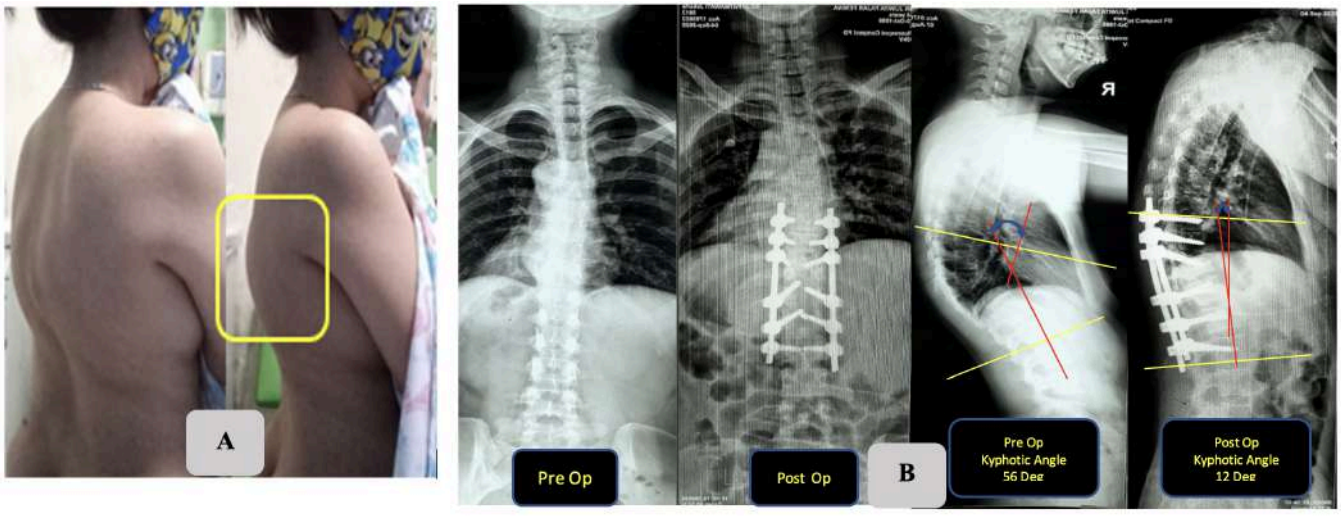

Figure 1. Subroto Sapardan's total treatment application in clinical practice; A. A female patient, 34, with back pain and kyphotic deformity, was diagnosed with TB spondylitis of Thoracal 11-12; B. She underwent decompression with laminectomy, posterior instrumentation, and kyphotic correction

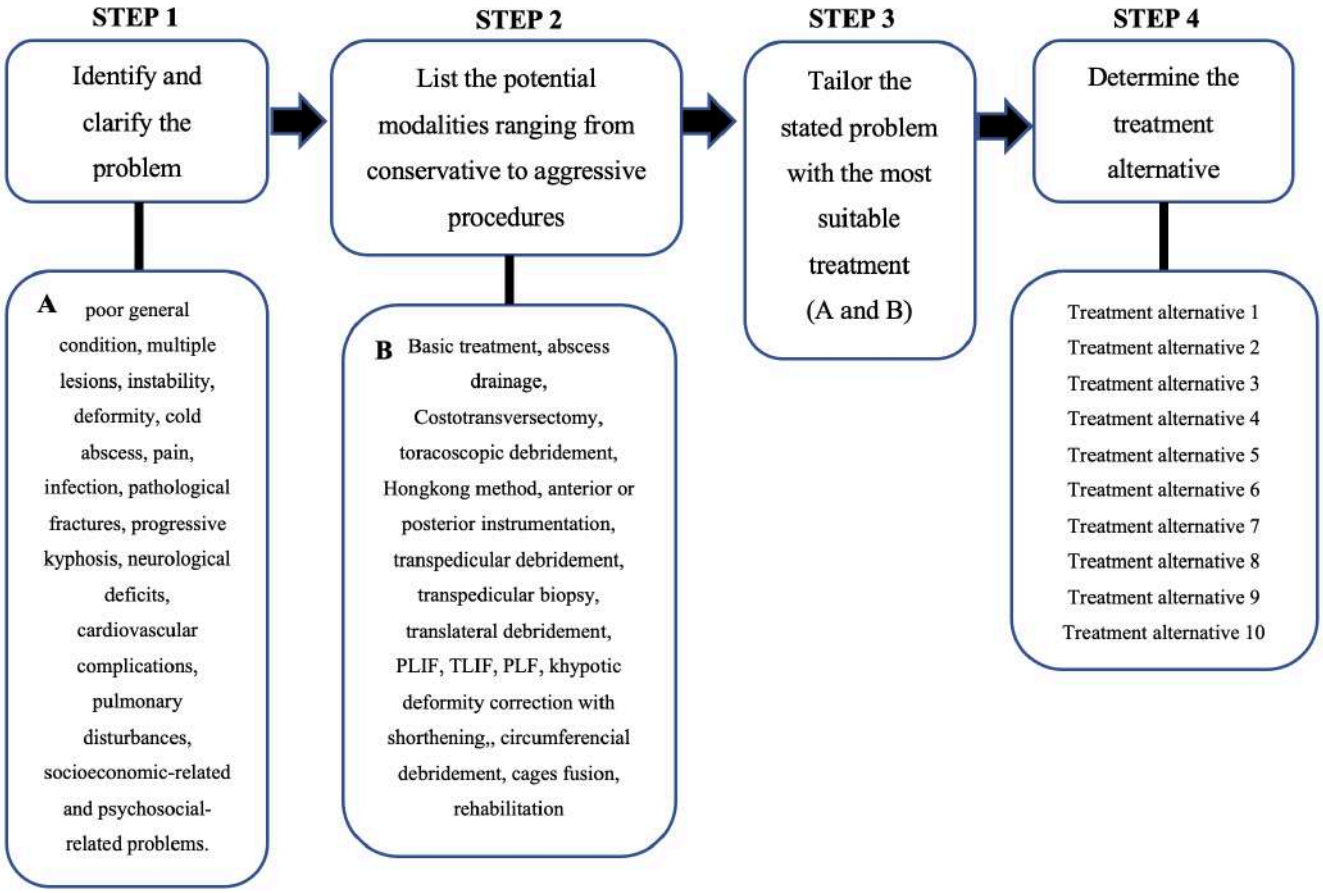

Figure 2. Subroto Sapardan's total treatment application in clinical practice; A. A female patient, 34, with back pain and kyphotic deformity, was diagnosed with TB spondylitis of Thoracal 11-12; B. She underwent decompression with laminectomy, posterior instrumentation, and kyphotic correction

The 4th alternative was a modification of the 3rd alternative, this procedure involved posterior instrumentation and correction of a nonrigid deformity followed by anterior debridement and fusion to achieve circumferential fusion. This procedure was targeted for patients with problems of infection, pain, instability, and deformity, with or without neurological deficit.[29]

5th alternative was made to be a continuation of the 4th procedure, the difference of 4th and 5th procedures is that the 5th alternative has a kyphosis deformity correction added. This alternative was tailored for patients with TB spondylitis on the cervical/thoracal/lumbar region with severe kyphosis that indicates correction.[23,30] This procedure included posterior instrumentation and anterior debridement and fusion which is removing the lamina facets, transverse process, and pedicles of the segments in the kyphosis until deformity is corrected. [23,29]

6th alternative was indicated in patients with stable anterior but unstable posterior, or those whose abscesses can only be reached through a posterior approach.[29] The procedure consisted of posterior decompression by laminectomy and costotransversectomy for debridement and evacuation of a paravertebral abscess followed by posterior instrumentation and fusion.[29]

Starting from the 7th alternative, the procedures were mainly reserved for more severe cases of spondylitis of the lumbar spine with hot paravertebral abscess. This alternative included laminectomy, limited shortening procedure, debridement, and fusion through translateral or posterior lumbar interbody approach. 7th alternative required rod and screw corrective manipulation. [23,29]

While the 8th required shortening and decompression procedures for spondylitis of the upper thoracic spine. This procedure consisted of laminectomy transpedicular debridement and biopsy, followed by posterior segmental instrumentation and fusion.[23,29]

The 9th required surgical repositioning of the spine, typically due to severe kyphosis (60° -90°) is still active or healed disease. This procedure consisted of removing lamina and facet joints, transverse processes, adjacent ribs, and middle segment until circumferential decompression of dura mater and cord is achieved correction by closing the posterior gap with posterior

segmental instrumentation.[23,29]

Lastly, the 10th procedure was applied for patients with extreme kyphosis (> 90°) without neurological complications, henceforth this procedure aims at preventing that from emerging.[23] This technique consisted of posterior instrumentation, debridement, distraction, and fusion.[23]

Finally, with the 10 alternatives formulated, Prof. Subroto Sapardan successfully formulated a new holistic treatment guideline for TB spondylitis. This procedure was then named after him in honor of his contribution and discovery. The total time taken for this method to be perfected was 5 years – whilst Prof. Subroto Sapardan introduced the treatment in 1984, it was not only until 1989 that the procedure, that has undergone various trials and improvements, reached a level of credibility that officiates its application in various hospitals in Indonesia.[29] 1989 marks the end of the long developmental history of the procedure, although minor improvements or modifications were made in the future, the general concept of the treatment was also officially finalized by that year.

Due to the credibility of *Subroto Sapardan* Total Treatment, as seen in a few published literature and case reports, the regimen is used in various hospitals throughout Indonesia. As previously described, each of the 10 alternatives listed in the guideline has its specific indication and goal, thus each alternative must be applied accordingly. This method is typically seen in practice at teaching hospitals, such as *Cipto Mangunkusumo* Hospital, and *Fatmawati* Hospital. It is also a widely spread procedure in orthopedic communities.[29] It is safe to say that as time progresses, this procedure will eventually be recognized further by the medical community, and as it has been proven to be quite effective and efficient, there may be an increase in its application in practicing hospitals.

As previously discussed, the *Subroto Sapardan* Total Treatment is a method of treating TB Spondylitis that has many strong assets. The holistic approach of the treatment is extremely beneficial for patients, as it takes into consideration not only the patient's disease but also their living condition – this can significantly improve patient's satisfaction and quality of life. The adaptability and flexibility of the procedure should also be complimented as it regards the possibility of medical advancements. The 10 alternatives that the regimen provided may be double-edged; one on side it benefits the patient and physician as it is very comprehensive, on the other, it may prove to be slightly inconvenient when a thorough consideration should be taken by clinicians under duress. One minor drawback of the treatment method is seen in the 6th alternative in which a guideline states that the procedure is inadequate if a patient exhibits an anterior abscess.[23] Meanwhile, one major weakness of this procedure is the lack of awareness in the medical community, though the procedure has been applied in several hospitals, it is not as widespread as it should be. In comparison to the majority of recognized treatment methods, there was a scarcity of published studies or reviews on *Subroto Sapardan* Total Treatment that could significantly increase its prestige.

Judging from the advantages and disadvantages of *Subroto Sapardan* Total Treatment, this review concludes that the method is positively applicable in clinical settings. With its holistic approach and having gone through years of application, the method holds both potential and credibility for clinical use.

Conclusion

TB spondylitis is the most common manifestation of skeletal TB, it is a severe condition that requires urgent care. TB spondylitis occurs when there is a hematogenous spread of MTB from a primary or dormant lesion. The *Subroto Sapardan* Total Treatment is an available method of managing TB spondylitis that is widely applied in Indonesian teaching hospitals. It has a very holistic approach towards TB spondylitis patients and it has a thorough 10 alternatives that can be suited to most of the 14 general issues TB spondylitis patients commonly face.

Recommendation

The application of *Subroto Sapardan* Total Treatment should be reinforced, its usage should be more widespread in hospitals throughout Indonesia. Awareness of both medical practitioners and patients on this treatment method should be amplified; as it may provide benefits for the medical practitioner in the form of expanding knowledge, and for the patients by increasing their satisfaction. The adaptability and flexibility of the method should also be used to both modernize and optimize the regimen. Lastly, it is highly recommended that more publications, in the form of articles or reviews, be made regarding the *Subroto Sapardan* Total Treatment to increase both its credibility and prominence.

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Case Report

Tuberculous Osteomyelitis Late Finding Affected The Fifth Metatarsal

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Abstract

Many studies have reported osteoarticular involvement of tuberculosis, but few cases of tuberculous osteomyelitis of the foot have been reported. We describe a case of tuberculous osteomyelitis affecting the fifth metatarsal bone in a 56- 56-year-old diabetic male patient and review the literature describing clinical manifestations, imaging aspects, and management of skeletal tuberculosis. A 56-year-old male patient presented with severe pain and swelling in his left leg for the past 6 months. He had no history of trauma. He had fever over his two months, had no cough, had lost weight, and had light sweats at night. His pain and swelling did not subside despite oral medication. The patient was diabetic. The patient also had radiating pain from his lower back to his left leg and numbness all over his lower back.

Tuberculosis is a widespread problem in Indonesia. It can affect any part of the body. However, the feet are rarely affected. Tuberculosis is on the rise and it is important to recognize the less common symptoms of this disease to allow early diagnosis and successful treatment. In urban areas where TB prevalence is high, there may be no TB exposure or 'typical' symptoms and signs. Radiological features are non-specific, so indicators of high suspicion are required. Patients with suspected risk factors or tuberculosis should have a biopsy to make the diagnosis and start treatment.

Introduction

Tuberculosis remains a public health challenge in countries such as Indonesia and other developing/ underdeveloped countries.[1] Tuberculosis (TB) is spread primarily through aerosol droplets exhaled by sneezes and spitting by patients with active TB, and most commonly causes pulmonary infection (pulmonary tuberculosis) in susceptible individuals.[2]

Osteoarticular tuberculosis accounts for less than 3% of extrapulmonary tuberculosis cases.[3] The overall incidence of tuberculous osteomyelitis is considered rare.[4] It can affect any bone in the human body. Short bone lesions are rare in clinical practice, and foot and ankle lesions are considered rare.[3,4] Tuberculosis of the feet and ankles is an important diagnosis. Dilemma; due to non-specific clinical manifestations, this entity is difficult to distinguish from other diseases such as suppurative osteomyelitis, fungal arthritis, and gout. arthritic and inflammatory processes such as amyloidosis.[5]

This case report aims to highlight the fact that tuberculosis can occur in unusual places and that care must be taken to identify it, especially in countries where it is endemic.

Case Presentation

A 56-year-old male patient had complained of severe pain and swelling in his left leg for the past 6 months. He had no history of trauma. Over 2 months, he developed fever, cough, and reduce weight, and developed mild night sweats. His pain and swelling did not subside despite oral medication. The patient

was diabetic. The patient also had radiation pain from the lower back to the left leg and numbness throughout the lower back. A physical examination revealed the presence of swelling on the left dorsum of the front and middle legs [Figure 1].

There was no local temperature rise. There was kindness. The patient had edema down to the lower leg. The swelling had a variable consistency. His hemoglobin was 11.2 g%, total white blood cell count was 8190, random blood glucose was 479 mg%, and serum creatinine was 0.9 mg%. Uric acid serology was 10.0.

An X-ray of the foot showed a prominent expansive lytic lesion at the distal end of the fifth metatarsal [Figure 2]. There was cortical thinning. The remaining visible bones and joints appeared normal.

An abscess due to osteomyelitis was suspected, and a debridement Guttering Sequestrectomy was performed. Intraoperative findings showed the presence of pus beads with unhealthy subcutaneous tissue and bone.

The postoperative course was uneventful and the patient was discharged from the hospital. Two months after his operation, he returned to our center complaining of radiating pain and numbness from his lower back to his left leg. The patient said that the pain was constantly decreasing and sometimes worsening. A physical examination revealed positive Lasegue and Kernig tests on the left side.

Figure 1. Swelling of the dorsum of the left foot. The clinical diagnosis of foot abscess was considered

Figure 2. X-ray of the left foot shows a well-definedextensible lytic lesion on the distal tip of the fifth metatarsal

He was readmitted to the hospital with severe pain and numbness from his lower back to his left knee. A radiograph of the patient's back revealed an odd finding [Figure 3].

The patient was diagnosed with grade 1 posterior vertebral lumbar spondylolisthesis and received ketorolac to tramadol injections for pain relief. After the pain subsided, the patient was referred to higher-levelel hospital for more comprehensive examination. At the referral hospital, the patient underwent an exploratory bone biopsy and new information was obtained from the histopathological report of the bone. Bone tuberculosis with epithelial granuloma and diffuse granulation tissue with multinucleated Langhans giant cells were shown. There were areas of psoriasis [Figure 4]. Features suggestive of tuberculous osteomyelitis of the fifth metatarsal.

The patient was referred to a primary care center and started on antituberculous drugs for 1 year. He came to our hospital for wound cleaning. After three weeks, his wound had completely granulated. and showed good healthy scars [Figure 5].

Discussion

Tuberculosis is known to affect up to 1-3% of bones and joints, most of which affect the spine and vital joints such as hips and knees. About 10% of osteoarthritic tuberculosis are known to affect the bones of the foot, most commonly the calcaneus, followed by the metatarsals and phalanges.[6] A possible explanation for the involvement of the calcaneus is that it is the largest bone in the foot, allowing early detection of lesions and being susceptible to trauma.[3] A literature review indicates an incidence of <1. 0.5% in metatarsal osteomyelitis[7], among them, the 1st and 5th metatarsal often involve.[8]

It was observed that 35 cases of metatarsal tuberculosis were documented in the literature. The literature indicates that metatarsal tuberculous osteomyelitis is less than 0.5%.[9] The fifth metatarsal is rarely affected by pyogenic tuberculosis infection.[4] The most common foot symptoms experienced by patients are pain, swelling, stiffness, redness, and sometimes abscesses.[1,10] Patients often have sinus ulcers with secondary infections or ulcers that do not heal.[1]

Musculoskeletal tuberculosis accounts for approximately 1-2% of all tuberculosis cases in the Western world and is often difficult to diagnose.[11] Tuberculous osteomyelitis is known for its abnormal course, and diagnosis is often delayed due to abnormal symptoms and lack of clinical features.[4]

Clinical manifestations of tuberculous metatarsals include chronic leg pain, swelling, difficulty walking,

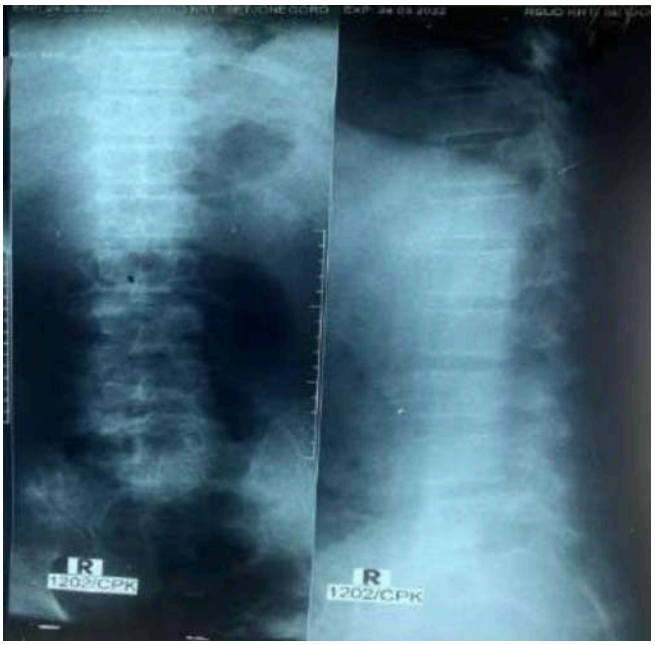

Figure 3. Vertebral Lumbar 5 body moved backwards Spine Lumbar 4 as 25%.

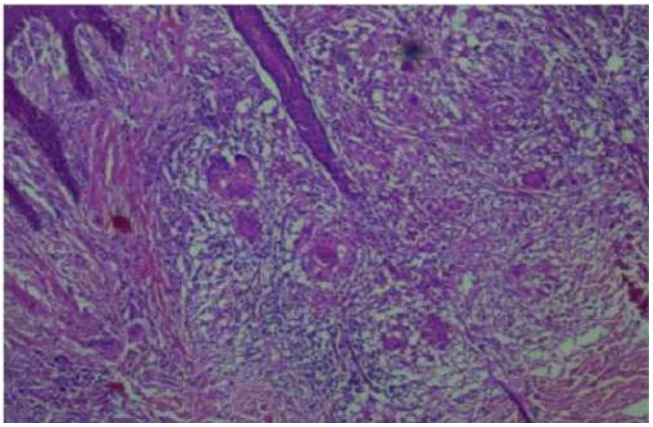

Figure 4. Shows the presence of epithelioidgranulomas, Langhans giant cells, and central bone necrosis.

and, in long-standing cases, draining sinuses/pain and pathologic fractures[12] Typical symptoms such as fever and weight loss are rarely seen.[11] Tuberculosis of the feet and ankles is divided into four basic forms: Periarticular granuloma, central granuloma, primary hematogenous synovitis, and bursal tuberculosis.[3,10]

Metatarsal tuberculous osteomyelitis is secondary to the spread of lymphohematogenous pulmonary lesions, with up to 50% of patients showing no pulmonary symptoms[4] Serological parameters of tuberculous metatarsals, such as total white blood cell count, ESR, CRP, and synovial fluid aspiration, are largely inconclusive.[13]

Mycobacterial organisms are rarely isolated from samples taken from wound secretions. Chest radiographs also appear normal most of the time, but metatarsal tuberculosis, like all other forms of extrapulmonary tuberculosis, is secondary to lymphohematogenous spread from the lungs to the bone.[12]

Foot radiographs for tuberculosis of the foot are nonspecific and include bone marrow edema, osteoporosis, or lytic lesions.[4,11] Mittal et al. Tuberculosis of the feet is radiologically classified into five types. Cystic tuberculosis, subperiosteal tuberculosis, rheumatoid arthritis, kisses, and spinal bentosa.[9] However, these features are not restricted to tuberculosis and are also observed in chronic suppurative osteomyelitis, sarcoidosis, and chondroma.[9]

Regarding oligo bacterial infections, mycobacteria are rarely isolated from tissues.[3,9] With early diagnosis and treatment, Prediction significant results. mantoux exam is the most common diagnostic tool for Tuberculosis infection, especially in children, Its effectiveness is still debatable.[14,15] Diagnosis is often histopathological.[11] Tissue assessment is therefore key to confirming the diagnosis. Granulomatous inflammation with or without typical nodules and with caseous necrosis, Significant discovery in histopathology. biopsy from the site of Infection is recommended as early establishment diagnosis facilitates early treatment.[16]

In our case, too, a definitive diagnosis could only be made after metatarsal histopathology. Anti-TB drugs are recommended for at least 12 months.[3,9] 4 drugs (isoniazid, rifampicin, pyrazinamide, ethambutol) for 2 months followed by 2 drugs (isoniazid and rifampicin) for ≥10 months.[9] The prognosis is usually good unless other adjacent bones or joints are involved.[3,9]

Conclusion

Tuberculosis is a common problem in Indonesia. It can affect any part of the body. However, the feet are rarely affected. Involvement of the 5th metatarsal is extremely rare, as in our case. Tuberculosis is on the rise and there is a need to screen for less common manifestations of this disease to allow early diagnosis and successful treatment. It's important to recognize. In

Figure 5. Indicates healed wounds during the follow-up period

urban areas where TB prevalence is high, there may be no TB exposure or 'typical' symptoms and signs. A high index of suspicion is required because the radiological features are non-specific. Patients with suspected risk factors or tuberculosis should have a biopsy to make the diagnosis and start treatment.

Competing interest
The authors declare that they have no competing interests.

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Case Report

Management of Polytrauma Patient in a Limited Setting: A Case Report

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Abstract

Polytrauma patients with multiple fractures present a significant challenge in limited resources settings. The application of damage control orthopedics (DCO) principles, including temporary stabilization, staged definitive fixation, and multidisciplinary collaboration, resulted in favorable outcomes for the patient. This case report describes the successful management of a polytrauma patient who sustained multiple injuries, including unstable pelvic fracture and fractures of the femur, radius, shoulder dislocation, and distal radio-ulnar joint dislocation. This report emphasizes the importance of timely intervention and resource optimization in limited settings.

Introduction

Polytrauma is often defined as having a high Injury Severity Score (ISS) and is frequently used interchangeably with terms like "severely injured" or "multiple injuries". An ISS above 16 is considered to predict a mortality risk over 10%.[1-3] Polytraumatic conditions are critical and require a unique approach. Patients with multiple injuries, including head, chest, abdominal or pelvic injuries with significant blood loss, benefit from fracture management principles. However, the term "polytrauma" may also refer to a severe single-system injury (monotrauma) with a high ISS.

The "Damage Control Orthopedic" (DCO) strategy is widely accepted for treating unstable severely injured patients. Polytrauma patients have a higher mortality rate. They require more extensive and costly treatments, intensive resuscitation resources, and longer stays in the Intensive Care Unit (ICU)[1,2] Fundamental principles of DCO involve stabilizing life-threatening conditions by using minimally invasive external frames to fix long bone fractures, followed by definitive fracture fixation after metabolic and respiratory recovery, typically after a few days.[1]

Case Presentation

Mechanism of Injury

A 17-year-old male arrived at the Emergency Department following a high-speed motorcycle collision with a utility pole.

Patient Care

The initial assessment revealed signs of hemorrhagic shock and multiple fractures. Examination of several areas such as the wrist showed swelling with obvious deformity upon inspection. Vascular, neurological, and motor function distal did not show a deficit, but the range of motion of the left forearm and left thigh were limited by pain. Pelvic was tender to palpation. The left thigh showed deformity upon inspection. (Figure 1a).

The patient's condition was stabilized following Advance Trauma Life Support protocols, including resuscitation of 2000 cc crystalloid fluids, blood products were not administered due to limited. Adjunct diagnostic procedures such X-Rays and Abdominal CT Scan were performed. Splints and Pelvic Binder was applied. (Figure 1a)

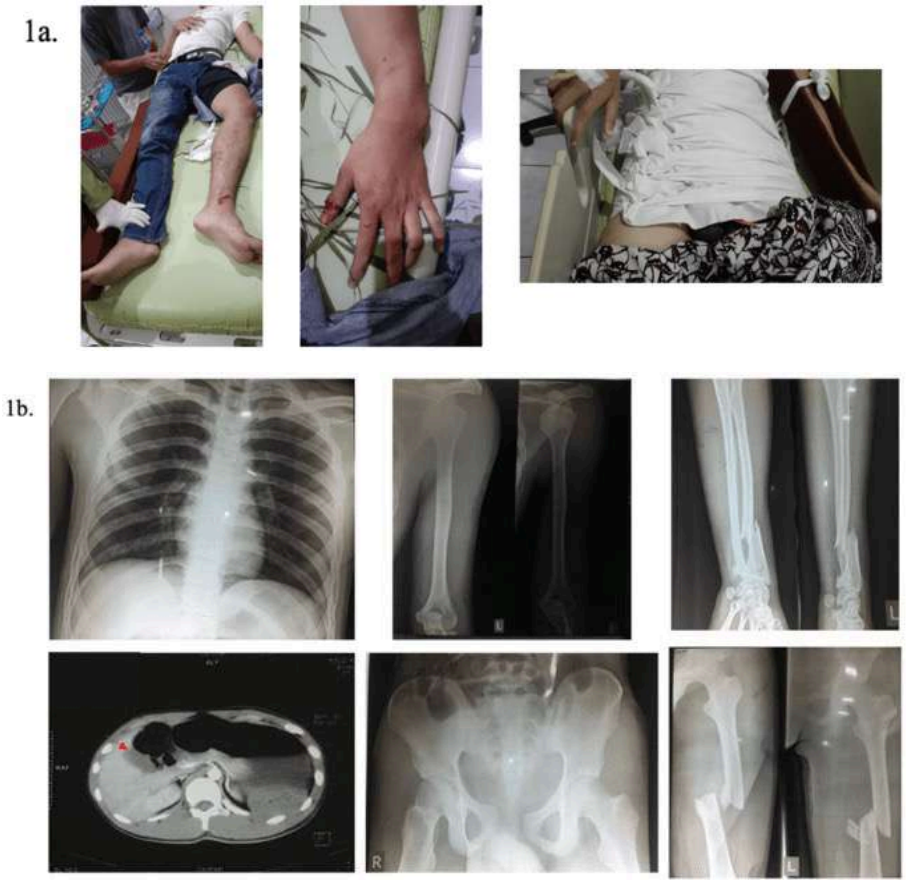

Figure 1. 1a) Clinical Photos of the patient upon arriving at the emergency department. **2b)** Plain X-ray films showing dislocation of left shoulder, multiple fractures on left wrist, pelvic, and left thigh. Abdominal CT-Scan showed minimal hemoperitoneum on the red arrow.

The patient presented with hemorrhagic shock (Grade IV) and multiple fractures. Adjunct diagnostic evaluation revealed an unstable pelvic fracture and blunt abdominal trauma and fractures of the left radius, left femur, shoulder dislocation, and distal radio-ulnar joint. (Figure 1b).

Surgical Exploration

Surgical resuscitation was performed, including laparotomy exploration to assess the abdominal trauma which revealed a minimal hemoperitoneum. Orthopedic intervention following damage control orthopedics (DCO) principles. Due the to limited availability of external fixation C-clamps Clamps at the hospital, open reduction and internal fixation (ORIF) of the symphysis pubis were performed as a temporary stabilization. (Figure 2a).

The patient's vital sign gradually improved in response to surgical resuscitation, definitive treatment was performed on a later day. This included ORIF of the radius and femur fractures and closed reduction of the shoulder and distal radio-ulnar joint. (Figure 2b).

Postoperative Care

The movement of other joints was maintained, and the patient was only irritablewhen required to move his left wrist and left thigh. The vascular and neurological function was retained and the wound was properly closed. Following the remarkable progress, we involved the medical rehabilitation specialist for rehabilitation. The patient was followed up daily after the second stage surgery. After 14 days length of stay at the hospital, the patients was discharged. There were no abnormalities found after damage control orthopedic performed on this patient shown in Figure 3a. Figure 3b shows The Lower Extremity Functional Scale with a of score suggest a minimal or no disability in performing daily activities.

Discussion

The Primary and Secondary evaluations are conducted regularly to detect any changes in the patient's condition that may require further intervention. Triage involves the sorting of patients based on the resources required for treatment and the resources that are available. Treatment is based on the ABC priorities.[1-4] Airway was clear, thoraco-abdominal breathing with respiratory rate 26 times per minutes. But there was hemorrhagic shock. Upon arrival patient was urgent resuscitation with 2000 cc of crystalloids. Splints and Pelvic Binder was assembled. After the

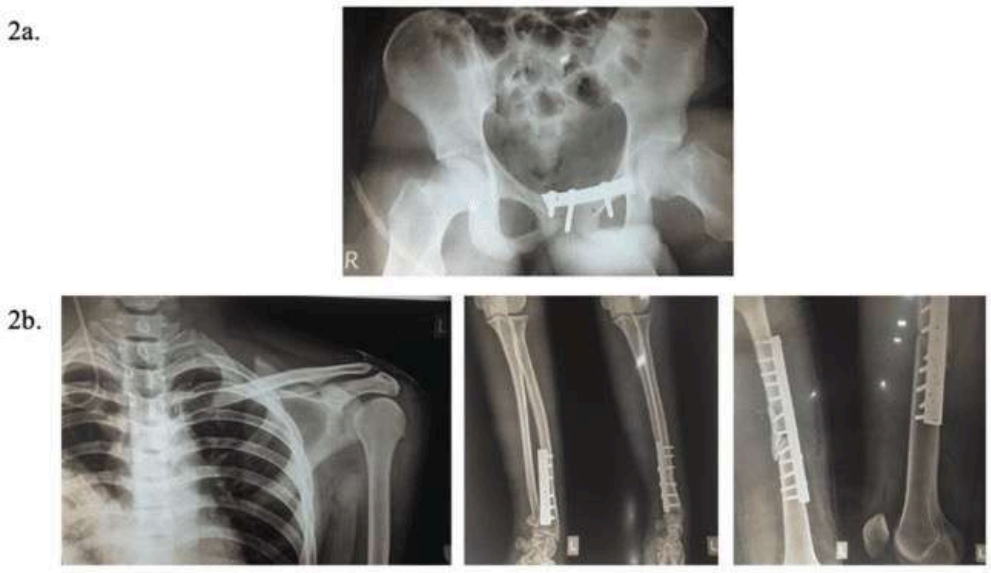

Figure 2. 2a) Plain X-Ray film after the first surgery showing a plate and screw was placed on the superior of pubic ramus. **2b)** After Damage Control Orthopedic Shoulder dislocation was reduced, plate and screw were placed on the distal of the radial bone and left shaft femur.

patient is stable, an X-ray and CT are performed. In mass-casualty events, patients have greatest chance of survival.[1-4]

Multiple trauma refers to the presence of severe injuries that pose a life-threatening risk to the patient. The location of these injuries particularly in the thorax and long bones, affects the clinical progression. Manifestations such as hemorrhagic shock, coagulopathy, hypothermia and soft tissue injuries may occur. An Injury Severity Score (ISS) above 16 indicates a mortality risk exceeding 10% hemorrhagicic shock is defined by a systolic blood pressure equal to or less than 90 mmHg in patients with trauma-related blood loss.[1-3] Upon the arrival at the ER, the patient's blood pressure showed 90/80 mmHg, heart rate was 144 beats per minute. The ATLS guidelines provide a classification system for hemorrhagic shock as shown in Figure 4a. It is the leading cause of preventable early mortality among polytrauma patients.[4]

The presence of high-energy trauma accompanied by bruising, swelling, and specific signs such as scrotal or labial edema, bleeding from the external meatus, vaginal bleeding, and rectal bleeding strongly indicates the likelihood of a pelvic fracture.[3] In cases of an open book type pelvic fracture with diastasis of the pubis symphysis as illustrated in Figure 1b.[4] Prompt use of a pelvic binder can be life-saving. The mortality rate for pelvic fractures ranges from 5% to 10%, but it increases to 60% with hemodynamic instability.[4-9] Bleeding is the primary cause of death following severe pelvic fractures, it can originate from arteries, veins or the bone itself. Patients with isolated pelvic fractures, without other urgent injuries are managed according to the pelvic fracture management algorithm as illustrated in Figure 4b.

The patient had to transient response after volume resuscitation with 2000 cc of crystalloids. A pelvic binder was applied due to the unavailability of external fixator C-clamp. Damage control orthopedics (DCO) is a specialized approach for treating fractures in patients with severe or multiple injuries.[6,7] Its primary objective is to postpone the definitive fixation of fractures until the patient's overall condition is stabilized. Orthopedic traumatologists prioritize the

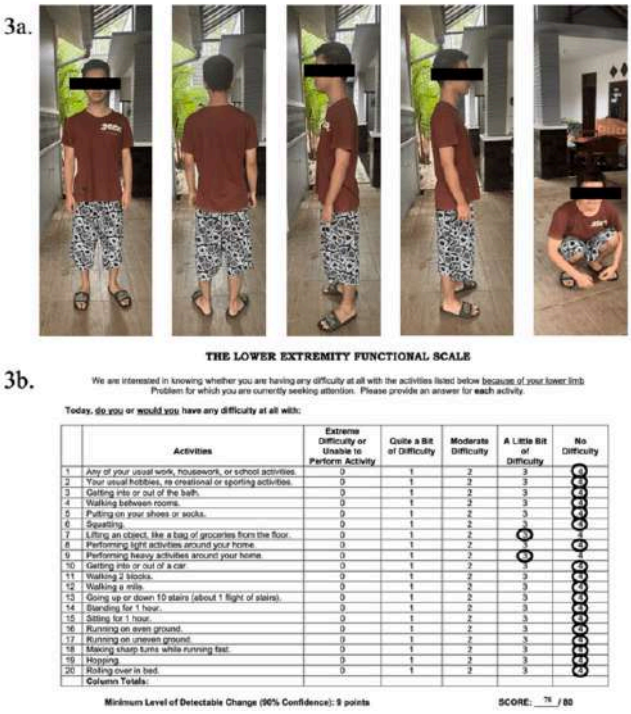

Figure 3. 3a) Clinical photos after a year follow-up, showing no abnormalities. **3b)** The Lower Extremity Functional Scale serves as positive indicator[12]

resuscitation process, focusing on promptly stopping bleeding and preventing hypovolemic shock and the "lethal triad." Once these immediate concerns are addressed, DCO measures are initiated to effectively manage the fractures.[7]

The injury Severity Score on this patient was 34, categorized as Extreme. Patients was transferred to the ICU as followed the algorithm treatment for major fractures, based on patient clinical categories as shown in Figure 5a.

The introduction of Early Total Care (ETC) highlighted the significance of stabilizing long-bone fractures as an initial step in managing multiple traumas. Previously, patients with these injuries were considered too medically unstable for surgery, and there was reluctance to manipulate the fracture sites due to concerns about potential *fat embolism syndrome* or second hit phenomenon as shown in Figure 5b.[10,11]

Conclusion

In limited resource settings, timely emergency response, appropriate timing of interventions, and the availability of adequate resources and skilled healthcare professionals are vital to minimize the risks of morbidity and mortality. The implementation of Damage Control Orthopedic principles proved to be an effective approach in managing this polytrauma patient, highlighting the significance of resource optimization and multidisciplinary teamwork.

4a.

Grading of Hemorrhagic Shock

PARAMETER	CLASS I	CLASS II (MILD)	CLASS III (MODERATE)	CLASS IV (SEVERE)
Approximate blood loss	<15%	15–30%	31–40%	>40%
Heart rate	↔	↔/↑	↑	↑/↑↑
Blood pressure	↔	↔	↔/↓	↓
Pulse pressure	↔	↓	↓	↓
Respiratory rate	↔	↔	↔/↑	↑
Urine output	↔	↔	↓	↓↓
Glasgow Coma Scale score	↔	↔	↓	↓
Base deficit	0 to –2 mEq/L	–2 to –6 mEq/L	–6 to –10 mEq/L	–10 mEq/L or less
Need for blood products	Monitor	Possible	Yes	Massive Transfusion Protocol

4b.

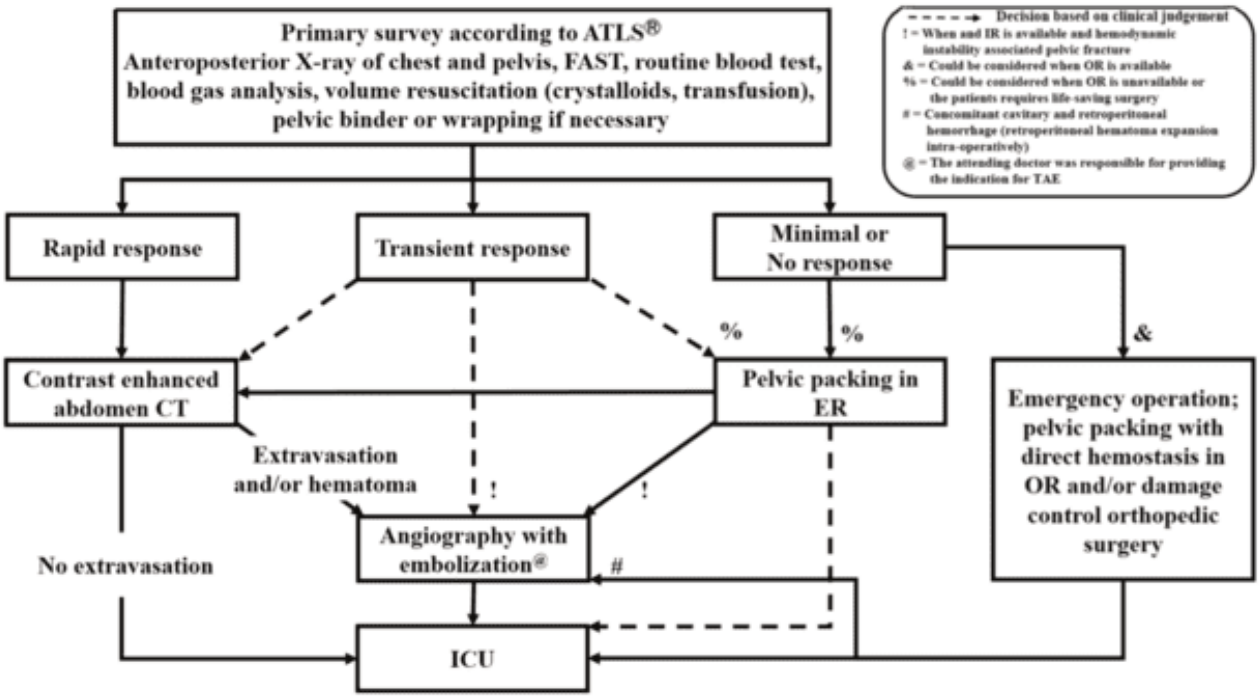

Figure 4. 4a) Grading for Hemorrhagic Shock based on ATLS.[4] **4b)** Algorithm for Unstable Pelvic Fractures based on ATLS.[9]

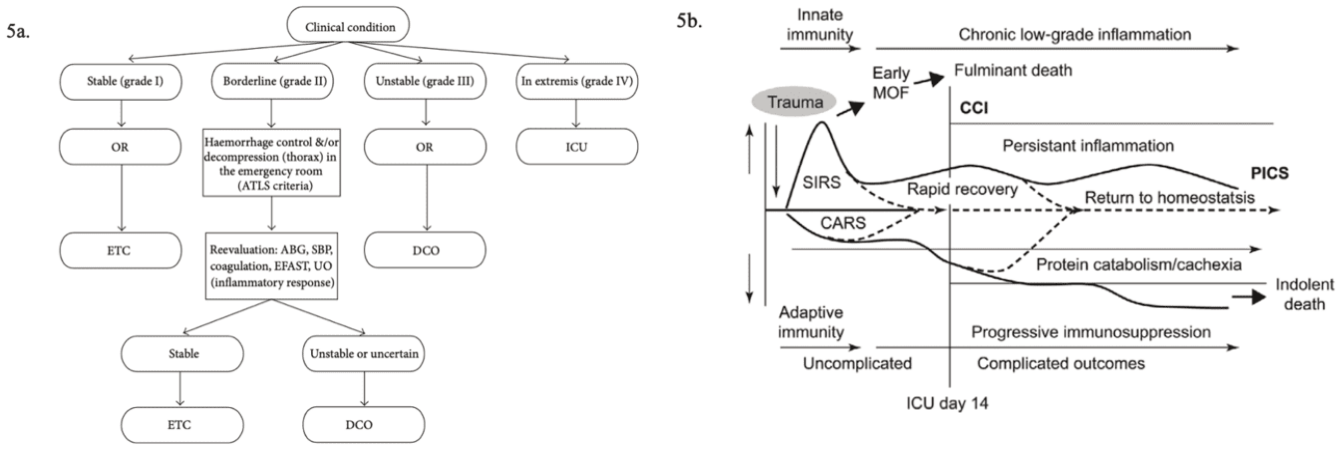

Figure 5. 5a) Chart Decision making based on clinical condition.[10] **5b)** Second Hit Phenomenon.[11]

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Literature Review

The Pathomechanics, Clinical Assessment and Management of Hallux Valgus: A Literature Review

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Abstract

Hallux valgus, the most common forefoot deformity, can restrict movement and cause pain. Several internal and external variables contribute to the development and advancement of the hallux valgus. Conservative and surgical treatment methods must be determined depending on the severity of the bunion, as well as any concomitant foot and ankle diseases. Only when the condition is still in its early stages can conservative management stop the progression of hallux valgus. Surgical treatment of hallux valgus is technically difficult and carries a high risk of recurrence and complications.

Introduction

Hallux is valgus (HV), generally known as a bunion which means turnip in Latin was first described by Carl Hueter.[1] Hallux valgus (HV) or bunion is the most prevalent deformity of the legs. HV often develops when the first toe thumb deviates to the lateral and metatarsal I deviate to medial.[2] The clinical image of hallux valgus is a lateral deviation of the proximal phalanx and a medial deviation of the first metatarsal head as a result of adduction of the first metatarsus, known as the metatarsus primus varus.[2]

Epidemiology & Etiology

The prevalence of this disease was 23% in people 18 to 65 years of age and increased by 36% in adults 65 years of age.[3] Women are more likely than men to have hallux valgus, with ratios as high as 15:1.2 compared to the barefoot population, the prevalence of this disorder is also higher among people who wear shoes, especially those who wear high heels or shoes with a small toe space (typically observed in women's shoes).[4,5] Intriguingly, in a study comparing men and women in a barefoot society, women were shown to have twice the chance of developing hallux valgus.[3] Some studies described that hallux valgus may develop in individuals who do not wear tight-fitting shoes or even often bare shoes can be associated with a congenital predisposition.[6,7]

In the United States, there are 64 million people who suffer from hallux valgus, however, there are no statistics on the total population of hallux valgus in Indonesia. However, studies have been conducted on certain population groups, such as research conducted by Soemarko et al. with the female population working in supermarkets, indicating the occurrence of hallux valgus up to 25.25% in the population of high-heel users compared to flat-heels users, which is only 10.87%.[8]

Although the precise etiology of HV is unknown, several factors support the presence of HV. These factors are classified into two types: internal and extrinsic factors. Intrinsic factors include heredity, gender, ligament weakness, age, metatarsal primus varus status, metatarsal architecture, pes planus, and a tight Achilles tendon. Meanwhile, a shoe model and weight load are the extrinsic components.[9]

Pathomechanics

Although the etiology of hallux valgus is complex, it is believed to be caused by an imbalance between extrinsic and intrinsic muscles, as well as the ligaments of the legs.[10] Hallux valgus commonly arises in phases.[12] These phases do not always occur, respectively, but simultaneously. 1. Since the medial sesamoid and medial collateral ligaments are the only medial supporting structures of the first metatarso-phalangeal joint, their failure is the "early and essential lesion".[13] 2. The metatarsal head can then move medially, detaching from the sesamoid structure. This movement can be aided by an oblique or unstable tarsometatarsal joint.[11,14] 3. As it is connected at its base to the sesamoids, the deep transverse ligament (via the plantar plate), and the adductor hallucis tendon, the proximal phalanx shifts into a valgus position. 4. The crista and cartilage may be eroded by the metatarsal head, which rests on the medial sesamoid. Although it is immobile, the lateral sesamoid may appear to be in the intermetatarsal region. 5. Due to pressure from the shoes on a prominent medial eminence, the bursa covering it may get thicker.[11,14] 6. The extensor and flexor hallucis longus tendons appear in the bowstring laterally, increasing valgus displacement and occasionally acting as proximal phalanx dorsiflexion.[15] 7. The muscle forces operating across the metatarsal head lead it to pronate as it detaches from the sesamoid apparatus.[11] 8. The abductor hallucis normally resists proximal phalanx valgus but becomes ineffective as its medial and plantar attachment rotates inferiorly. Because the adductor hallucis is laterally connected to the plantar surface, it tends to draw the phalanx into pronation while also anchoring its base. 9. The weaker dorsal metatarsophalangeal joint capsule is not supported by tendons and rotates medially with pronation, providing low stability. 10. Plantar pressure can be transferred laterally by elevating the metatarsal head with medial motion. The fifth metatarsal, which is relatively movable, may also play.[11]

Diagnosis

History

Hallux valgus has a chronically progressive onset. Bunions, aesthetic problems, and shoes that require to wear shoes are the three most frequently reported problems by patients. Patients typically report acute pain in the MTP joint, and difficulty with shoe wear due to the medial eminence.[5] As the disease progresses, the frequency, duration, and severity of the discomfort gradually increase. Patients often complain of swelling, tingling, or burning in the dorsal area due to the compression of the digital nerve. This burning and tingling sensation shows the presence of medial dorsal cutaneous nerve neuritis, which could be caused by compression of the deformity. Patients may also have blisters, ulcers, interdigital keratosis, and sensitive skin near abnormalities. These problems can result in severe morbidity and frequently prevent the patient from engaging in physical exercise.[5]

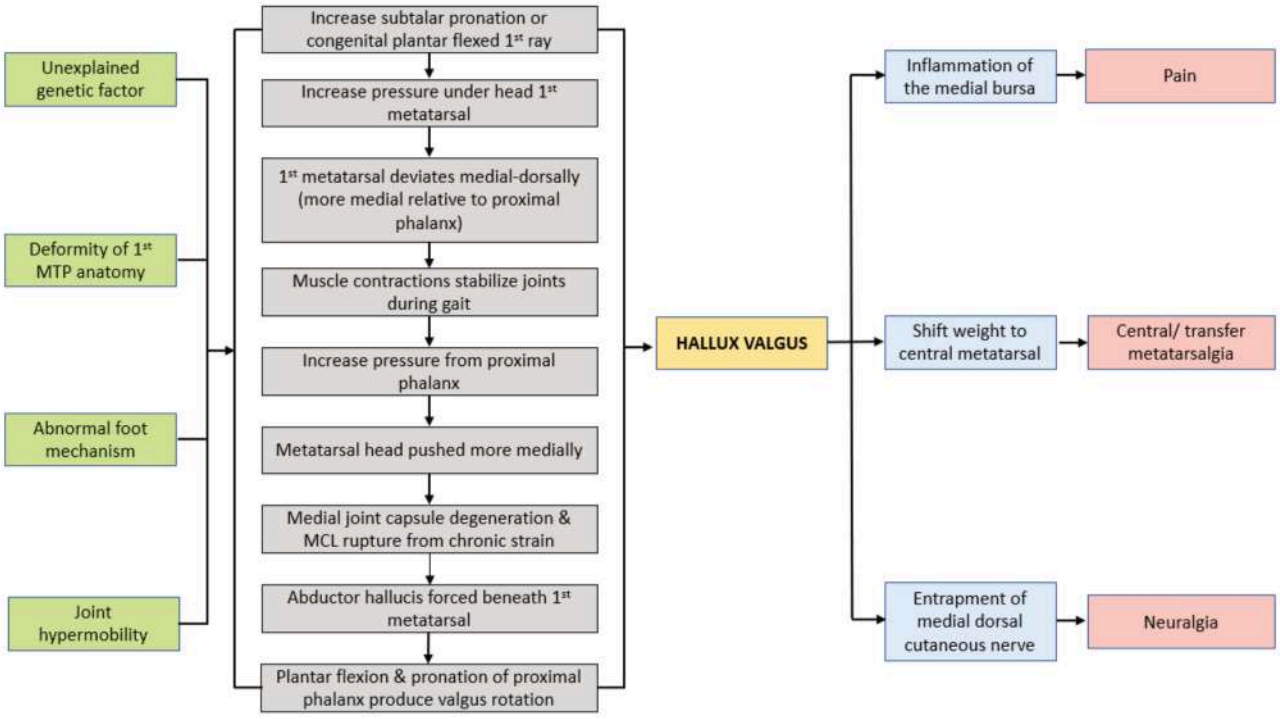

Figure 1. Pathophysiology and mechanism Hallux valgus

Physical examinations

The physical examination revealed: 1. Hallux rests in the valgus position and pronates as a result of the force generated by the deformity; 2. the entire first ray section to evaluate the range of motion (ROM) of the first metatarsophalangeal (MTP) (normal plantar-flexion <15° and dorsiflexion 65 ° - 75°), the first tarso-metatarsal, callus formations, sesamoid/arthritis pain; 3. check other deformities such as pes planus, lesser toe deformities (mallet toe, hammer toe, claw toe, curly toe, and crossover toe), midfoot and hindfoot conditions. The severity based on the ROM of the first MTP is: 1. normal (<15°); 2. mild (<20°); 3. moderate (20° - 40°); 4. severe (>40°).[16,17]

Additional Examinations

Radiological findings

Standing position (weight-bearing AP, lateral and oblique views) may reveal metatarsal, hallux angulation, and lateral displacement of sesamoids. On the medial section of metatarsal I and metatarsal II, as well as in the proximal phalanx I, imaginary lines are depicted. Normally, the intermetatarsal angle is 9 degrees and the valgus angle in the MTP joint is 15 degrees. Angulations that are greater than the normal angle will result in the diagnosis of hallux valgus. (2) There are 4 classifications based on hallux valgus angle (HVA)/intermetatarsal angle (IMA): 1. normal (<15°/ 9°); 2. mild (15° - 30 ° / 9 ° - 13°); 3. moderate (30° - 40°/ 13° - 20°); 4. severe (>40°/ >20°).[2,5]

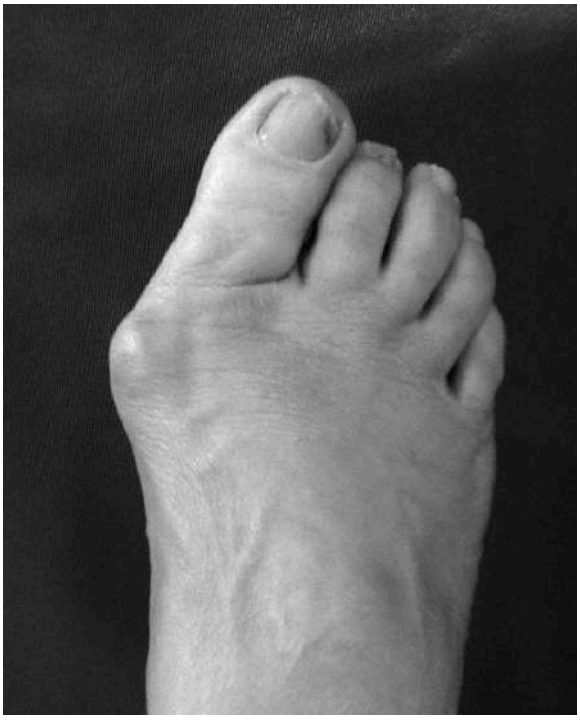

Figure 2. Deformity of Hallux Valgus on 1st MTP joint

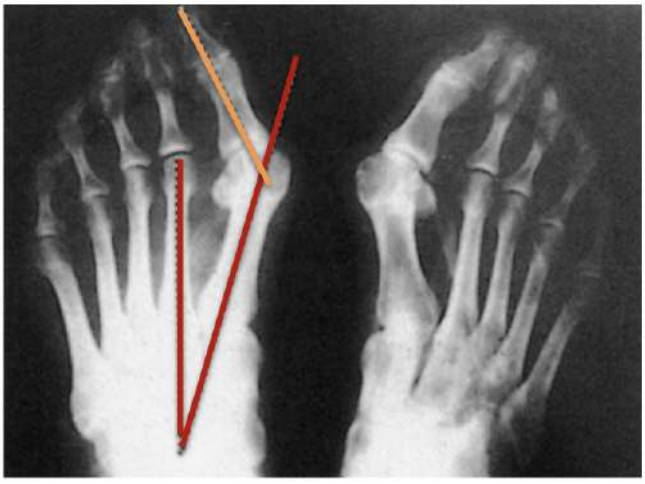

Figure 3. Radiologic picture of Hallux valgus. Red line is intermetatarsal angle (IMA). Orange line is Hallux valgus angle (HVA).

Treatments

Nonsurgical treatments

The American College of Foot and Ankle Surgeons still encourages nonsurgical or conservative therapy before contemplating more invasive therapies. If medical intervention fails, surgical repair should be taken into consideration.[16] The patient's specific complaints are necessary to be determined. Pain without a cosmetic concern is a proper indication for conservative treatment. Conservative treatment options for hallux valgus include activity modification, soft and comfortable wide-toe box shoes, spacers between the big toe and the second toe, and avoidance of tight and high-heeled shoes.[18,19] Bunion pads can help alleviate symptoms even more.[6] Although orthotics may help reduce pain, they have not been demonstrated to effectively prevent the advancement of hallux valgus.[20,21] At one year's follow-up in a randomized controlled trial comparing surgery, orthosis, and watchful waiting, 83%, 46%, and 24% of patients in the surgery, orthosis, and control groups, respectively, reported improvement in their pain symptoms.[22] The surgical group had the fewest uncomfortable days, cosmetic disruption, and footwear problems, as well as the best functional status and treatment satisfaction.[22] If symptoms continue despite conservative treatment, the revision surgical technique should be selected using the same criteria as for the basic HV deformity.[23]

Surgical treatments

Non-surgical therapeutic failures, recurring infections, and ulcerations are all indications for surgery.[18] Meanwhile, surgical correction for cosmetic deformities alone is not advisable because of the recovery time and the potential for complications associated with operative correction.[16] The planned

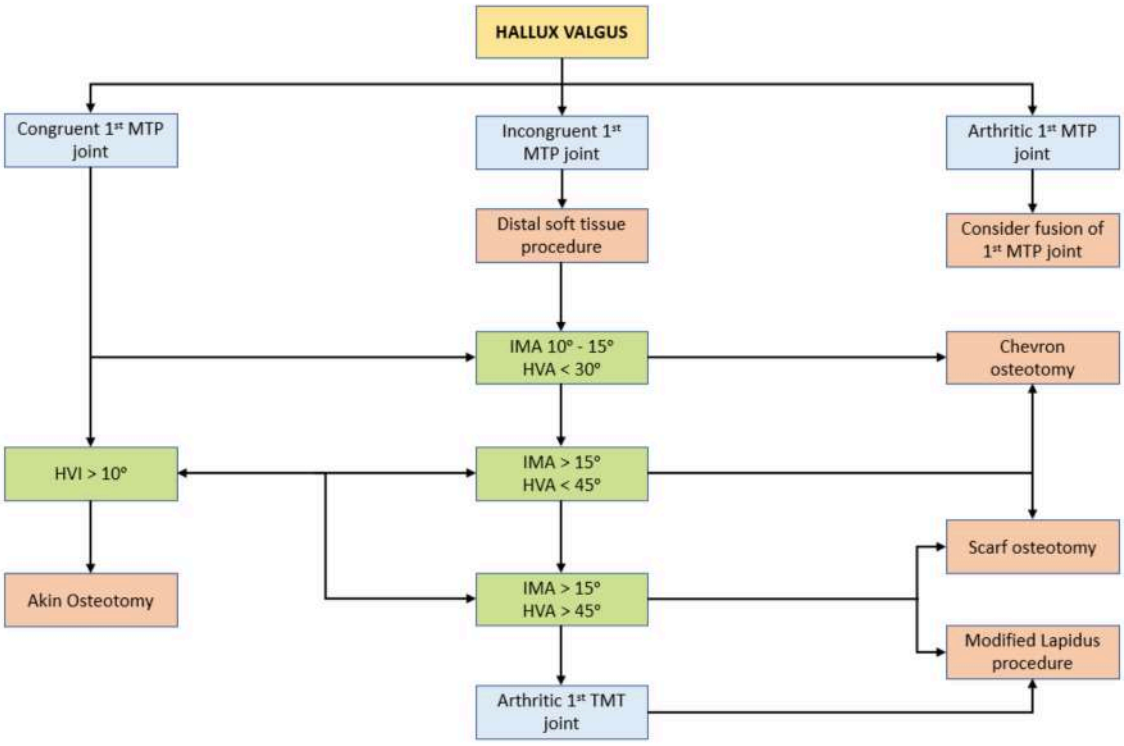

Figure 4. Operative treatment algorithm

operation is determined by the severity and extent of the malformation. In general, there are four types of surgeries: 1. metatarsal osteotomy, 2. proximal phalanx osteotomy, 3. fusion procedures, and 4. resection arthroplasty. Soft tissue procedures are usually indicated for a very mild deformity in young patients. Surgical correction is best performed until skeletal maturity.[2] The decision as to which type of correction is chosen will depend on 1. MTP congruency, 2. the presence of arthritic at the MTP, 3. IMA and 4. HVA.[24]

According to research, distal osteotomy is associated with reduced discomfort and increased ability to resume exercise in the medium to long term. Patient satisfaction with post-distal osteotomy HV is generally good (75%), with a complication rate of 10%.[2] If the deformity is minor (less than 25°), it can be repaired by mending the surrounding soft tissues or by metatarsal osteotomy. If a congruent articulation radiograph is found, the deformity is most likely caused by bone and can be corrected with distal osteotomy. On the contrary, if the MTP articulation is not congruent and the deformity is already present in the joint, this is an indicator that a realignment is required.[2]

If the articulation is still congruent, a distal osteotomy combined with a correction osteotomy based on the proximal phalanx can be performed in HV in the moderate and severe categories (> 30 degrees / > 15 degrees). However, if the distortion is severe enough to cause joint subluxation, soft tissue repair, and proximal metatarsal osteotomy can be performed. The goal of this basal portion osteotomy is to narrow the intermetatarsal angle.[2] The Hallux valgus in the elderly should be addressed with footwear modification, and if it fails, arthroplasty excision can be performed. In Keller's procedure, the proximal phalanx and the bun protrusion are removed first. Previously, this type of surgery was the most widely used, but the recurrence rate was high, and complications such as loss of control of the movement of the big toe, other metatarsals having excessive loads, metatarsalgia, and other cosmetic reasons could arise.[2]

Complications

Undercorrection, recurrence, overcorrection (hallux varus), transfer metatarsalgia, nonunion, malunion, avascular necrosis, arthritis, hardware removal, nerve injury, and subsequently patient unhappiness are some of the most frequently reported complications following HV reconstruction.[23,25] These complications are likely to occur in 10% - 55% of cases.[26] These complications can be asymptomatic at times, but they frequently result in a painful and/or dysfunctional first metatarsal. After HV surgery, a recent systematic analysis of the literature found a combined rate of postoperative patient dissatisfaction of 10.6% and a residual pain level of 1.5% in the first metatarsophalangeal (MP).[27] In comparison to distal methods (Chevron: 5.56%), proximal operations

(closing base wedge osteotomy: 8.82%; Lapidus: 8.19%) have higher rates of revision surgery.[28] Revision surgery can be necessary if conservative methods do not relieve pain. In certain circumstances, revision of the first ray alone may result in a satisfactory outcome; however, in others, surgery on the lesser rays or both together may be required to obtain a mechanically sound forefoot.[29]

Summary Points

1. Hallux valgus (HV) is a complex disorder with a variety of deformities varying in severity, implying that numerous variables are involved. Although the exact etiology of HV is unknown, it is believed that both intrinsic and extrinsic factors may play a role in its development.
2. Physical examination and imaging assessment in a weight-bearing position are required for the diagnosis of HV.
3. Imaging assessment should describe the status of MTP, mobility, presence of arthritis, and radiographic parameters such as hallux valgus and intermetatarsal angles.
4. Asymptomatic HV does not necessitate surgical correction.
5. The first-line treatment for symptomatic HV is conservative; including shoe modification, orthotic use, and night splinting which unfortunately will not reverse the deformity.
6. If conservative treatment fails, surgical correction is recommended to improve functional outcomes.

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Case Report

Open Reduction and Internal Fixation with Tension-Band Wiring and Cerclage for 8 Years Neglected Patellar Fracture: A Case Report

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Abstract

Introduction: Fractures of the patella are serious injuries commonly caused by direct trauma of the anterior knee surface. Various techniques such as tension band wiring (TBW) and cerclage wiring have been proposed.
Case: A 55-year-old woman who had a neglected left patellar fracture for 8 years. Radiographic evaluation revealed complete fracture of the left patellar bone with displacement and visible callus, fusion of the superior patellar fragment with the epi-metaphysis of the right femur with soft tissue swelling, malunion impression, left patellar subluxation anteriorly and grade III osteoarthritis. An open reduction internal fixation using tension band wire and cerclage was performed and post-operative evaluation revealed acceptable alignment of the patella and implant. Total Bostman knee was 28 points to analysis knee function.
Discussion: TBW is one of treatment methods for patella fracture fixation by counteracting muscle traction, maintaining the reduction and transforming the tensile forces between the quadriceps muscle and the anterior tibia tuberosity to compress the patella articular cortex during knee flexion. It also stabilizes the fracture and enhances bone healing by closing the fracture gap and maintaining the interfragmentary contact. Cerclage wire is passed through the quadriceps and patellar tendon. Knee immobilization is unnecessary and the functional outcome is always adequate.
Conclusion: TBW with cerclage is favorable to stabilize a neglected transverse patella fracture. It is associated with satisfying clinical outcome and less complications. The placing of the tension band close to the patella decreases the rate of major loss of reduction and implant failure.

Introduction

Fractures of the patella are serious injuries with a broad range of subtypes. These injuries account for about 1% of all skeletal injuries and are most prevalent within the age group of 20-50 years, commonly caused by direct trauma of the anterior knee surface. Epidemiologic studies demonstrated that the incidence in men is twice as high as in women. Because of the subcutaneous anterior location, the biomechanical function and the high level of force transmission during extension and flexion, stable reconstruction of patellar fractures continues to represent a major surgical challenge.[1] The majority of cases are caused by direct injury mechanism. The resulting fracture type depends on the trauma mechanism (i.e., direct or indirect), the energy transmitted to the bone and the bone quality. The most common fracture pattern is a simple 2-part diversion caused by a direct blow (i.e., dashboard injury). As a result of the bony lesion, the extensor mechanism of the knee joint can become insufficient. The degree of insufficiency depends among other factors on accompanying damage to the reserved extensor mechanisms. Additional injuries to the adjacent bones are rare but can affect the articular surface of the distal femur. The most frequent indirect

mechanism is fall on the feet with eccentrically contracted quadriceps muscle. Depending on the velocity of the fall and the resistance of the extensor mechanism, either the patella or the adjacent tendons might fail.[2] Surgical treatment is suggested for displaced fractures of the patella to restore the extensor mechanism. Various techniques such as tension band wiring and cerclage wiring have been proposed for treating such fractures.[1]

We reported a case of a 55-year-old woman with a neglected left patellar fracture for 8 years. The patient went to traditional bone setter for more than 10 times. After the first time visiting orthopedic clinic, the patient decided and agreed to undergo an open reduction and internal fixation surgery using TBW and cerclage technique.

Case Presentation

A 55-year-old woman presented at the clinic complaining difficulty to straighten her left knee since April 2013. She had a history of falling down from her motorbike in a traffic accident with her left knee bumping onto the asphalt 8 years ago. Following the accident, she did not seek any medical treatment, instead she went to a traditional bone setter and felt better after getting traditional massages for more than 10 times. Ever since, she got a difficulty to extend her knee but could still walk properly without any walking aid. Eight years after the accident she decided to seek medical treatment for her complaint. From pre-operative physical examination, patellar gap at the left knee was obviously seen. Neither sign of acute inflammation nor any deformity was seen. When palpated, no tenderness was noted, however, the superior pole of the patella was mobile and inferior pole was fixed (Figure 1). The patient was able to walk normally without any walking aid. She could extend her knee to 0^{o} and flex her knee to 120^{o}. There was no pain during flexing and extending the knee but weakness of the extensor mechanism of the left knee was observed.

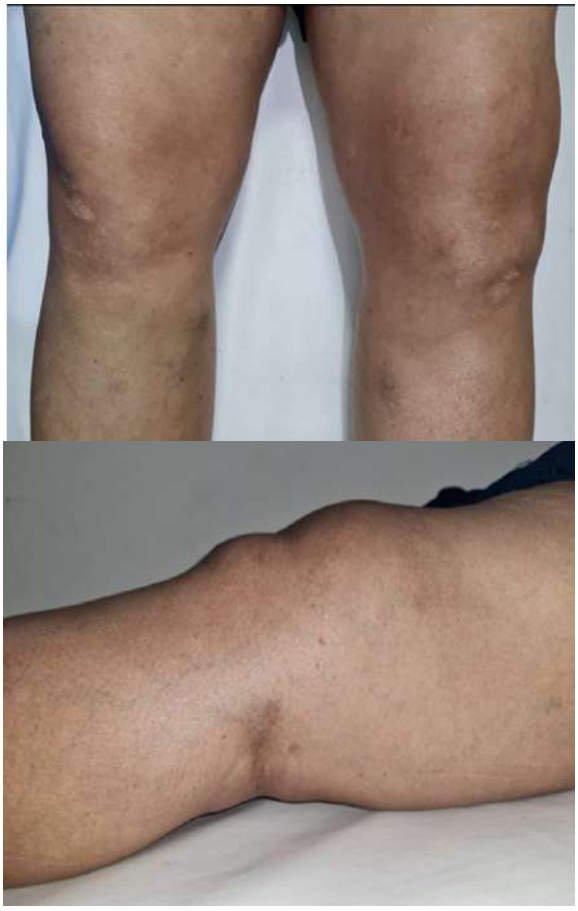

Figure 1. Clinical picture of the left knee with an obvious patellar gap

Radiograph was taken, revealing complete fracture of the left patellar bone with displacement, accompanied with some visible callus around it, with fusion of the superior patellar fragment with the epimetaphysis of the right femur with soft tissue swelling around it, malunion impression left patellar subluxation anteriorly and also OA grade III according to the classification of Kellgren and Lawrence (Figure 2). All these findings supported the diagnosis of neglected closed fracture left patella. Open reduction and internal fixation by using tension band wire and cerclage technique was planned and the patient agreed to surgery.

During surgery, the patient was positioned in supine position. Mid-axial longitudinal approach incision was performed on the anterior of the left knee. Callus formation around patellar bone fragment was

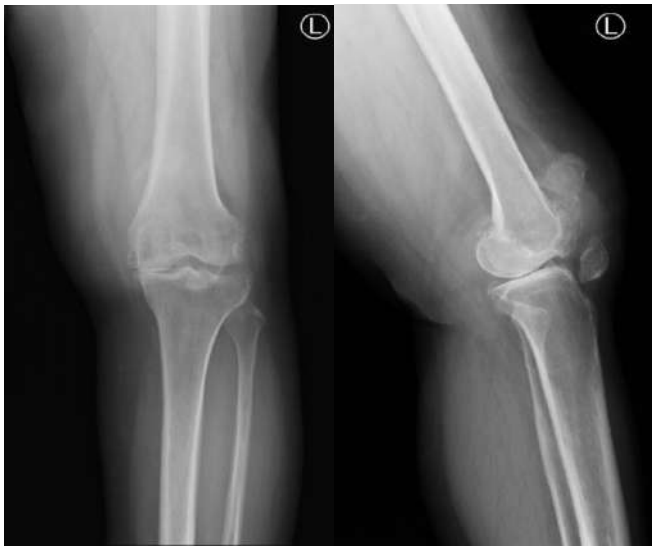

Figure 2. Left knee radiograph showing complete fracture of the left patellar bone with displacement, some visible callus around it, with fusion of the superior patellar fragment with the epi-metaphysis of the right femur with soft tissue swelling around, malunion impression left patellar subluxation anteriorly and OA grade III (according to the classification of Kellgren and Lawrence)

then identified. Next, osteoclasis for cleaning fracture fragments from callus for easier reduction and fixation was performed. Anatomical reduction of the patellar bone fragment was performed, subsequently continued with fixation using S-Wire 1.2mm with cerclage method, then followed by placing 2 K-Wires 1.8mm perpendicular with the fracture line with 5 cm distance between each K-Wire and followed by applying a figure-of-eight using 1.2mm S-Wire for additional compression of the fracture site (Figure 4). An acceptable alignment of the patella and implant was observed postoperatively (Figure 3).

On a follow-up evaluation three months post-operatively, there was no pain in the affected knee, no pus and inflammation sign observed. Evaluation using Bostman Knee Score, showed that the patient was able to move the knee at about 135 degree flexion and 0 degree extension. The patient was also able to walk without assistance and perform daily routine task such as climbing stairs and sitting. The patient was also able to return to work with a total score of 28 points, an excellent result. Fracture line was no longer visible on a 3-months post operative radiograph (Figure 6).

Figure 3. Postoperative left knee radiograph of anteroposterior and lateral view showing the bones and the wires in good alignment

Figure 4. Intraoperative clinical picture of the left knee

Figure 5. Postoperative clinical picture of the left knee (A), and one week after (B).

Discussion

Conservatively, the technique involves two parallel K-wire upright to the fracture line and one figure of eight wire passing anteriorly concluded the patella and behind the K-wire. Tension band wiring is one of treatment approaches for patella fracture fixation, especially for transverse fracture. It counteracts muscle traction, maintaining the reduction and transforming the tensile forces among the quadriceps muscle and the anterior tibia tuberosity to compress the patella articular cortex during knee flexion. By ensuring recurrent compressive force when the knee is flexed, the fracture healing progression can be enforced. It also stabilizes the fracture and enhances bone healing by finishing the fracture gap and sustaining the interfragmentary contact cerclage wire is passed through the quadriceps and patellar tendon. Adding it with two Kirschner wires is suggested by the AO (*Arbeitsgemeinschaft für osteosynthesefragen*) group to fix this defect.[3,4]

Knee immobilization is unnecessary, and the functional outcome is always adequate. In this case, two K-wires traversing the fragment can prevent collapse then the cerclage wire is tightened. K-wire is extra effective than a lag screw when the tension band procedure is applied.

Patella contains of cancellous bone, therefore bony healing progression will be fast as long as the stability can be sustained. Bony union is predictable, and the period is shorter than in other bones. Though, in neglected fractures, it is better to add cancellous bone in the lesion site to support osteogenesis.[5]

Figure 6. Postoperative left knee radiograph of anteroposterior and lateral view showing the bones and the wires in good alignment

In principle, total patellectomy should be avoided due to the importance of the patella as the extensor mechanism. Even though TBW is one of the most common used procedures to fixed patellar fracture fixation, poor clinical outcomes have been reported in up to 55% of the cases. In this case, we bend the both ends of the K-wire. K-wire bending still controversial, however, it is supposed to provide higher stability by preventing the figure-eight-wire migration. Single proximal bending of the K-wire saves the operating time during implantation or removal.[6] Complication within our case is minor. The skin may be irritated but the wire does not migrate and no loss of fragment reduction.

Bostman in 1981 created a functional outcome scoring for patient who undergo patella surgery. Bostman knee score, which takes into consideration factors such as range of motion, pain, ability to return to work, muscle atrophy, use of aids, effusion, instability of the knee and ability to climb stairs. Out of a maximum score of 30 points, an excellent outcome is between 30 and 28 points, a good outcome between 27 and 20 points and a poor outcome is less than 20 points. In this case the patient able to flex the knee 135 degree without pain. No effusion was observed. The patient also able to perform simple task such us climbing and walking without assistant. The Bostman knee score in this patient was 28 points which indicated excellent result.[7] Presently, there is no current available study on pressure distribution in the, displacement, rotational movement and patellar fracture gap at the fracture site, related to knee flexion and extension during the early mobilization phase, proving that tension band wiring by using K-wire is an effective surgical treatment.[3]

Conclusion

Tension band wiring with cerclage is favorable method to stabilize and fixate a neglected transverse patella fracture. It is associated with satisfying outcome and minor complications. The placing of the tension band close to the patella reduce the rate of major loss of reduction and implant failure

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