Quality and Quantity of Motion of a Mobile Axis of Rotation Polycrystalline Diamond Cervical Disc Prosthesis after 1- and 2-level Arthroplasty

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Cervical Total Disc Arthroplasty- Background

- ACDF is associated with Adjacent Segment Degeneration (ASD)
- Cervical TDA has been developed to prevent ASD
- Some arthroplasty designs have been linked to facet degeneration possibly due to a center of rotation (COR) mismatch with the native segment
- Cervical TDA using a disc with a mobile axis of rotation may better accommodate the unique COR of implanted segments

Purpose

To assess the effect of a mobile axis of rotation TDA on the COR of cervical motion segments during flexion-extension (FE).

Triadyme-C,

Tri-lobed Polycrystaline Diamond Arthroplasty

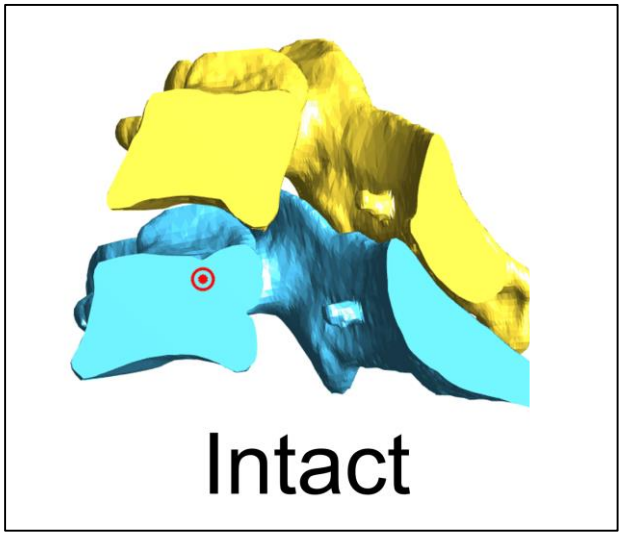
Dymicron Inc.

Materials & Methods

- 9 cadaveric C3-T1 spine specimens (38.3±5.8 years)
- Continuous cycling in FE ±1.5 Nm
- Compressive preloads (0N, 150N)
- Vertebral motion was measured using optoelectronic measurement
- Six-axis load cell measured applied forces
- TDA implantation was performed consistent with company guidelines

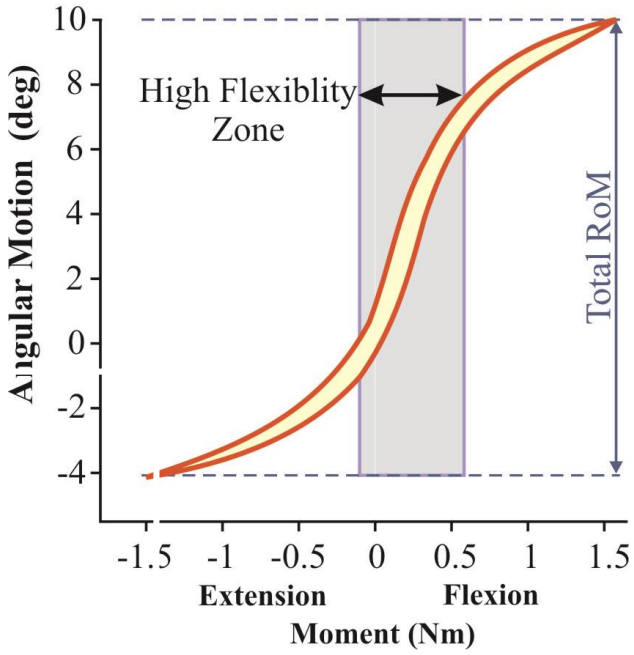
Materials & Methods

- Specimen-specific 3D CT based kinematic technology was used to locate the segmental COR for the implanted motion segments.



- COR was measured between the start of the high flexibility zone (HFZ) in extension, to its end point in flexion.

Average HFZ:
-0.1Nm extension to 0.65Nm flexion

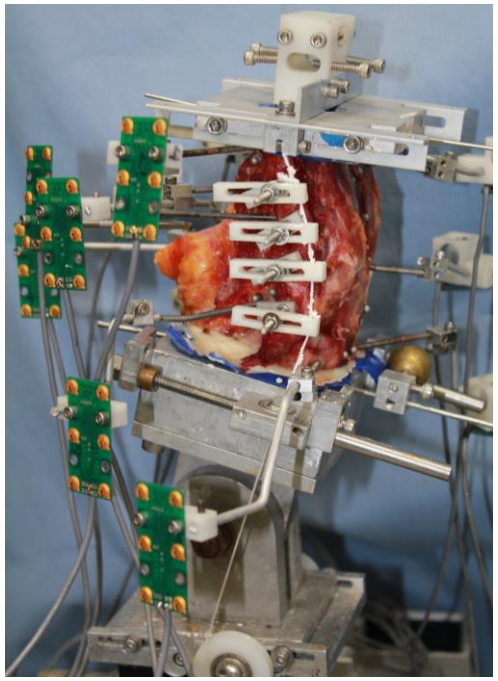


Materials & Methods

Experimental protocol:

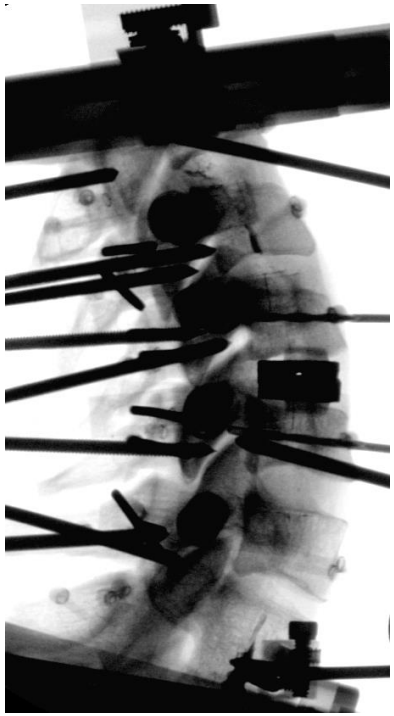
- Intact
- C5-C6 TDA (n=9)
- C6-C7 TDA (n=7)

ANOVA was used for statistical analyses, significance: $p<0.05$

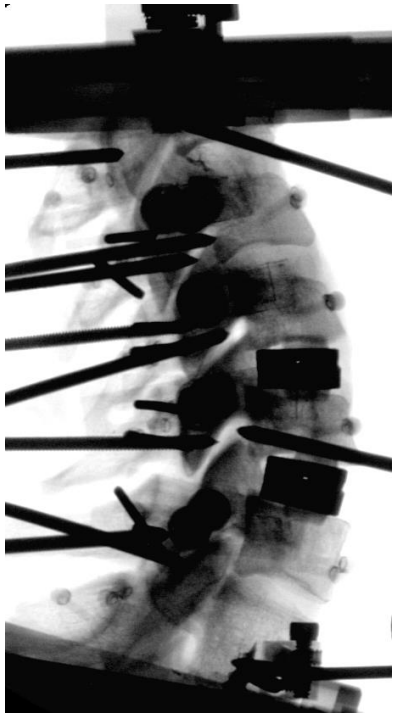


Cervical spine set-up showing intact specimen

Intact

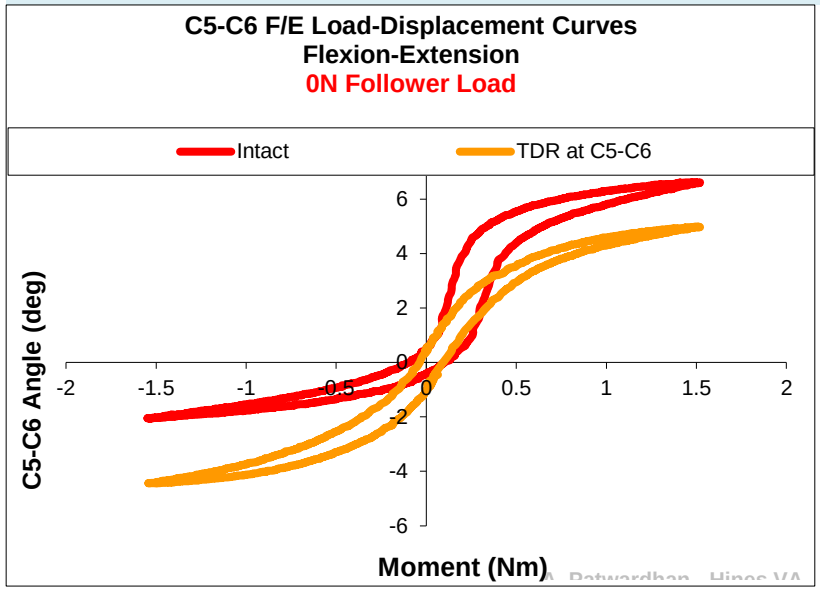


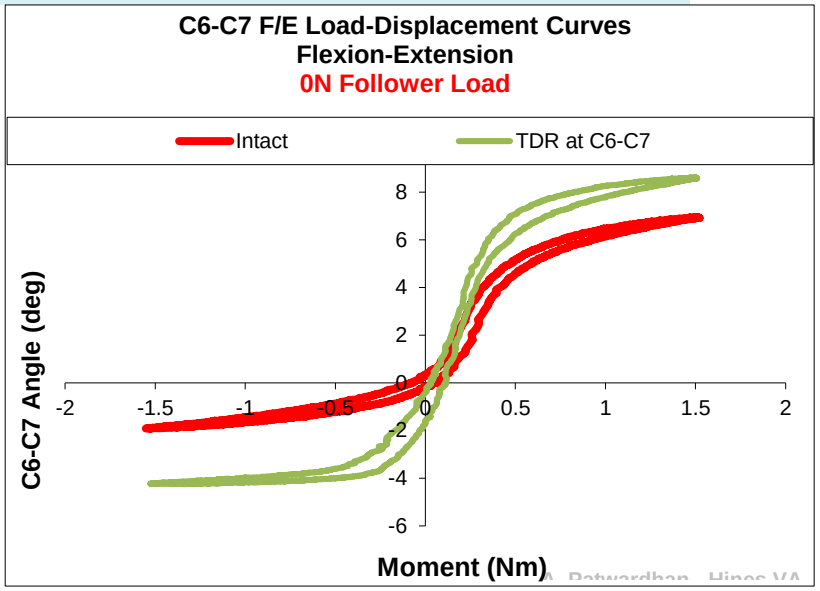
C5-C6 TDA

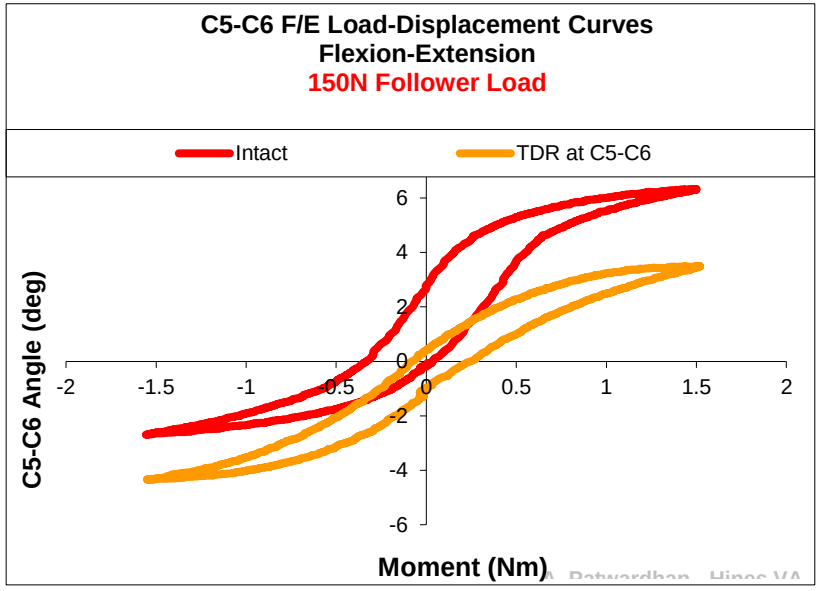


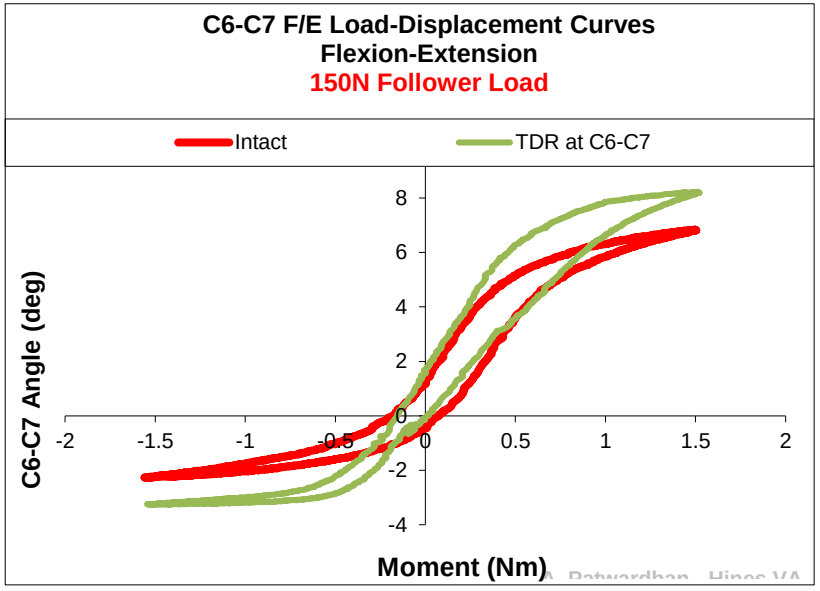
C5-C6 & C6-C7 TDA

Results


C5-C6 F/E Load-Displacement Curves
Flexion-Extension
0N Follower Load
Intact
TDR at C5-C6
C5-C6 Angle (deg)
Moment (Nm)


C6-C7 F/E Load-Displacement Curves
Flexion-Extension
0N Follower Load
Intact
TDR at C6-C7
C6-C7 Angle (deg)
Moment (Nm)


C5-C6 F/E Load-Displacement Curves
Flexion-Extension
150N Follower Load
Intact
TDR at C5-C6
C5-C6 Angle (deg)
Moment (Nm)

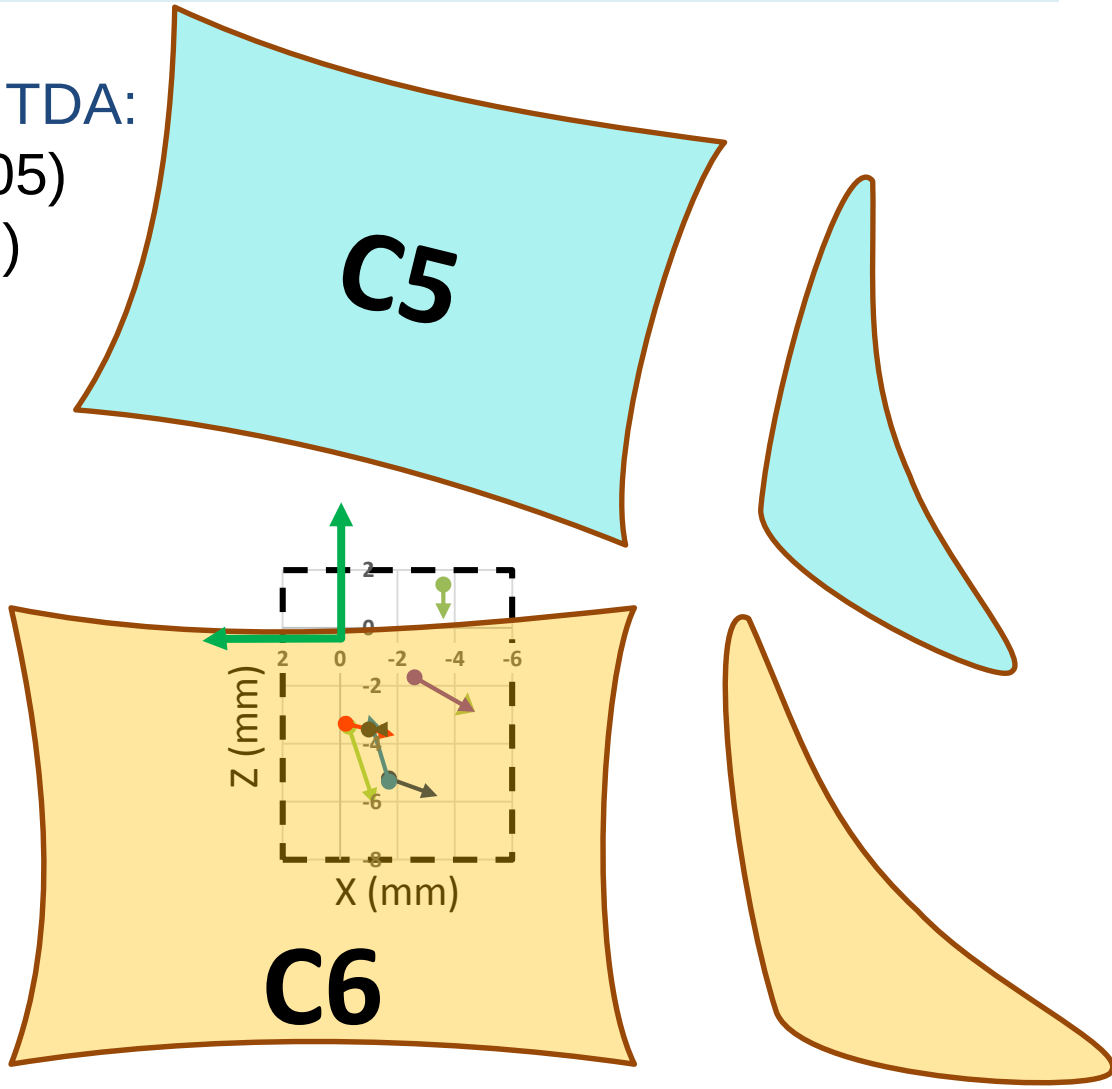

C6-C7 F/E Load-Displacement Curves
Flexion-Extension
150N Follower Load
Intact
TDR at C6-C7
C6-C7 Angle (deg)
Moment (Nm)

Results: C5-C6 FE/ High Flexibility Zone COR (n=9)

C5-C6 change in COR after TDA:

1.0±1.1mm posterior ($p<0.05$)

0.6±1.4mm caudally ($p=0.3$)

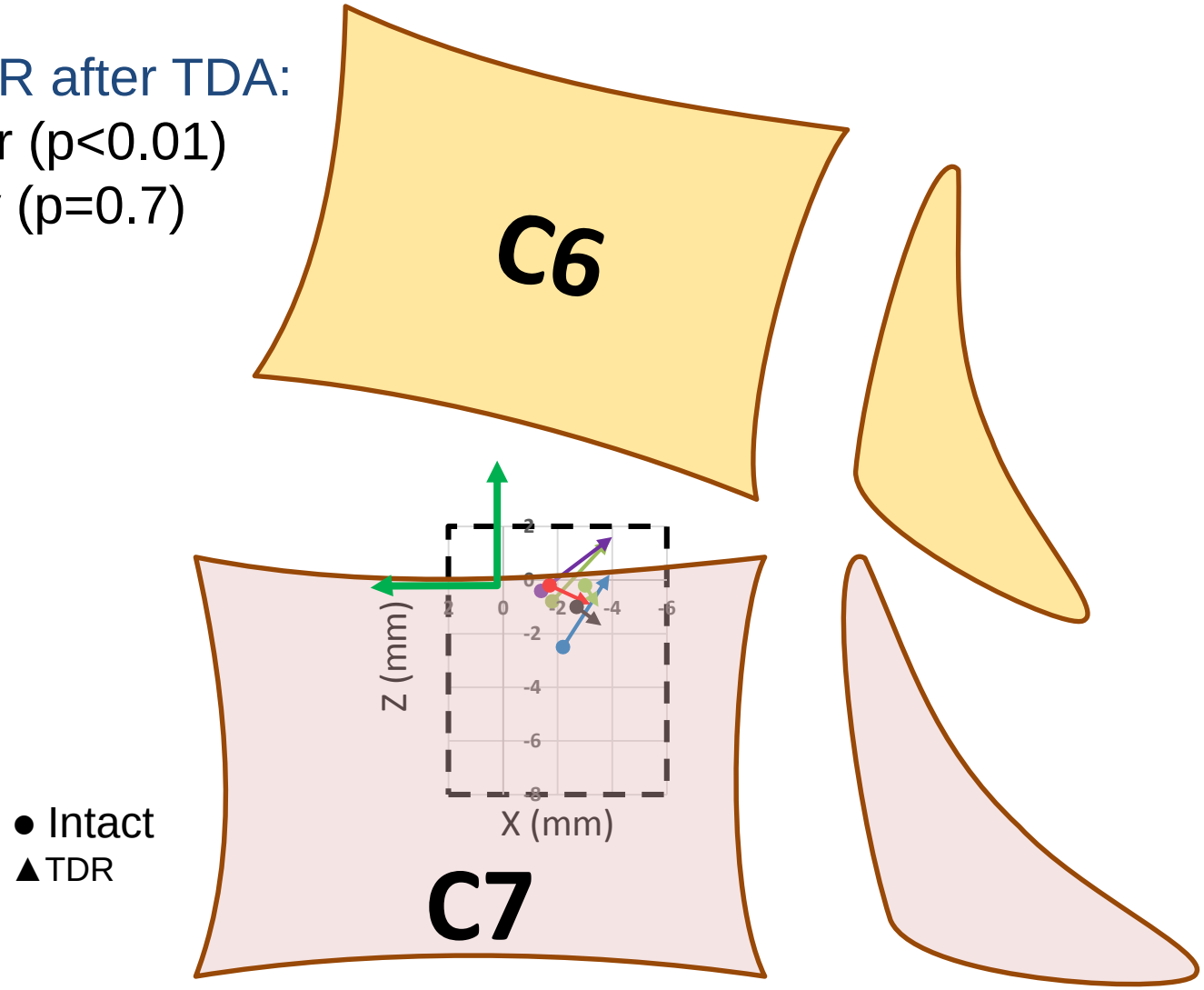


Results: C6-C7 FE/ High Flexibility Zone COR (n=7)

C6-C7 change in COR after TDA:

1.4±0.8mm posterior (p<0.01)

0.3±2.0mm cranially (p=0.7)



Conclusions

- Each motion segment has a unique COR defined by bony and soft tissue anatomy as well as posture.
- Fixed COR TDA designs force a static non-physiologic COR upon implanted motion segments which may cause abnormal quantity and quality of motion resulting in altered facet loading and degeneration.
- Activities of daily living occur primarily in the HFZ making traditional measures of COR from full extension to full flexion inaccurate. (Facet hinging, lift off, soft tissue tension).

Conclusions

- A new COR measure has been presented to measure COR in the high flexibility zone where it is less affected by the facets and tensioned soft tissues.

- The investigated TDA allowed individual motion segments (C5-C6 & C6-C7) to maintain their HFZ-COR position within:

  1.2±1.0mm (p=0.00) in the A-P direction and 0.2±1.7mm (p=0.70) in the cranial-caudal direction

- This novel tri-lobed TDA design effectively replicates COR at both operated levels.

Disclosures

Leonard Voronov: Nothing to disclose

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Thank you!

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