Acta Scientific Orthopaedics (ISSN: 2581-8635)

Volume 6 Issue 7 July 2023

Clinical Case Reports

Unconstrained Cervical Total Disc Replacement not One Design Suits Every Patient. Case Report

Juan Manuel Amaya Sánchez[1]*, John Choi[1] and Hong Lee Terry Teo[2]

[1]*Spine Ortho Clinic, Melbourne, Victoria, Australia*

[2]*Department of Orthopaedic Surgery, Changi General Hospital, Singapore*

***Corresponding Author:** Juan Manuel Amaya Sánchez, Spine Ortho Clinic, Melbourne, Victoria, Australia.

DOI: 10.31080/ASOR.2023.06.0763

Received: April 20, 2023

Published: June 10, 2023

Abstract

Degenerative disc disease is one of the main causes of cervical radiculopathy and myelopathy. It has been treated traditionally with anterior cervical discectomy and fusion (ACDF) [1]. However, this procedure was not immune from different types of complications, one of the most frequent is adjacent segment disease (ASD). As a result, new techniques such as total disc replacement (TDR) have emerged as an alternative to preserve motion and decrease the risk of ASD [2].

Keywords: Cervical Disc Replacement; Metallosis; Mobi C; Cervical Radiculopathy

Introduction

Despite showing good results in the short to long term, it has a number of complications that can occur related to the type of device used [1,2]. Some of them are related to the materials and biomechanics of the different types of devices the available. The purpose of this case report is to demonstrate that not all unconstrained devices are suitable for all patients. Therefore, there are different factors that must be considered in order to avoid failure [1,2,4].

Clinical Case

Our patient is a forty-year-old male, who works as a fabricator and has a smoking history. He presented to the clinic with neck pain radiated to the right hand at the level of thumb with pins and needles. At the time, his physical examination presented with decreased right C6 power. Imaging diagnostic studies such as, Magnetic resonance imaging (MRI) showed right lateral recess stenosis at the level of C4/5, C5/6 (Figure 3,4).

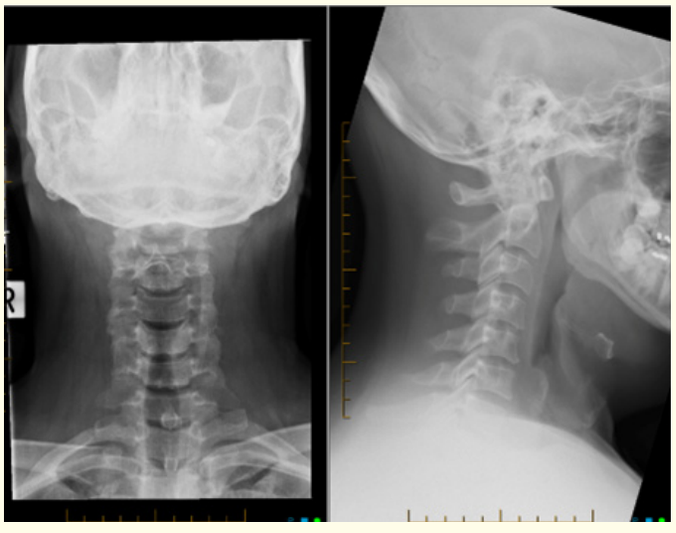

Figure 1: AP Lateral Cervical Spine (6/3/18) – Pre – op.

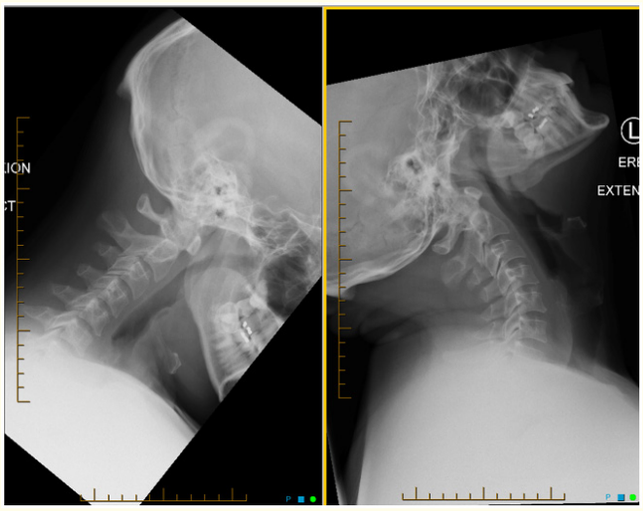

Figure 2: AP Lateral Cervical Spine (6/3/18) Pre – op.

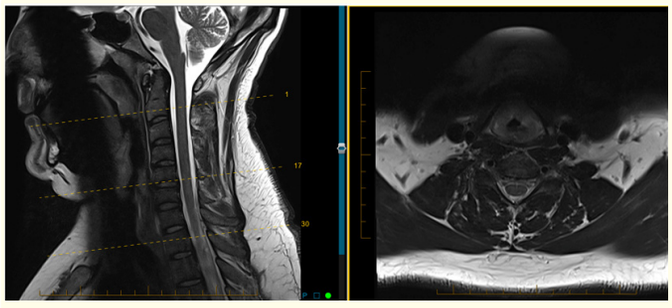

Figure 3: MRI Cervical Spine (6/3/18) Pre – op.

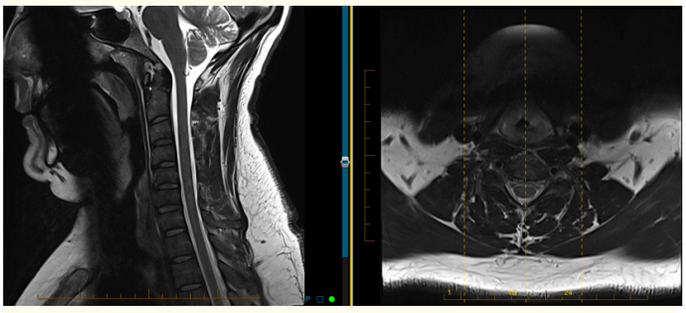

Figure 4: MRI Cervical Spine (6/3/18) Pre – op.

As initial course of treatment, he underwent epidural injection without relief of symptoms. Hence, surgical treatment was performed with Cervical TDR at C5/6 with Mobi-C (Zimvie) device in March 2018 (Figure 5). At four weeks post op review, the patient had relief of his symptoms and had returned to work earlier than advised, raising concerns about device integration were made. At six months post – op, TDR was fully integrated on X-ray (Figure 6, 7), but the patient complained about some right arm pain after work. Later, at nine months post – op the patient was discharged with improved function and no symptoms.

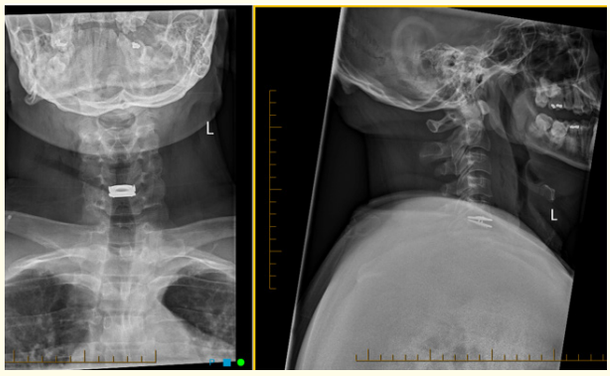

Figure 5: Post – op Cervical Spine X – ray (24/3/18).

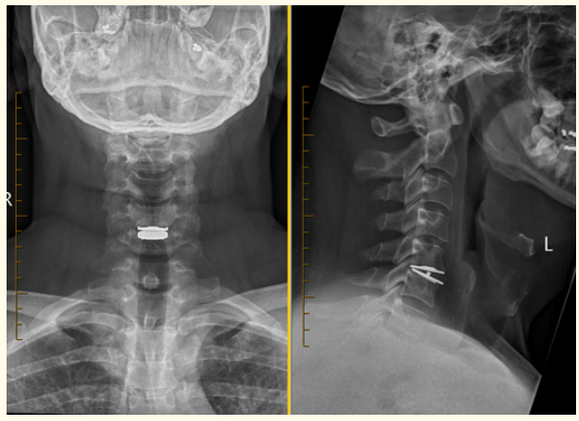

Figure 6: Three months Post – op Cervical Spine X – ray (20/6/18).

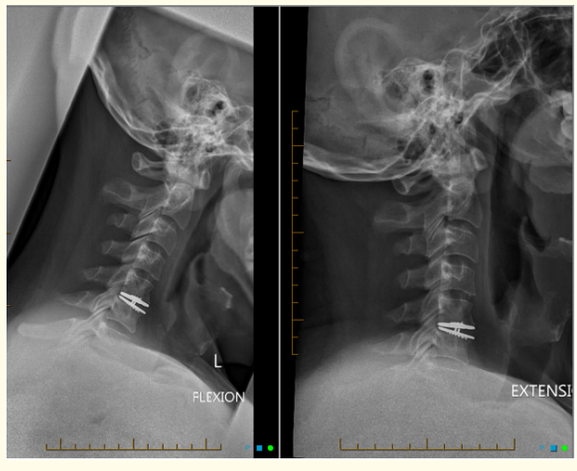

Figure 7: Three months Post – op Dynamic Cervical Spine X – ray (20/6/18).

Five years post – op, the patient complained of neck pain and right arm pain, a cervical X–ray was done showing hyperextension of the construct and 6 mm anterior translation of the inferior endplate (Figure 8), leading to revision surgery with Simplify (Nuvasive) device. Significant metallosis was found intraoperatively as well as breakage of the device (Figure 9 – 13) (video 1). In the immediate post – op period, the patient experienced relief of symptoms, along with restoration of radiological alignment on x – ray (Figure 14, 15).

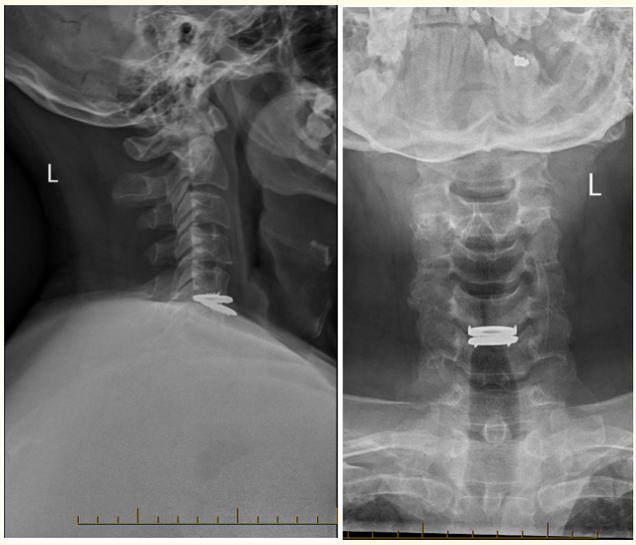

Figure 8: Five years Post – op cervical spine X – ray (19/1/23).

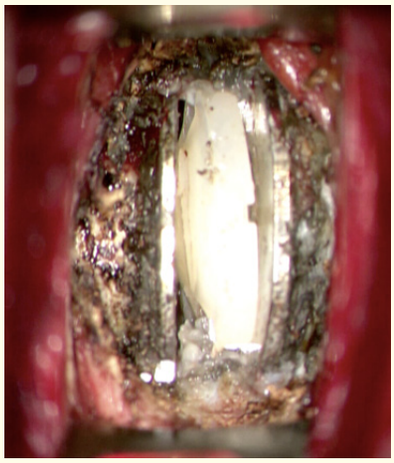

Figure 9: Intraoperative findings (loosening, breakage of implant and metallosis).

Figure 10: Intraoperative findings (loosening, breakage of implant and metallosis surrounding the endplates.).

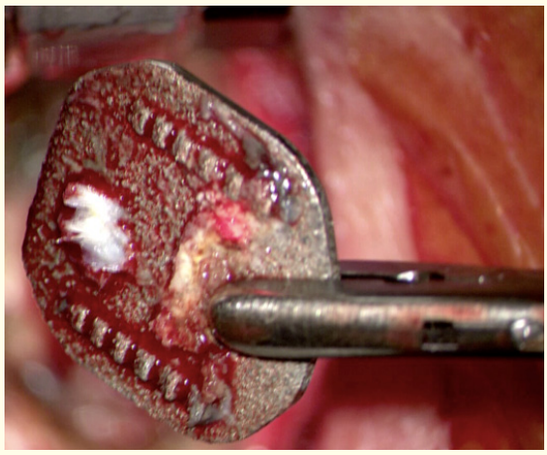

Figure 11: Intraoperative findings (breakage of implant).

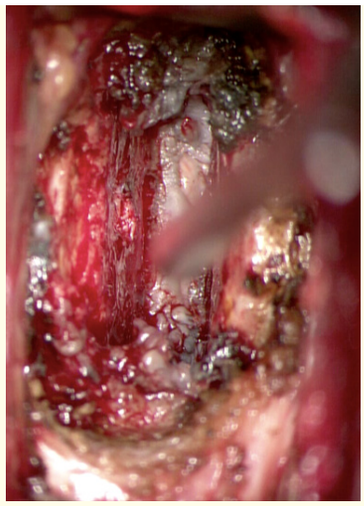

Figure 12: Intraoperative findings (metallosis surrounding the endplates.).

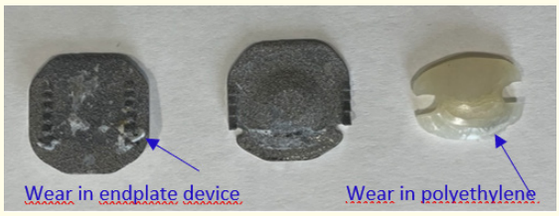

Figure 13: Intraoperative findings (Wear at device polyethylene and endplate.).

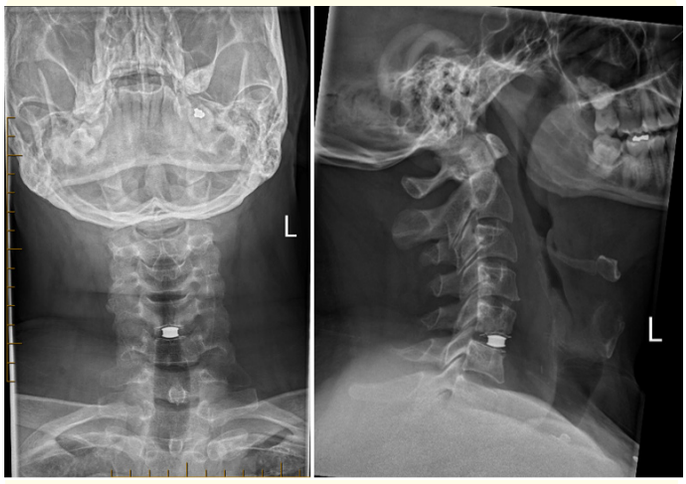

Figure 14: Revision Post – op cervical spine X – ray (17/2/23).

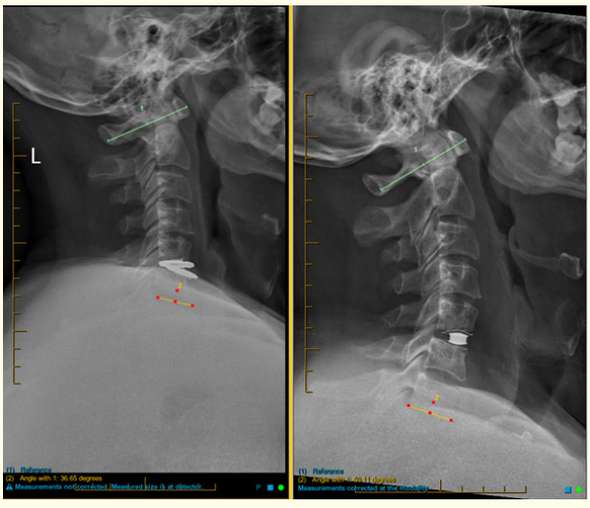

Figure 15: Comparison cervical spine X – ray (17/2/23).

Degenerative disc disease is one of the main causes of cervical radiculopathy and myelopathy. It has been treated traditionally with anterior cervical discectomy and fusion (ACDF) [1]. However, this procedure was not immune from different types of complications, one of the most frequent is adjacent segment disease (ASD). As a result, new techniques such as total disc replacement (TDR) have emerged as an alternative to preserve motion and decrease the risk of ASD [2]. Despite showing good results in the short to long term, it has a number of complications that can occur related to the type of device used [1,2]. Some of them are related to the materials and biomechanics of the devices available [4]. Every device has design limitation and it is critical to select the correct patient to achieve the best result. The purpose of this case report is to demonstrate that not all unconstrained devices are suitable for all patients. There are different factors that must be considered in order to avoid failure [1,2,4].

Disc herniation and degenerative disc disease (DDD) has been surgically treated with ACDF as the gold standard for many years. Nevertheless, evidence suggests that up to 25% of patients have a recurrence of symptoms in a time lapse of ten years after surgery [1,12]. As a result, an alternate technique, such as cervical disc replacement was introduced in 1960 [12]. Its main goals are to preserve motion at the affected disc level and avoid degeneration of the adjacent segments of the cervical spine [1,4,12].

Every device has its own risks. The first generations of cervical TDR were derived on the concept of hip and knee implants based on ball on socket concept. Outcomes were similar and even superior to ACDF [2,4,11,12]. However, their design is highly simplified in regard to the anatomy creating instability in all the environment such as ligaments, muscles, uncovertebral joints and facet joints [11]. Also, devices such as Bryan Disc (Medtronic) or ProDisc (DePuy Synthes Johnson and Johnson) involved damage to the vertebral endplates thus, increasing the risk of heterotopic ossification (HO). This insults into the endplates were due to its design, in which a keel was driven into the endplate before insertion of the device [6,12].

The new generation of implant devices has been improved in many different aspects that are blunt shaped, allowing a smoother implantation of the device to take place and preservation of the endplates [6]. With these new modifications, devices are almost perfect in recreating the physiological movements of the segment [6].

An important aspect of the devices relies on their bearing design in which there are mainly three different types. A constrained device, which possess a stop device within the normal range of motion [2,4]. It allows for greater stability on the facet joint thus, decreasing the shear forces that affect the facet joints [4]. Nevertheless, it requires an excellent surgical technique in order to recreate the natural axis of rotation. On the other hand, the spectrum of unconstrained devices does not have a physical stop in their design, making them more mobile to the expense of stability [2,4,12]. As a result, the shear forces on the facet joint are higher. Last, the semi-constrained devices that possess a physical stop outside the physiological range of motion [4].

Nowadays, more than fifteen different devices are available in the market. Thus, every surgeon faces a very difficult decision regarding which implant is the most adequate one for every single patient.

Discussion

There are many factors that must be taken into consideration when assessing the success of TDR. The prothesis design can influence different anatomic components that conjointly resist shear forces and loads [13]. The implanted segment could undergo greater shear forces depending on the sagittal alignment of the cervical spine and the orientation of the affected segment [7,13].

Another important factor is in the ball – and – socket articulation two component prothesis model, bears more resistance and shear forces that take place in the motion segment [13]. However, devices that possess independent translational degree of freedom (DOF) such as the one provided by a 3-component disc prothesis and 2 – component with a mobile core, have no inherent resistance and it will allow the core to move until its own built -in resistance stops it or until the facet joints act as stop on the implanted segment [13,14].

Also, it is important to note that when a mismatch between the lateral bending and axial rotation axes of the native segment and the prothesis one would cause an abnormal contact ad loading in the facets [14]. This is also seen on the uncinate process due to abnormal coupling therefore, leading to segmental instability [4,13,14].

Several studies have shown that unconstrained multipiece devices such as Mobi – C rely on axial loading and limited range of motion of the disc segment in order to preserve integrity [12-14]. However, it is likely that these types of unconstrained implants are at greater risk of migration when distraction is combined with flex extension. It might be attributed to a combination of COR translation of the mobile core in the Mobi – C device leading to either complete or partial extrusion [14]. In addition, hyperextension could also increase the risk of anterior translation, leading to loosening of the articulation between pieces. As a result, people subject to strenuous activities that involve excessive extension with head mounted gear or an unexpected whiplash injury are at greater risk of developing migration of the device [6,8,13,14]. Avoid it in hypermobile cervical spine.

Another important aspect to consider in cervical TDR is sagittal alignment. Although many studies have shown no significant change in lordosis, it is documented that a mean 4.7º decrease in lordosis is seen in patients who undergo single level disc replacement [10]. Also, it is important to note that overall sagittal alignment was preserved in 86% of cases in final follow up [10,14]. Kulkarni et al. described in his paper evaluating effects of Synergy (Synergy spine solutions Inc) artificial discs in lordosis, where changes resulted in 1º - 3º in extension and 1º in flexion [10].

Other studies support the fact that sagittal alignment parameters such as cervical lordosis were significantly improved except for the SVA [14]. Also, kyphotic segmental alignment was found in patients that developed ASD [14].

Reports have been made that highly active patients after TDR return to unrestricted full activities in 10 weeks post – op. Although trauma is a key factor in causing early failure of the device [15,16]. TDR migration is a rare event making information limited to case reports. The majority of cases are due to trauma [15,16]. However, in the absence of trauma migration of the device is related to wear of the components of the device that occurs many years later [15]. It is also important to take into consideration the integration of the device with the bone – endplate interface, as it occurs in the subacute phase post – op [15].

Conclusion

Motion preservation devices are a new tool in the treatment of degenerative disc disease however, choosing the right implant for every patient is the most important challenge every surgeon must face. In order to achieve success and avoid complications as much as possible, it is paramount to consider some key aspects such as sagittal alignment, stability of the cervical spine and the characteristics of the intended device [10,13,14]; so that, unconstrained 3 – piece devices have a higher risk of migrating in patients that perform high grade activities or involve head mounted gear in every patient before surgery [10-14]. Therefore, keeping these in mind, the correct device can be adequately chosen.

Bibliography

1. Findlay C., *et al*. "Total disc replacement versus anterior cervical discectomy and fusion: a systematic review with meta-analysis of data from a total of 3160 patients across 14 randomized controlled trials with both short- and medium- to long-term outcomes". *The Bone and Joint Journal* 100-B.8 (2018): 991-1001.

2. Leven D., *et al*. "Cervical disc replacement surgery: indications, technique, and technical pearls*". Current Reviews in Musculoskeletal Medicine* 10.2 (2017): 160-169.

3. Lazennec J Y. "Lumbar and cervical viscoelastic disc replacement: Concepts and current experience". *World Journal of Orthopedics* 11.8 (2020): 345-356.

4. Durbhakula M M and Ghiselli G. "Cervical total disc replacement, part I: rationale, biomechanics, and implant types". *The Orthopedic Clinics of North America* 36.3 (2005): 349-354.

5. Epstein NE and Agulnick MA. "Cervical disc arthroplasty (CDA)/total disc replacement (TDR) vs. anterior cervical diskectomy/fusion (ACDF): A review". *Surgical Neurology International* 13 (2022): 565.

6. Onken J., *et al*. "Revision surgery for cervical artificial disc: Surgical technique and clinical results". *Clinical Neurology and Neurosurgery* 152 (2017): 39-44.

7. Di Martino A., *et al*. "Cervical spine alignment in disc arthroplasty: should we change our perspective?". *European Spine Journal : Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* 24 (2015): 810-825.

8. Bertagnoli R., *et al*. "Cervical total disc replacement, part two: clinical results". *The Orthopedic clinics of North America* 36.3 (2005): 355-362.

9. Guyer R D., *et al*. "Early failure of metal-on-metal artificial disc prostheses associated with lymphocytic reaction: diagnosis and treatment experience in four cases". *Spine* 36.7 (2011): E492-E497.

10. Goel V K., *et al*. "Parameters that effect spine biomechanics following cervical disc replacement". *European Spine Journal : Official Publication of the European Spine Society, the European Spinal Deformity Society, and the European Section of the Cervical Spine Research Society* 21.5 (2012): S688-S699.

11. Jacobs C A M., *et al*. "Viscoelastic cervical total disc replacement devices: Design concepts". *The Spine Journal : Official Journal of the North American Spine Society* 20.12 (2020): 1911-1924.

12. Shin J J., *et al*. "Cervical disc arthroplasty: What we know in 2020 and a literature review". J*ournal of Orthopaedic Surgery (Hong Kong)* 29 (2021): 23094990211006934.

13. Patwardhan A G and Havey RM. "Biomechanics of Cervical Disc Arthroplasty-A Review of Concepts and Current Technology". *International Journal of Spine Surgery* 14.s2 (2020): S14-S28.

14. Wang X., *et al*. "Cervical sagittal alignment after Prestige LP cervical disc replacement: radiological results and clinical impacts from a single-center experience". *BMC Musculoskeletal Disorder* 22 (2021): 82.

15. Niu T., *et al*. "Cervical artificial disc extrusion after a paragliding accident". *Surgical Neurology International* 8 (2017): 138.

16. Tumialán LM., *et al*. "Arthroplasty in the military: a preliminary experience with ProDisc-C and ProDisc-L". *Neurosurgical Focus* 28.5 (2010): E18.