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Treatment of lumbar discitis using silicon nitride spinal spacers: A case series and literature review

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ABSTRACT

INTRODUCTION: Septic infection of a lumbar intervertebral disc is a serious disorder which is often difficult to diagnose and appropriately treat because of the rarity of the disease, the varied presentation of symptoms, and the frequency of low-back pain within the overall population. Its etiology can be pyogenic, granulomatous, fungal, or parasitic; its incidence is rising due to increased patient susceptibility and improved diagnostic tools. Conservative treatments involve antibiotics, physical therapy, and/or immobilization. More aggressive management requires discectomy, debridement, and spinal fusion in combination with local and systemic antibiotic administration.

PRESENTATION OF CASES: Presented here are two case studies of lumbar pyogenic discitis associated with *Escherichia coli* and *Candida albicans* infections. Both required single-level anterior discectomy followed by spinal fusion using an antimicrobial silicon nitride (Si_3N_4) spacer for stabilization without instrumentation. Localized antibiotics were used for only one of the patients. Follow-up CT and MRI scans showed that the infections had been resolved with no recurrence of symptoms.

DISCUSSION: Si_3N_4 is a relatively new spinal spacer material. It was utilized in these two cases because it reportedly provides a local environment which promotes rapid arthrodesis while resisting bacterial adhesion and biofilm formation. It is also highly compatible with X-ray, MRI, and CT imaging modalities. These properties were particularly attractive for these two cases given the patients' histories, presentation of symptoms, and the decision to forego instrumentation.

CONCLUSION: The use of Si_3N_4 as an antimicrobial spacer may lead to improved outcomes for patients with pyogenic discitis of the lumbar spine.

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1. Introduction

Infections of the spine are persistent global problems [1]. Historically, they were predominantly associated with tuberculosis (Pott's disease), and this pathology remains a common cause in today's world [2]. However, their overall etiological roots can either be bacterial, mycobacterial, fungal, or parasitic. The incidence of spine infections has been steadily increasing in developed countries and ranges up to 6.5 cases per 100,000 [3,4]. It currently accounts for $\approx 5\%$ of all bone lesions in people over 50 years of age [3]. Spinal infections can be classified as osteomyelitis, facet joint septic arthritis, epidural bacterial abscesses, and septic discitis or spondylodiscitis [5]. Most arise from a remote haematogenous source with *Staphylococcus aureus* being the dominant pathogen accounting for over 28% of reported cases or about half of non-tuberculous causes [4]. An increasing number of these cases are, in fact, due to methicillin-resistant *Staphylococcus aureus* (MRSA), particularly in the elderly. Nevertheless, there are a number of both gram-positive and gram-negative bacteria that have been found

as infection sources. These pathogens can also infect the spine by external inoculation or from contiguous tissues (*i.e.*, vascular catheters, epidural injections, previous surgical interventions, diabetic wounds, and bed pressure sores, *etc.*) [3]. Fungal infections are less common and are generally associated with compromised immune systems due to neutropenia, granulomatous disease, and chronic steroid or drug use. *Candida albicans* reportedly is the source for 1–2% of all discitis cases [6].

The diagnosis of spinal infections is problematic because its presentation can be varied. Often, there are long incubation periods prior to the onset of significant symptoms. Back pain is common, but it may range from mild to severe, sometimes worsening with the supine position [2]. Most symptoms are similar to common degenerative spinal disorders such as disc herniation, stenosis, and spondylolisthesis. Chest, abdominal, or radiating pain in the extremities are not unusual which may further complicate or delay a correct diagnosis. The presence of febrile symptoms is an indicator of a contagion; however fevers are only present in about half of the reported cases [6]. The infection is rarely polymicrobial so blood cultures and a microbiological analysis for the causative pathogen are essential diagnostic tools. Routine radiographs are ineffective in early detection of the disease because it takes up to 6 weeks for

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Fig. 1. Case 1: Non-contrasted pre-op MRI showed marked disc degeneration and adjacent vertebral body inflammation at L5-S1, consistent with discitis.

significant abscesses to form [3]. Conversely, magnetic resonance imaging (MRI) is the preferred modality for early radiological diagnosis [2]. It is the most sensitive (93–96%) and specific (92.5–97%) secondary imaging method for detection of discitis [4]. Without an appropriate MRI diagnosis and subsequent treatments, serious complications can ensue including vertebral abscess, osteomyelitis, meningitis, disabling deformities, neurological defects, and death [7].

While the optimal treatment remains unsettled [4], typical conservative management includes extended parenteral and antibiotic therapy – 6 weeks is sufficient in most cases [3] – coupled with orthotic immobilization if minor spinal instability is observed, or limited physical therapy if it is indicated [2]. Surgical intervention is required where there is significant pyogenic damage of osseous tissues, epidural abscess, severe spinal instability, kyphosis, or where conservative management has failed [2].

This paper reports on the successful outcomes of two patients with lumbar spinal infections, both of whom underwent single-level anterior discectomy, debridement, and arthrodesis using

a silicon nitride (Si_3N_4) spinal spacer. Successful resolution of the sepsis, arthrodesis without instrumentation, and significant improvements in their clinical status were achieved in both cases. Pre- and post-operative MRIs and/or CT images were found to be essential in the diagnosis and recovery monitoring of their respective conditions. Furthermore, the novelty of these cases relates to the use of a ceramic interbody material that possesses both antibacterial and osteoconductive properties. The case series was retrospective in design on non-consecutive patients. All surgeries were performed at a single private practice center by the same surgeon (WMR), and the reported studies are in line with the PROCESS criteria [8].

2. Case history 1

A 56 year-old male developed acute severe lumbosacral pain one month after receiving antibiotic treatment for systemic *Escherichia coli* (*E. coli*) sepsis arising from a urinary tract infection. Both blood and urine cultures tested positive for *E. coli* prior to treatment.

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