“Management of Adjacent Segment Disease- ACDF vs. Arthroplasty”
Cervical Spine Research Society 20th Instructional Course

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I. BACKGROUND
A. Adjacent segment disease risk (Hilibrand et al, JBJS 1999) Evaluated risk of adjacent segment disease becoming symptomatic with single level ACDF vs multilevel. Kaplan-Meier survivorship analysis - 25.6% chance of symptomatic ASD requiring surgery at 10 years. Therefore, recommended fusion for all degenerative segments causing radiculopathy/myelopathy.
B. Adjacent segment disease – biomechanics (Eck et al, Spine 2002). Demonstrated increased intradiscal pressures and segmental ROM adjacent to simulated fusion. Potential increased risk - ASD adjacent to fusion
C. Adjacent segment disease – does disc replacement decrease it?
   1. (Nunley et al, Spine 2012) Local results – 3 prospective, randomized series. At 2-4 years follow-up, no difference between fusion and arthroplasty for symptomatic ASD. Only predictive factor for cervical ASD – concurrent lumbar degenerative disc disease.
   3. (Kelly et al, Spine 2011) ROM after one level TDR vs. ACDF. Flexion/ extension x-rays- no difference in kinematics

II. BIOMECHANICS
A. Disc replacement adjacent to fusion (Lee et al, Spine 2011) PCM disc replacement. Prosthesis biomechanics not adversely affected adjacent to fusion.
B. Biomechanical analysis of disc replacement and fusion using one, two-level and hybrid constructs. Cadaveric using Bryan, Prestige LP TDR. (Ghandi et al, Spine 2015)
   1. TDR preserved motion at implanted level and maintained normal motion at non-operative level.
   2. Fusion-increased ROM at non-fused levels
   3. Fusion + TDR construct – TDR adjacent to fusion preserved motion at arthroplasty level.
   4. Moment to achieve intact motion increased in hybrid construct, more than doubled for two level fusion
D. Biomechanical analysis of disc pressure fact contact – 2 level TDR vs ACDF, hybrid (Park et al – ahead of print) Two-level TDR, hybrid decreased adjacent disc pressure/ facet contact compared to ACDF.

III. CLINICAL

A. TDR adjacent to fusion (Phillips et al, Spine 2009) 126 one level TDR, 26 one level TDR adjacent to fusion. No difference in outcomes, 2 revisions each group.

B. 2 level TDR
   1. TDR versus ACDF
      a. (Davis et al, J Neurosurg Spine, 2015) Mobi-C TDR prospective, randomized. TDR superior clinically at most time points. Reoperations: ACDF: 11.4%, TDR: 3%
      b. (Fay et al, Eur Spine J 2014) No difference clinically nor secondary surgery in either group – 3 year follow-up
      c. Cost effectiveness 2 level TDR vs. fusion (Ament et al, JAMA 2014) TDR- faster recovery, $50K/ QALY
      d. (Davis et al, J Neurosurg Spine 2013) 2 level TDR vs ACDF. ACDF higher ASD. Revision at index – 4% TDR, 15% ACDF. Clinically relevant HO: 25%

   2. Single / multilevel TDR vs single/ multilevel ACDF
      a. (Kim et al, Eur Spine J 2007) Clinical results equal. Radiographic ASD 3.5 times in ACDF.
      b. (Alvin and Mroz, Medical Devices: Evidence and Research 2014) – Literature review. 2-level TDR may be superior to 2-level ACDF.

   3. Single vs multilevel TDR
      a. (Pimenta et al, Spine 2007) 229 patients. 69 patients had a multilevel TDR. No difference – reoperations between single, multilevel TDR
      b. (Huppert et al, Eur Spine J 2011) No clinical difference single vs. multilevel TDR. Multilevel TDR- analgesic use higher, HO lower

C. Hybrid procedures (TDR +ACDF)
   1. Hybrid procedures vs. vs. ACDF for multilevel disease
      a. (Jia et al, Eur Spine J 2014) ACDF lead to statistically significantly higher adjacent level ROM compared to hybrid
      b. (Cardoso et al, J Neurosurg Spine 2011) Safety of 2-3 level hybrid surgery. No implant failures TDR, ACDF.
      c. (Hey et al, Eur Spine J 2013) No difference- outcomes, ROM
      d. (Kang et al, Orthopedics 2013) 3-level hybrid vs. 3-level ACDF, no clinical difference, hybrid regained pre-op ROM.
      e. (Lee et al, J Korean Neurosurgical Society 2012) 51 patients, 2 and 3-level hybrid procedures. No surgery related complications, H.O., etc.
      f. (Barbagallo et al, Eur Spine J 2009) Selection criteria for TDR vs ACDF.
         1) type of degenerative disc disease
            a) soft HNP- TDR preferred
            b) spondylosis – determined by flexion / extension angular motion. <3 degrees- ACDF preferred
2) degree of spondylotic vertebral body/facet joint degeneration. NO advanced vertebral body nor facet joint degeneration – TDR preferred

3) amount of bone removal to decompress neural structures. Significant drilling increases risk of HO- ACDF preferred

4) shape of inferior endplate of cranial vertebra. Extensive endplate removal increases risk- device subsidence/ split fractures- ACDF preferred

5) presence of adjacent degenerated discs not needing surgery at index procedure – TDR preferred.

REFERENCES


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