



**INNOVATION**  
INNOVATE / INVOLVE / INVENT



**8TH ANNUAL  
SPINE SURGERY  
SYMPOSIUM**

Feb 21-24    The Montage Resort  
Deer Valley, Utah



**ACDF vs Cervical Disc Replacement**  
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Fusion  
VS



Arthroplasty



## Rationale for Cervical TDR:

- favorably alter the natural history of motion segments adjacent to the operative level
- enhance postoperative recovery
  - avoid brace immobilization
  - permit earlier return to activity
- avoid negatives of ACDF
  - pseudarthrosis
  - plate related complications
  - adjacent segment disease



# Radiculopathy and Myelopathy at Segments Adjacent to the Site of a Previous Anterior Cervical Arthrodesis\*

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Case Western Reserve University School of Medicine, Cleveland*

Hilibrand et al. JBJS 1999

2.9% per year incidence of  
Adjacent Segment Disease (ASD)  
after ACDF



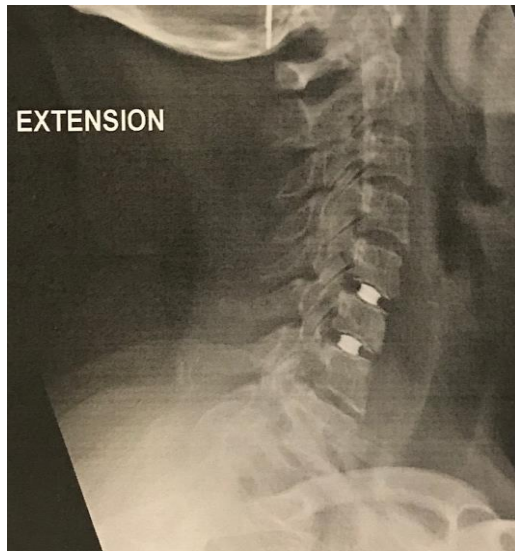




Currently available artificial cervical disc in USA. (A) Prodisc-C, Synthes® (B) Prestige LP, Medtronic® (C) MobiC, LDR Medica® (D) Discover, DePuy® (E) M6, Spinal Kinetics® (F) ActivC, Aesculap® (G) Discovery, Scient'X® (H) Bryan, Medtronic®.

## Effect of Two-Level Total Disc Replacement on Cervical Spine Kinematics

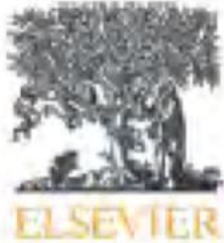
Frank M. Phillips, MD,\* Michael N. Tzermiadianos, MD,† Leonard I. Voronov, MD, PhD,††  
Robert M. Havey, BS,‡ Gerard Carandang, MS,‡ Andrew Dooris, PhD,§  
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Phillips et al. Spine 2009  
Two level TDR preserves near normal  
motion at operated AND adjacent levels

2012

Clinical Biomechanics 27 (2012) 226–233



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journal homepage: [www.elsevier.com/locate/clinbiomech](http://www.elsevier.com/locate/clinbiomech)



Adjacent level effects of bi level disc replacement, bi level fusion and disc replacement plus fusion in cervical spine- a finite element based study

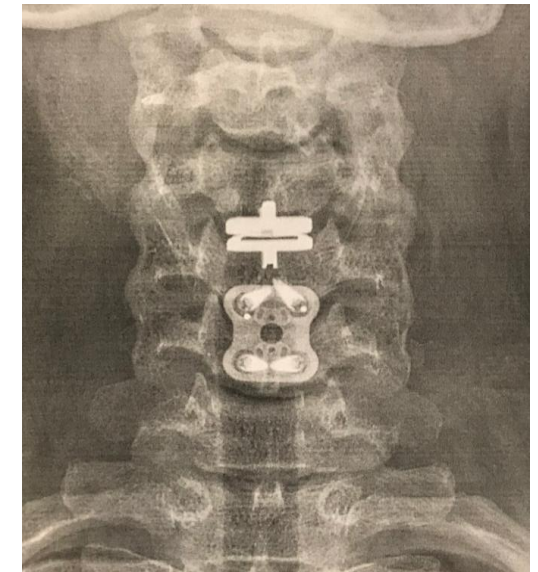
Ahmad Faizan <sup>a</sup>, Vijay K. Goel <sup>a,\*</sup>, Ashok Biyani <sup>a</sup>, Steven R. Garfin <sup>b</sup>, Christopher M. Bono <sup>c</sup>

Faizan et al. two level ACDF vs TDR vs Hybrid

ACDF alters Kinematics

TDR similar to intact spine

Hybrid preserves more motion than 2 level ACDF







## Prospective, randomized multicenter study of cervical arthroplasty versus anterior cervical discectomy and fusion: 5-year results with a metal-on-metal artificial disc

Domagoj Coric, MD,<sup>1</sup> Richard D. Guyer, MD,<sup>2</sup> Pierce D. Nunley, MD,<sup>3</sup> David Musante, MD,<sup>4</sup> Cameron Carmody, MD,<sup>5</sup> Charles Gordon, MD,<sup>6</sup> Carl Laurysen, MD,<sup>7</sup> Margaret O. Boltes, RN,<sup>1</sup> and Donna D. Ohnmeiss, DrMed<sup>8</sup>

Coric et al. J Neurosurg Spine 2018

One level ACDF vs TDR

5 year results (TDR n=136, ACDF n=133)

NDI and VAS significantly improved both groups



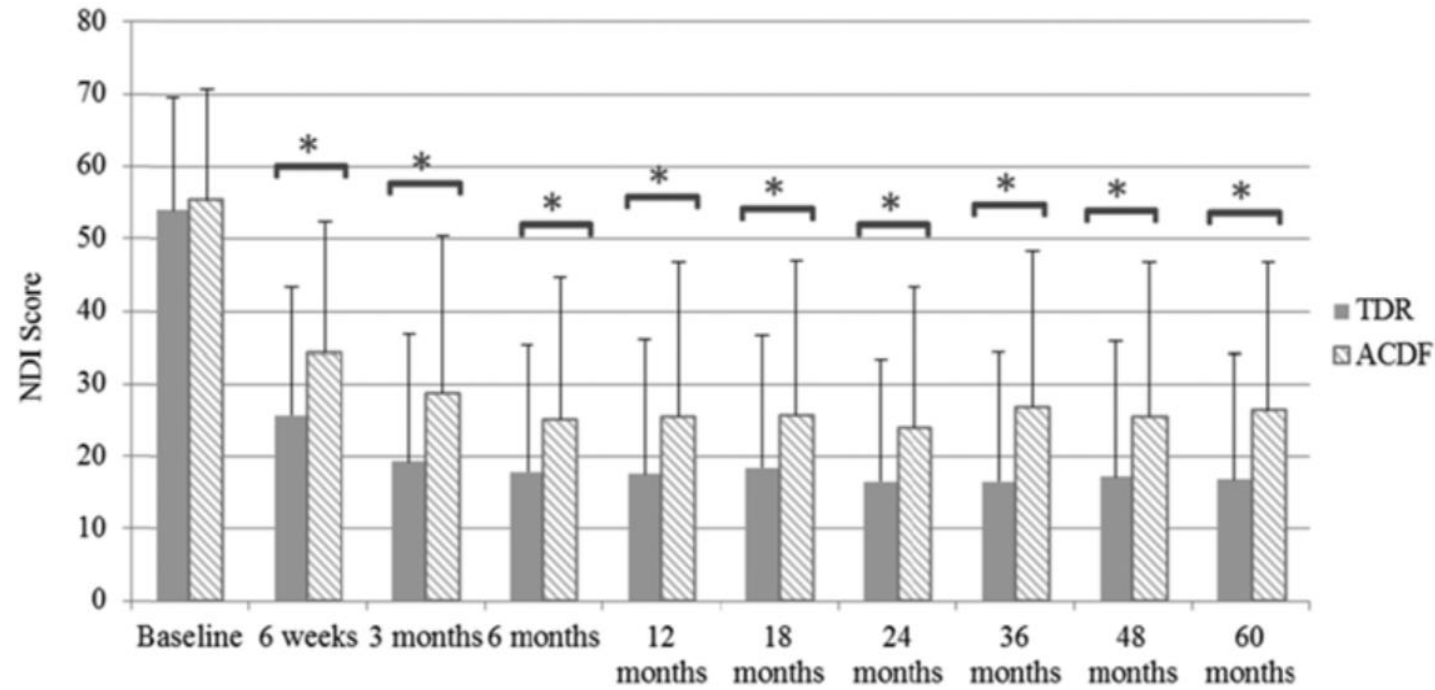


## Five-year clinical results of cervical total disc replacement compared with anterior discectomy and fusion for treatment of 2-level symptomatic degenerative disc disease: a prospective, randomized, controlled, multicenter investigational device exemption clinical trial

Kris Radcliff, MD,<sup>1</sup> Domagoj Coric, MD,<sup>2</sup> and Todd Albert, MD<sup>3</sup>

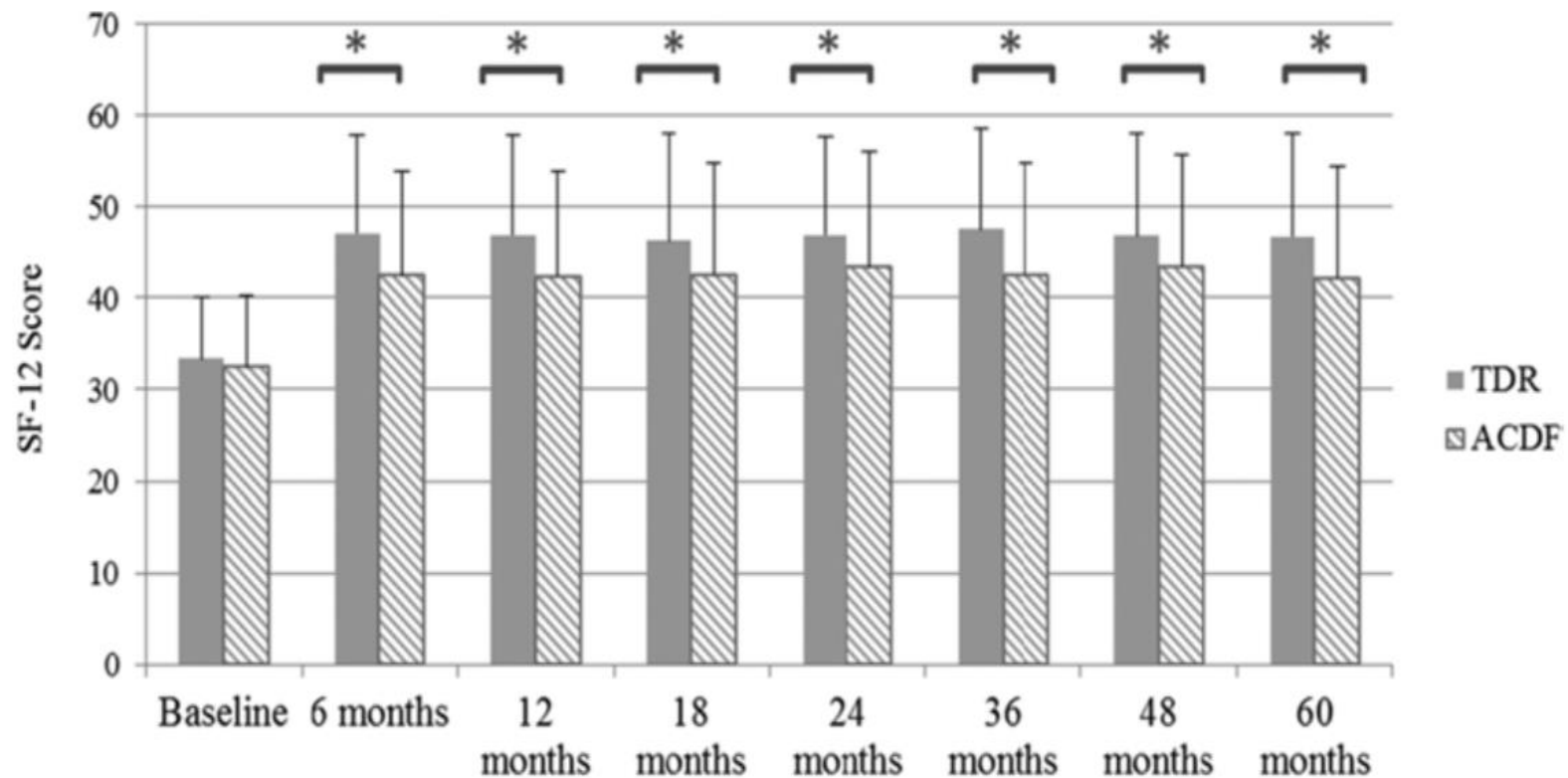
Radcliff et al. J Neurosurg Spine 2016

Two level ACDF vs TDR, 5 year results  
ACDF n=105, TDR n=225  
TDR superior outcomes



**FIG. 2.** Mean NDI score by time point. *Error bars* represent standard deviations. Both groups improved significantly at each time point compared with baseline. \*Unpaired t-test to compare change from baseline between groups,  $p < 0.05$ .

2 level TDR greater improvement in Neck Disability Index (NDI) vs ACDF at all time points

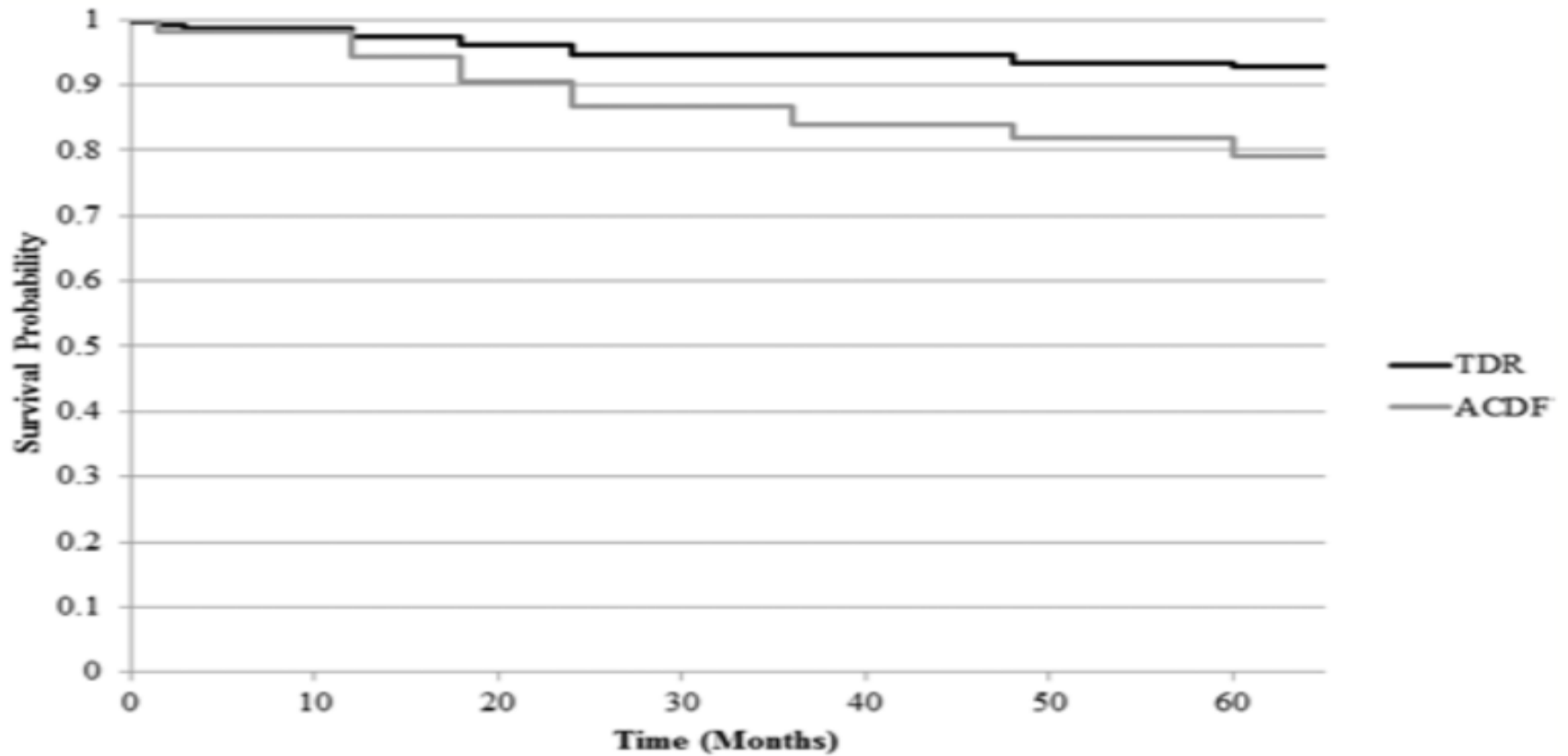
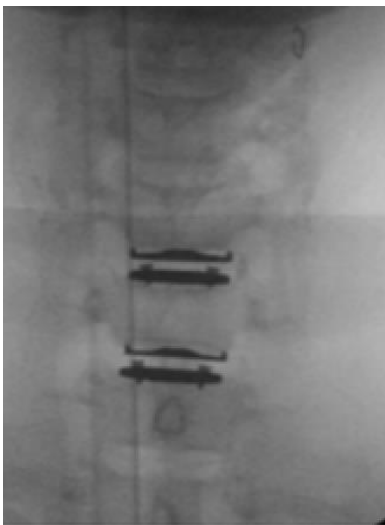


**FIG. 3.** Mean SF-12 PCS score by time point. *Error bars* represent standard deviations. Both groups improved significantly at each time point compared with baseline. \*Unpaired t-test to compare change from baseline between groups,  $p < 0.05$ .

J Neurosurg Spine Volume 25 • August 2016

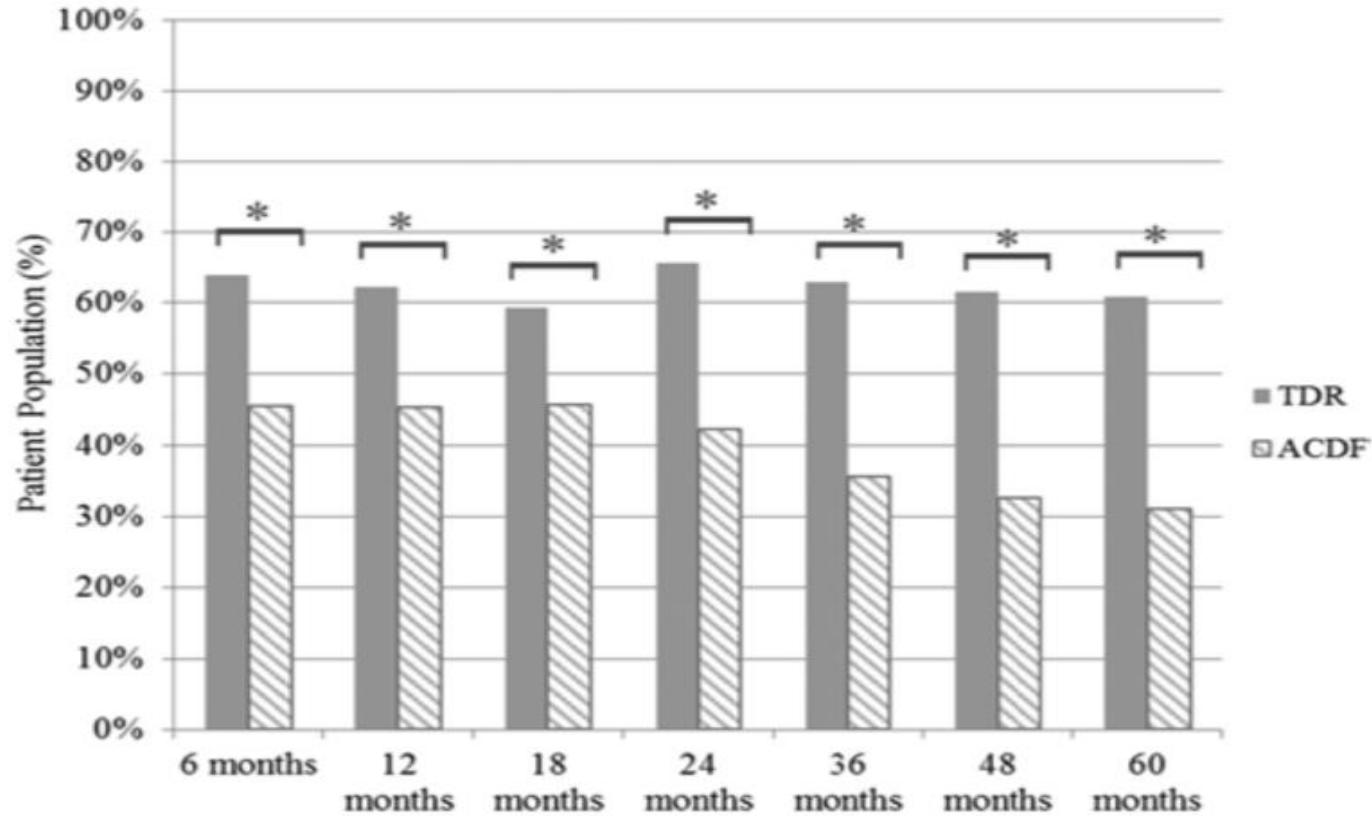
2 level TDR greater improvement in SF-12  
Physical Component Summary vs ACDF  
at all time points





**FIG. 4.** Kaplan-Meier survival functions for subsequent surgical interventions in ACDF and TDR patients. TDR patients demonstrate a significantly different survival function than ACDF patients for subsequent surgical intervention through 60 months ( $p = 0.0002$ , log-rank test).

**Lower TDR reoperation rates vs ACDF**  
at **index** level (4.3% vs 16.2%)  
and **adjacent** levels (3.1% vs 11.4%)



**FIG. 5.** Overall success through 60 months. Superiority of TDR over ACDF ( $p < 0.025$ ).

Overall success rate at 5 years:

TDR 61% ACDF 31%

(Meets non-inferiority AND superiority criteria)



## Contraindications of cervical TDR

- significant **facet** joint degeneration
- spinal **instability**
- deformity**
- severe **spondylosis**
- malignancy**
- infection**
- OPLL**
- rheumatoid arthritis (**RA**)
- osteopenia** (chronic steroid use, etc)

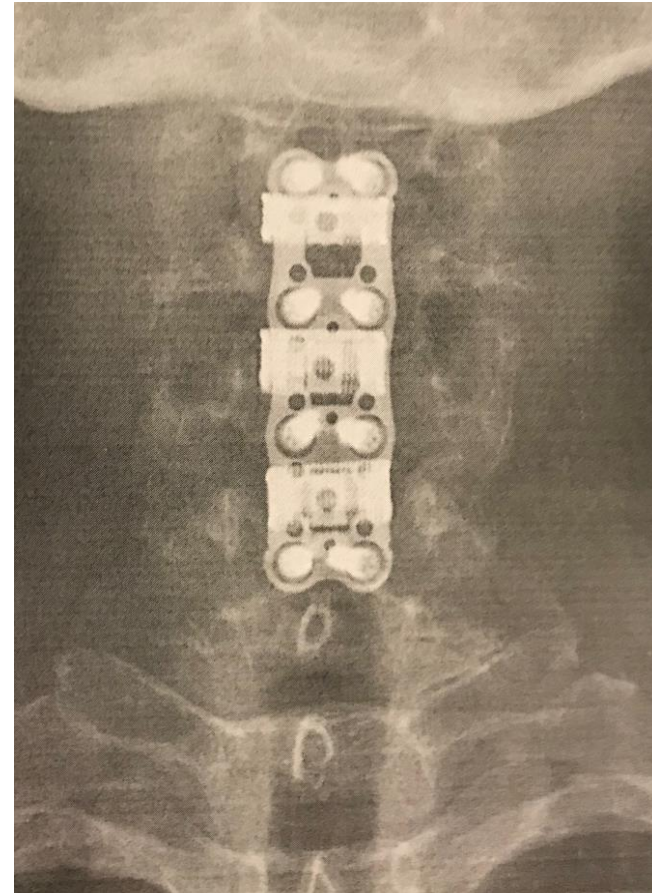




## 45yo female teacher

- chronic neck pain
- bilateral radiculopathy
- failed PT/NSAIDS/injections
  
- PE: 4+/5 bilateral biceps
  
- kyphotic** deformity
- HNP C3-4,C4-5,C5-6





3 level ACDF

## 25 yo male laborer

- wrestling with friend
- heard a “pop”
- acute neck pain x 2 weeks
- right upper extremity  
**weakness & numbness**
  
- 4/5 triceps on exam
- decreased sensation C7**
- mild posterior tenderness







CT: C6-7 widened  
interspinous distance



Flexion view  
increased kyphosis



ACDF C6-7

## 47yo male dentist

- difficulty working x 6-9 months
- worsening numbness & weakness into dominant left upper extremity
- failed PT/NSAIDS/injections

PE: 4/5 left wrist ext & triceps  
decreased sensation left C6







2 level TDR  
C5-6 & C6-7



# Complications of TDR

- subsidence, migration, kyphosis,
- heterotopic ossification

Anderson et al. 2017 Global Spine J  
**Meta-Analysis** of all 8 FDA approved TDR  
3027 randomized (ACDF 1377, TDR 1652)  
ACDF **neurologic relative risk 1.62**  
ACDF **2<sup>nd</sup> surgery relative risk 1.79**  
(Statistically significant  $p < .05$ )



## Meta-analysis:

*Konig et al. 2016 Neurosurg*

*Zou et al. 2017 European Spine Journal*

*Xu et al. 2017 Nature*

## TDR vs ACDF

- greater improvement in **NDI**
- improved **functional outcomes**
- less secondary surgery (**index & adjacent**)

## 48yo male bus driver

- progressive neck pain x 3 years
- bilateral upper extremity weakness  
x 9 months
- failed PT/NSAIDS/injections

PE: -weak bilat wrist extension (4+/5)  
-decreased sensation bilat C6





**Hybrid procedure**  
C6-7 ACDF and C5-6 TDR  
(LDR Mobi-C)



## 52yo female accountant

- worsening bilateral radicular pain
- mild chronic neck pain
- failed conservative treatment

PE: -decreased sensation C6 & C7  
-strength intact





**2 level TDR**  
C5-6 & C6-7

## 49yo female nurse

- chronic neck pain
- worsening bilateral radicular symptoms
- failed PT, NSAIDS, injections

PE: -decreased sensation C6 & C7  
-strength intact  
-loss of ROM





TDR C3-4 (Prodisc-C)  
ACDF C5-6 and C6-7



## 42yo female lab tech

- worsening neck pain and bilateral radicular symptoms x 3 years
- failed PT, NSAIDS
- multiple series of epidurals

PE: decreased sensation Bilat C6

2017 MRI vs 2018 MRI & X-rays





ACDF C5-6  
TDR C4-5 & C6-7