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**ORIGINAL ARTICLE**

# Unstable Infected Fractures and Spinal Stability: A Critical Role in Treatment

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## ABSTRACT

**Background:** An uncommon infection of the spinal column that can be caused by either bacteria or fungi is known as vertebral osteomyelitis.

**Objective:** Aim of current study was to determine the importance of spinal stability among patients of unstable infected fractures.

**Methods:** Total patients of unstable infected were presented in this study. Patients were included after getting informed written consent. All the patients were underwent for minimal invasive surgery. Post-surgery outcomes among all cases were assessed. SPSS 22.0 was used to analyze all data.

**Results:** There were majority 37 (61.7%) males and 23 (38.3%) females among all cases. The mean age of the presented cases was 58.9 years and had mean BMI 26.5 kg/m$^2$. 32 cases had DM, 20 cases had hypertension and 8 cases had smoking history. Road traffic accident was the most common cause of fracture found in 35 (58.3%). Post-treatment, 27 (45%) cases showed excellent results, 15 (25%) showed good and 13 (21.7%) cases showed fair outcomes. Poor outcomes were only resulted in 5 patients.

**Conclusion:** We concluded in this study that spinal stability is necessary to treat the unstable infected fractures. The healing process is impeded by instability, which leads to a vicious circle of damaged soft-tissue, impaired neovascularity, and osteolysis.

**Keywords:** vertebral osteomyelitis, spinal stability, outcomes

## INTRODUCTION

Muscles provide support for the spine, which is a complex system of joints that ensures the stability of the trunk and head in different positions and motions. Furthermore, it is crucial in protecting the spinal cord, nerve roots, and arteries in the cervical spine. Stable spines not only shield neural systems from harm, but they also facilitate efficient force transmission between the upper and lower bodies, creation of force in the trunk, conservation of muscular energy, and reduced biomechanical wear on spinal components[1,2].

There is currently no agreed-upon definition of the word "spinal stability" despite numerous attempts from biomechanical and therapeutic perspectives. Spinal instability, often called poor stability, is a major cause of back discomfort, particularly lumbar pain, among many others. A promising new approach to treating degenerative spinal illnesses has emerged with the advent of mobile stabilisation devices, which can reduce harmful pressures, restore normal segment function, and protect adjacent structures. More and more, these systems are being considered in surgical operations and bioengineering. Stability, according to the American Academy of Orthopaedic Surgeons, is "the capacity of the vertebrae to remain cohesive and to preserve the normal displacements in all physiological body movements"[3].

Recent developments in vertebral and pedicle screw fixation have enhanced spinal stability while decreasing the necessity for long-term immobilisation. King originally described the insertion of lumbosacral screws in 1948. Along with laparoscopic procedures, minimally invasive spine surgery evolved from chemonucleolysis in 1964 to microdiscectomy in 1977. In 2003, Foley made improvements to the TLIF approach that had been introduced in 1998 by Harms and Jeszenszky, making it less obtrusive. System such as ROSA Spine, ExcelsiusGPS, and SpineAssist (2004), which have been authorised by the FDA, have further revolutionised spine surgery by increasing precision and minimising radiation exposure[4].

In the early stages of vertebral osteomyelitis, there may not be any noticeable signs, making it difficult to diagnose. Although 35% to 60% of individuals experience fever, the most common presenting symptom is back discomfort[5]. Infection usually starts off with nonexistent or widespread pain and moves to specific areas, most often affecting the cervical spine, then the lumbar spine, and eventually the thoracic spine. Additional symptoms that may appear include a lack of appetite, muscle cramps, incontinence, neurological impairment, and sensitivity to touch[6]. Serious complications, including spinal deformities, paraplegia, and even death, can arise from the advanced stages of vertebral osteomyelitis.

Confirmation of a spinal infection diagnosis can be achieved through imaging, blood testing, and a biopsy. The most sensitive diagnostics now available are blood tests that evaluate erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP). Their sensitivity ratings vary between 94% and 100%. These inflammatory markers also act as a measure of the treatment's effectiveness. It is important to get a blood culture before treating patients with febrile back pain with antibiotics, especially if they are stable enough to wait for the findings. When imaging findings point to infection but culture results show no infection in the blood, a CT-guided biopsy of the spinal canal or disc space can be taken to identify the offender[7]. We also propose imaging to help find the specific location and appearance of the sickness. With a sensitivity of 91% and a specificity of 77%, magnetic resonance imaging (MRI) with or without gadolinium contrast enhancement is the most dependable tool for identifying spinal infection[8]. Additionally, CT scans may be utilised to determine the extent of bone loss[9].

The complex diagnosis and treatment of vertebral osteomyelitis is best handled by a multidisciplinary team. Every patient begins their treatment with a six-week course of antibiotics. The only conditions that need for surgical intervention are those that are particularly complicated, have neurological abnormalities, or infections that antibiotics have failed to treat. Physical rehabilitation to restore muscle strength and track healing with serial imaging is recommended after treatment[9].

## MATERIALS AND METHODS

This retrospective study was conducted at and comprised of 60 patients. A patients with a history of tobacco use, a T8 spinal fracture, multiple pelvic and lower limb fractures, primary

hypertension, splenectomy, and poorly controlled type 2 diabetes mellitus (A1c 12.1) is being treated at this time. While majority of the fractures required surgery, the T8 fracture was handled conservatively. After a challenging hospital stay due to methicillin-resistant Staphylococcus aureus (MRSA) bacteremia, the patient was sent to an inpatient rehabilitation centre to finish a four-week daptomycin regimen.

The patient's symptoms such as fever, chills, body aches, and intractable mid-back pain worsened about a week after the antibiotic course ended. A CT scan of the abdomen and pelvis with IV contrast revealed paravertebral fluid collection around the fracture at T8. Lab tests confirmed bacteremia with MRSA once again. A few days later, the interventional radiology team placed a drain. However, his blood cultures kept coming back positive for a couple more weeks. Finally, a PET CT scan revealed hypermetabolic activity around T8-T9.

Within one week following surgery, the patient's several blood cultures returned negative results. Because of the patient's eosinophilia, the doctor switched her from daptomycin to vancomycin and gave her six weeks of oral rifampin in addition to 600 mg of intravenous vancomycin every eight hours. There was no sign of persistent infection in the MRI data obtained eight days prior to the antibiotic treatment's completion, even if the results were limited by a metallic susceptibility artefact associated to the hardware. They recommended discontinuing intravenous antibiotic treatment after discussing the case with the Infectious Disease team. The patient has met with the Infectious Disease team at the clinic after their release to go over the details of taking 100 mg of doxycycline once a day. The patient has been consistently following up for about a year now, and they have now proposed the idea of continuing doxycycline treatment. SPSS 22.0 was used to analyze all data. Categorical variables were assessed by frequencies and percentages.

## RESULTS

There were majority 37 (61.7%) males and 23 (38.3%) females among all cases. The mean age of the presented cases was 58.9 years and had mean BMI 26.5 kg/m$^2$. 32 cases had DM, 20 cases had hypertension and 8 cases had smoking history.(table 1)

Table-1: Demographics of the presented cases

| Variables | frequency | Percentage |
|---|---|---|
| Gender | | |
| Male | 37 | 61.7 |
| Female | 23 | 33.3 |
| Mean age (years) | 58.9 | |
| Mean BMI (kg/m$^2$) | 26.5 | |
| Comorbidities | | |
| DM | 32 | 53.3 |
| HTN | 20 | 33.6 |
| Smokers | 8 | 13.3 |

Road traffic accident was the most common cause of fracture found in 35 (58.3%) cases, followed by fall from the height and sports.(figure 1)

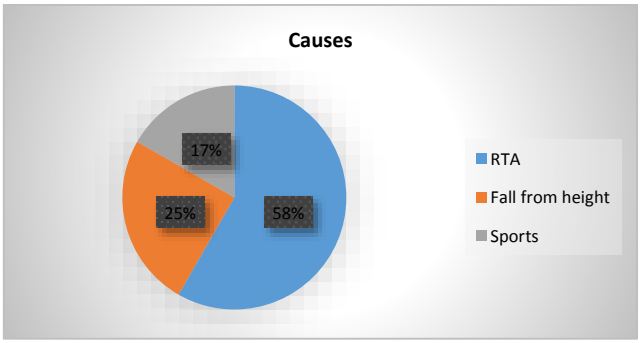


Figure-1: Causes of unstable spin fracture

Post-treatment, 27 (45%) cases showed excellent results, 15 (25%) showed good and 13 (21.7%) cases showed fair outcomes. Poor outcomes were only resulted in 5 patients.(table 2)

Table-2: Post-treatment outcomes among call cases

| Variables | Frequency | Percentage |
|---|---|---|
| Outcomes | | |
| Excellent | 27 | 45 |
| Good | 15 | 25 |
| Fair | 13 | 21.7 |
| Poor | 5 | 8.3 |

## DISCUSSION

Intravenous antibiotic or antifungal treatment remains the gold standard for treating spinal infections, despite the suggestion of oral administration regimens[10]. The average duration of a patient's medical therapy is six to eight weeks. Despite the fact that most authorities still recommend six weeks of therapy, research has shown that longer courses of treatment are not more effective in most cases. Immobilisation is frequently recommended in cases when there is a significant possibility of instability or intense pain[11].

Surgical removal of osteomyelitis may be required in cases where the infection has progressed to the point where the spine is unstable, there are neurological deficits, a large epidural abscess has formed, the back pain is intractable, there is sepsis with clinical toxicity due to an unresponsive abscess, culture results have not been obtained, or antibiotics have failed to clear the infection. Surgical procedures aim to remove diseased tissue, increase healing blood flow, stabilise the spine by fusing together weak spots, and restore neurological function, among other things. The patient underwent spinal stabilisation surgery following the ineffectiveness of antibiotics in eliminating the illness. Debridement is a part of the surgical treatment for osteomyelitis, as it is for other forms of the condition[12]. The main objective of the surgery was to stabilise the afflicted vertebrae in order to make infection clearance easier, since the patient was not expected to tolerate a debridement procedure.

Titanium screws and rods made of cobalt and chromium were utilised here. Research on the antibacterial properties of titanium and cobalt-chromium has shown somewhat conflicting results. One study found that cobalt-chromium alloys were more effective antibacterially than titanium alloys[13]. Titanium spinal implants, in contrast to their cobalt-chromium counterparts, showed much lower rates of S. aureus biofilm formation[14].

Titanium and stainless steel also have mixed results when it comes to their antibacterial properties. One earlier study found that compared to stainless steel implants, titanium ones had a reduced infection rate[15]. Titanium in Kirschner wires showed better resistance to infection and biofilm formation than stainless steel and hydroxyapatite-coated steel, according to another study[16]. Titanium does not possess any inherent antimicrobial properties, and in fact, multiple investigations have shown that it raises the likelihood of implant-associated infections (IAIs)[17]. When comparing titanium and stainless steel for IAIs, a recent systematic evaluation came to the conclusion that there is no clear winner[18]. Another comprehensive analysis[19] found no evidence that titanium alloy protects against IAI, despite these patterns. We still don't know how implant materials affect IAI, and more research into the infection risk of these metals is required to settle this question [20]. Among the many benefits of IAI, keep in mind that implants with less soft tissue injury and sustained periosteal perfusion are the best option[20].

Incorporating antibacterial compounds into a titanium implant's surface is one of several surface modifications that can be made to reduce infection risk[21]. Also, research into the possibility of UV light reducing infection rates is ongoing. Although the introduction of metallic implants is controversial while a patient is sick, an increasing number of surgeons are coming to the realisation that instruments can actually help the body fight off infections instead than getting in the way of healing.

Early researchers believed that removing osteomyelitis surgically increased the likelihood of infection persistence or recurrence. In the 1990s, as more and more surgeons reported positive results from their patients' surgical courses, the use of internal fixation to treat acute infections started to gather momentum[22]. Metallic implants are controversial to use during an infection because, as is often believed, they can attract bacteria, which can then lead them to form biofilms[4].

Some research suggests a 2% to 9% increase in infection rates after spinal instrumentation[4]. Despite significantly better neurologic function and decreased discomfort, surgery for spinal osteomyelitis is linked with a high prevalence of adverse events[23]. Alternatively, a more thorough investigation found that metallic implants inserted into an infected spinal area do not prolong or worsen the illness[4]. The likelihood of adverse clinical outcomes is not increased by surgical interventions for vertebral osteomyelitis, according to current studies[1].

Even while we know mechanical stability plays a crucial part in bone healing, there is still a lot we don't know about how it affects fracture-related infection (FRI). Few preclinical animal models are being used to inform surgical decision-making[24]. Most people think that stability is very important for treating FRI, although some disagree. The vicious cycle begins with instability, which in turn hampers neovascularity, which worsens soft-tissue trauma and osteolysis. Fracture instability sets this cycle in motion. In the end, this weakens host defences and encourages the spread of bacteria. Because of this, osteolysis and instability worsen even more[24].

## CONCLUSION

We concluded in this study that spinal stability is necessary to treat the unstable infected fractures. The healing process is impeded by instability, which leads to a vicious circle of damaged soft-tissue, impaired neovascularity, and osteolysis.

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