

Zigler J, Delamarter R, et al. Results of the Prospective, Randomized, Multicenter Food and Drug Administration Investigational Device Exemption Study of the ProDisc-L Total Disc Replacement Versus Circumferential Fusion for the Treatment of 1-Level Degenerative Disc Disease. Spine 2007;32:1155-1162.

Design: Randomized clinical noninferiority FDA Investigational Device Exemption (IDE) trial

Population/sample size/setting:

- 236 patients (116 men, 120 women, mean age 39) treated for degenerative disc disease (DDD) of the lumbar spine as part of an FDA IDE study of a lumbar disc prosthesis
- Inclusion criteria were back and/or leg (radicular) pain with radiographic confirmation either (1) instability with ≥ 3 mm translation or $> 5^\circ$ angulation, (2) loss of disc height of > 2 mm, (3) scarring/thickening of the anulus fibrosis, (4) herniated nucleus pulposus, (5) vacuum phenomenon; other criteria were Oswestry score ≥ 40 , failure of at least 6 months of conservative therapy, ability to adhere to protocol, and written informed consent
- Exclusion criteria were having DDD at more than 1 level, vertebral endplates too small for the artificial disc, allergy to disc components, prior fusion at any vertebral level, compromised vertebral bodies at the affected level due to trauma, radiographic facet joint disease or degeneration, lytic spondylolisthesis or spinal stenosis, osteoporosis with DEXA ≤ 205 , back or leg pain of unknown etiology, metabolic bone disease, pregnancy, BMI > 40 , use of drugs which may inhibit bone or soft tissue healing (such as steroids), and several systemic or autoimmune diseases

Main outcome measures:

- Randomized in a 2:1 ratio to either ProDisc-L (n=161) or circumferential fusion (n=75)
- Outcomes were measured before surgery and again at 6 weeks, 3, 6, 12, 18, and 24 months
- At each follow-up visit, clinical evaluation included the Oswestry, the SF-36, pain VAS, patient satisfaction on a 10 point VAS, physical examination and radiographic evaluation
 - o These included range of motion, root tension signs, reflexes, muscle strength, and sensory deficits
 - o Imaging included AP and lateral, flexion-extension, and coronal right and left lateral bending films
- Overall success was defined by 10 primary endpoints: 1 for the Oswestry, 1 for the SF-36, 1 for device success, 6 for radiographic success, and 1 for neurologic success
 - o Rate of success was defined as the percentage of patients meeting criteria for all 10 endpoints
 - o “Device success” meant that no reoperation was required during the study period
 - o “Neurologic success” meant the maintenance or improvement of sensory, motor, and reflex functions, and a straight leg test

- The FDA required additional analyses to be done using different criteria for success besides those of the sponsor; both success rates were reported and favored the disc implant group over the circumferential fusion group at 24 months
 - o By the sponsor's definition, overall success on all 10 criteria was achieved by 63.5% of the disc arthroplasty group and by 45.1% of the fusion groups
 - o By the FDA definition, overall success rate was 53.4% in the disc arthroplasty group and 40.8% of the fusion group
- One of the components of overall success, restoration of normal motion in the operated segment, was met by 64% of disc implant patients, averaging 7.7° at 24 months
- At 24 months, the pain VAS scores had improved about equally (by 39 points in the disc implant group and by 32 points in the fusion group)
- At 24 months, patient satisfaction was higher and willingness to have the same operation again was greater in the disc implant than in the fusion group
- At 24 months, 92.4% of the disc implant group and 85.1% of the fusion group were employed
- Narcotic usage decreased from 76% to 31% in the disc implant group and from 84% to 39% in the fusion group
 - o This applies only to the "success" groups; the "failure" groups maintained narcotic use of 76% and 79%
- No major complications were reported in the study, but there were 2 infections in the fusion group and none in the disc implant group

Authors' conclusions:

- Compared to circumferential fusion, the lumbar disc implant results in greater overall success with greater range of motion in the operated segment, greater patient satisfaction, and greater willingness to have the procedure again
- The ProDisc-L is safe and effective for single level lumbar DDD

Comments:

- There are small discrepancies in the text regarding the 24 month success criteria
 - o On p 1158, the success rates for the ODI $\geq 15\%$ for the disc and fusion groups are 77.2% and 64.8%, but on p 1159 the rates are 67.8% and 54.9%, about 10% less for each group
 - o Similarly, it is not clear whether the 15% Oswestry improvement was that of the sponsor or the FDA
 - A Freedom of Information request has been sent to the FDA to disclose the study protocol, which is not posted on the FDA website
- The time frame for the narcotic use is 24 months, and for the supposedly "successful" patients with the disc implant, remained at 31%; meaning that nearly one third of all treatment "successes" still took narcotic analgesics 2 years after the intervention, which is less than the 39% of fusion patients, but still quite high
- There is some potential for bias on some of the success measures which required the judgment of a clinician and which were not blinded; the neurological examinations and the radiographic evaluations involve elements of judgment, and in an industry-sponsored trial, may have been influenced by knowledge of treatment group

- The evidence for non-inferiority appears to remain convincing in spite of potential biases; the evidence for superiority is less convincing but may be valid

Assessment: High quality for good evidence of non-inferiority of the lumbar disc prosthesis compared to circumferential fusion; high quality for good evidence of preservation of segmental motion compared to circumferential fusion; adequate for some evidence of superior function of the lumbar disc implant compared to fusion; however, the use of narcotics remains high even two years after a successful operation