



## Pedicle stress fracture following total disc replacement: Case report of a rare complication, and literature review

### Abstract:

*Degenerative disc disease is a leading cause of pain in adults in the United States. A 37 year-old man presented to the clinic with a one-year history of low back pain. He was found to have a bulge of L5-S1 segment on MRI. The patient failed conservative treatment, and underwent a Charite™ disc replacement for L5-S1 lumbar degenerative disc disease. The patient returned for follow-up visit complaining of continued pain, and was found to have a left sided L5 pedicle fracture. The patient had resolution of symptoms with conservative treatment, and at 24 month follow up he had improvement of his symptoms. Pedicle fracture is a rare entity, and a result of multiple factors. The most sensitive diagnostic imaging modality is a CT scan, and the best course of action for a pedicle fracture is conservative treatment. To the author's knowledge, this is first reported case of pedicle fracture following Charite™ disc replacement.*

### Introduction

Degenerative disc disease (DDD) is the leading cause of pain and disability in adults in the United States. Currently lumbar arthrodesis is the gold standard treatment for degenerative disc disease and discogenic pain that have failed conservative treatment. Multiple alternatives exist for treatment of DDD including, total artificial disc replacement, nucleus replacement, and viscoelastic hydraulic systems. The Charite™ artificial disc was designed to

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duplicate the dynamics of a normal motion segment in the lumbar spine while restoring intervertebral space height and motion segment flexibility. A 37 year old male underwent a Charite™ total disc replacement at L5-S1 level for discogenic pain. At one year follow-up, the patient reported low back pain, and computerized tomography (CT) showed a pedicle stress fracture of the fifth lumbar (L5) vertebrae. To the author's knowledge, this is the first published report of pedicle stress following single-level artificial lumbar total disc replacement.

### Case Report

A 37 year old male with a one year history of intermittent axial back pain presented to the spine clinic. The patient stated that his symptoms began after a motor vehicle accident where he was a restrained driver. The patient reported three episodes of back pain radiating mostly to the right posterior thigh. The patient worked as a writer, and reported working at his desk for prolonged periods of time, which exacerbated the pain in his lower back. His initial Oswestry Disability Index (ODI) was 55%, indicating severe disability. No past medical history except arthroscopic knee surgery six years prior to the visit was noted. At the time of injury, work up included plain films and MRI. The plain films were unremarkable, and the MRI showed decreased signal intensity on T2 weighted image at L5-S1 with mild bulge on axial and sagittal images (Fig. 1). The patient received three months of physical therapy and home exercises. He visited a neurosurgeon for the above stated complaints and was recommended a series of epidural steroid injections. The patient did not wish to pursue this treatment and presented to our clinic for a second opinion. Clinical examination revealed signs of left-sided nerve irritation at L5-S1 without any neurologic compromise. The patient was given ibuprofen as needed and told to continue low back pain stabilization exercises. At six month clinic follow up, his symptoms had been unresponsive to non-operative measures. His ODI at this time



Figure 1. Lumbar Spine MRI showing a bulge at L5-S1

was 50%. On subsequent MRI, he had degenerative changes at the L5-S1 disc. The patient also had a positive discogram, isolated to the L5-S1 level, and was otherwise normal at all levels. The patient was offered total disc replacement or fusion. The patient elected to have artificial total disc replacement with Charite™ implant for the treatment of lumbar degenerative disc disease. The operation was performed through an anterior vertical skin incision and retroperitoneal approach. A size 4 implant with 12.5mm angulation was inserted.

At one year follow-up in clinic, the patient reported a 2 week history of left sided low back pain and buttock pain. The pain was unresponsive to non steroidal anti-inflammatories, and there was no evidence of radiculopathy in the lower limbs. Anteroposterior and lateral lumbosacral spine radiographs showed the implant in an acceptable position. A lumbosacral CT scan was obtained to assess for facet joint arthritis. CT of the lumbosacral spine showed stress fracture through the left L5 pedicle (Fig 2). The patient was advised to get a SPECT scan of the lumbosacral spine, which correlated with the stress fracture seen by CT.



Figure 2. CT scan at follow-up showing a left L5 pedicle fracture

The patient was given meloxicam for better pain control, and advised to participate in physical therapy sessions. At 14 months post-operatively, the patient reported moderate back pain without leg pain. He was able to sit and walk, as well as perform his daily work activities. The patient continued his physical therapy sessions with stretching exercises. He also participated in yoga, and took meloxicam as needed. The patient was last seen at 24 months, and reported decreasing back pain. He denied any leg pain and was able to do his normal daily routine prior to surgery. His last ODI score was 18% during this time. On physical examination, he had full strength in his lower extremities and was neurovascularly intact. Plain films showed no change in alignment and there was healing of the pedicle pars stress reaction.

## Discussion

The Charite™ disc was developed by Schellnack and Buttner-Janz during the early 1980's at the Charite Hospital in Berlin. The first and second generation Charite™ prostheses had significant problems with implant failure including migration, plate fissuring, plate breakage, and core dislocation.<sup>1-8</sup> The third generation design of Charite™ began in 1987, thus the experience with the device, and the duration of follow-up is more extensive compared to ProDisc™.

Complications following Charite™ disc replacement in short-term and mid-term clinical results include hematoma, sympathetic disturbances, retrograde ejaculation, urinary tract infections, deep vein thrombosis, acute leg ischemia, and phlebitis.<sup>8-17</sup>

These complications are mostly related to surgical approach, anterior retroperitoneal vs. transperitoneal approach.

Lemaire et al.<sup>15</sup> retrospectively reviewed 153 prostheses in 105 patients with a mean follow-up of 51 months. The authors reported four device complications, including two cases of heterotopic ossification, one case of subsidence and one case post-traumatic end plate fracture of L5 requiring revision to arthrodesis. David retrospectively reviewed results from 108 patients, with a mean follow-up of 13 years.<sup>18</sup> He reported that 82% of patients had either good or excellent clinical outcomes, and nearly 90% were able to return to their previous work.

This is the first published report of a single-sided pedicle stress fracture following Charite™ disc replacement. Pedicle fractures are commonly associated with spondylolysis.<sup>19-27</sup> Previously there have reports of isolated C2 pedicle fractures,<sup>28</sup> pedicle fractures in athletes,<sup>29-31</sup> in a sedentary worker<sup>32</sup>, following postero-lateral lumbar fusion,<sup>33-35</sup> as a complication of laminectomy<sup>36</sup>, and congenital anomalies.<sup>37-39</sup> There have been recent reports of bilateral pedicle fractures in a patient with osteoporotic compression fracture,<sup>40</sup> a patient with lumbar stenosis,<sup>41</sup> and a patient with pycnodysostosis.<sup>42</sup>

Pedicle fractures are a rare entity for multiple reasons. They are difficult to identify radiographically. There is greater strength in the pedicle relative to the pars interarticularis,<sup>43,44</sup> and there is a shorter moment arm between the body and pedicle compared with the body and the pars. They generally occur at L2-L5 levels, and are more common on the right side, while a pars interarticularis defect is often seen on the left. In this patient, the pedicle fracture was on the left side.

Pedicle stress fracture in our patient is likely multi-factorial. The same mechanism (susceptibility to fatigue under repetitive stress) that is responsible for spondylolysis acquisita may also be responsible for a pedicle fracture. Abnormal forces across the neural arch that result in fractures of the pars may cause a redistribution of forces, which can lead to a pedicle fracture in the contralateral side. Also, the Charite™ core can have a very sudden and rapid motion anteriorly in extreme extension, and posteriorly in extreme flexion. Such a non fluid motion in extension can cause rapid stress transfer and abnormal loading of the posterior elements. On a repetitive basis this may cause a stress injury leading to a pedicle fracture.

Although the diagnosis of a pedicle fracture is possible by plain films, its sensitivity is limited

similar to other well-known stress fractures. Plain films may demonstrate hypertrophy and sclerosis of the pedicle. Aland et al.<sup>21</sup> and Garber and Wright<sup>19</sup> have reported that fractures of the pedicle that were not detected by plain films were seen on CT. CT is the method of choice in the evaluation of the fracture, treatment planning, follow-up, and differentiation from other possible etiologies, such as arthritis, infection, or neoplasia.<sup>26,45</sup> It can be detected as a linear lucency.

Symptoms of pedicle fractures may include low back pain (as seen in this case), leg pain due to nerve root irritation, limitation of straight leg raising, scoliosis, and local tenderness. Neurological deficits are rare. Compression of the nerve root may result in sensory loss, or absent knee or ankle reflex.

Table 1	Charite™ Total Disc Replacement
<b>Criteria for Surgery</b>	<ol style="list-style-type: none"> <li>1. L4/L5 or L5/S1 Degenerative Disc Disease (DDD)</li> <li>2. Failure of symptomatic relief with at least six months of conservative treatment</li> </ol>
<b>Contraindications</b>	<ol style="list-style-type: none"> <li>1. Multiple level degeneration</li> <li>2. Osteoporosis/Osteopenia</li> <li>3. History of chronic steroid use</li> <li>4. Pregnancy</li> <li>5. Morbid Obesity</li> <li>6. Spondylolisthesis, Scoliosis</li> <li>7. Previous back surgery (Not including discectomy or laminotomy)</li> <li>8. Systemic infection/Spinal infection</li> </ol>
<b>Possible Complications</b>	<ol style="list-style-type: none"> <li>1. Hematoma</li> <li>2. Sympathetic Disturbances</li> <li>3. Retrograde Ejaculation</li> <li>4. Urinary Tract Infection (UTI)</li> <li>5. Deep Vein Thrombosis (DVT)</li> <li>6. Acute Leg Ischemia</li> <li>7. Phlebitis</li> <li>8. Heterotopic Ossification</li> <li>9. Dural Tear</li> <li>10. Allergic Reaction to implant</li> <li>11. Anterior Subluxation</li> <li>12. Pedicle Stress Fracture</li> </ol>

**Table 1- Indications, Contraindications and potential complications of Lumbar Disc Replacement**

Treatment should consist of pain medications, resting, bracing, and exercises such stretching of the thoracolumbar fascia, and gluteal muscle strengthening.<sup>31</sup> In cases in which conservative treatment fails, surgical intervention may be necessary. Sherman et al.<sup>25</sup> demonstrated that

resection of the pedicle combined with fusion to the level above and below was not effective. Another potential option is compression fixation.

Choosing a device for artificial disc replacement should be based on candidate criteria, possible contraindications, long-term results and complications in the literature, and surgeon's

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