pro**disc**® Clinical Studies

Overview

- pro**disc** is the most studied artificial disc, with over 540 published studies[i].
- Investigational Device Exemption (IDE) studies were used to gain FDA approval for both pro**disc** L[ii] and pro**disc** C[iii].
- Long-term results have been published on both pro**disc** L[iv] and pro**disc** C[v] with both studies showing all outcome measures with pro**disc** either superior or equivalent to fusion

pro**disc L**

- An IDE study was conducted to evaluate the safety and effectiveness of the pro**disc** L compared to circumferential spinal fusion surgery for the treatment of discogenic pain associated with degenerative disc disease at **two levels** between L3 and S1[ii]
- The study design used:
  - 17 centers, 236 patients - 161 pro**disc** L patients, 75 fusion patients
  - Single level treatment (L3 to S1), 2:1 randomization (2 pro**disc** L : 1 fusion)
  - Follow-up at 6 weeks, and 3, 6, 12, 24, 60 months
- Two-Level 60 Month Study[iv] Findings:
  - 9.6% of subjects underwent a secondary surgery in this study
  - The percentage of subjects undergoing secondary surgeries was significantly lower in the pro**disc** L group versus fusion (5.6% vs. 19.1%, P=0.0027)
  - Most secondary surgeries (65%, 17/26) occurred at the index levels; more common in the fusion cohort (16.2%) versus pro**disc** L (3.1%, 5/161, P=0.00009)
  - The most common reason for index level reoperation was instrumentation removal (n=9)
  - Excluding instrumentation removals, there was not a significant difference between the treatments in index level reoperations or in reoperations overall – the results were indicative that lumbar TDR with pro**disc** L was noninferior to fusion
- An IDE study[ii] was conducted to evaluate the safety and effectiveness of the pro**disc** L compared to circumferential spinal fusion surgery for the treatment of discogenic pain associated with degenerative disc disease at **one level** between L3 and S1
- The study design used:
  - 17 centers, 292 patients - 162 pro**disc** L patients, 80 fusion patients
  - Single level treatment (L3 to S1), 2:1 randomization (2 pro**disc** L : 1 fusion)
  - Follow-up at 6 weeks, and 3, 6, 12, 24, 60 months
  - Patient satisfaction among all patients at 5 years was 77%; the percentage of pro**disc** L patients indicating that they would have the surgery again was 82.5%

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- Over 80% of pro**disc** L patients experienced improvements in recreational status that were maintained 5 years after they received the pro**disc** L
- pro**disc** L patients were 3x less likely to newly develop adjacent level disease than fusion patients
- pro**disc** L patients were 2x less likely to require an adjacent level surgery than fusion patients

• Long-Term (5-10 Year) Follow-up Study (One and Two Level Procedures)[vi]:
- Only 2.2% of patients had adjacent level reoperations in an average follow-up of 7.4 years compared to 18%-35% reported in similar time points for fusion patients in other studies

• Long-Term Follow-up Study (Two Level Disc Replacement vs Hybrid)[vii]:
- After a minimum of 24 months follow-up, the two-level pro**disc** L TDR demonstrated superiority in absolute lumbar mobility and pelvic motion
- The hybrid construct demonstrated an overall lack of compensation in lumbar mobility and pelvic motion as compared to the two-level lumbar TDR
- Although measures of activity and pain were equivalent between the study groups, the two-level TDR also demonstrated functional superiority versus the hybrid construct

pro**disc** L two-level clinical study[viii]:
- Patients undergoing 2-level TDR improved significantly postoperatively based on VAS and Oswestry scores, and there were no significant differences in outcome scores when comparing 1- and 2-level TDR.

• pro**disc** in the military study[ix]:
- 83% of patients in the pro**disc** L group returned to unrestricted full duty compared to 67% of fusion patients

<u>pro**disc C**</u>

• An IDE study[iii] was conducted to evaluate the safety and effectiveness of the pro**disc** C compared to anterior cervical discectomy and fusion (ACDF) surgery for the treatment of pain associated with symptomatic cervical disc disease at **one level** between C3 and C7.

• The study design used:
- 13 centers, 209 patients – 103 pro**disc** C patients, 106 fusion patients
- Single level treatment (C3 to C7), 1:1 randomization (1 pro**disc** C : 1 fusion)
- Follow-up at 6 weeks, and 3, 6, 12, 24, 60, 84 months

• 84 Month Study[v] Findings:
- Patient satisfaction was 83.39 out of 100 for pro**disc** C at 2 years, and increased to 85.81 at 7 years
- At 7 years follow-up, 4x fewer pro**disc** C patients required a reoperation, and 4x fewer adjacent level disease cases than ACDF patients
- All outcome measures except for the SF-36 General Health domain were improved, compared with the pre-operative status at two years, with improvements maintained at 7 years follow-up

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- Strong or weak narcotic pain medications were reduced from 48% of patients to only 12% at 7 year follow-up in the pro**disc** C group compared to a decline of 46% to 14% of ACDF patients
- At 7 years, fusion patients were approximately 4x more likely to receive a reoperation than patients treated with pro**disc** C
- pro**disc** C is designed with a keel to resist migration – no migrations or expulsions were reported in the entire 7 year follow-up study

pro**disc C Vivo**

- 65 Month follow-up study[x] reviewing clinical and radiographic outcomes with pro**disc** C Vivo
  - Range of motion was maintained, with VAS (neck and shoulder) reductions from 5.4 baseline to 0.7 at the 5 year follow-up, VAS (arm) reduced from 5.1 to 0.5. of 49 adjacent segments observed, 13 (26.5%) had adjacent segment degeneration (ASD).
  - No patients developed recurrent cervical radiculopathy or myelopathy due to ASD.
  - No patients needed a reoperation.
- 40 consecutive patients[xi] were treated with spike-fixation based pro**disc** C Vivo or keel-fixation based pro**disc** C to study the development of heterotopic ossification (HO) formation with 2-year follow-up.
  - Clinical outcome parameters for both groups improved significantly: pro**disc** C VAS (arm & neck) from 6.3 and 6.2 to 0.7 and 1.3, pro**disc** C Vivo VAS (arm & neck) from 6.3 and 4.9 to 1.4 and 1.6.
  - The pro**disc** C Vivo cohort demonstrated a significantly lower incidence of HO than the pro**disc** C group at both 1 and 2-year follow-up. Hi-grade HO occurred in 9% versus 31%.
  - These findings demonstrate that prosthesis designs that allow primary anchoring without violation of the cortical surface help to reduce the incidence of severe ossification, possibly affecting the functionality and mobility of the artificial disc device over time.
- 56 patients[xii] were treated with either pro**disc** C Vivo or an integrated fusion device and short-term effectiveness and the impact on cervical segmental range of motion were studied.
  - Both the pro**disc** C Vivo artificial disc replacement and Zero-P fusion have satisfactory short-term effectiveness in the treatment of single-segment cervical spondylosis.
  - pro**disc** C Vivo artificial disc replacement can also maintain the cervical spine range of motion to a certain extent, while reducing the occurrence of excessive motion of adjacent segments after fusion.
- Prospective comparison with 382 patients[xiii] with retrospective review of patient-reported outcome measures, failure scenarios, and revision surgeries.
  - 189 (49.5%) of patients were treated with pro**disc** C Vivo with only 1 (0.5%) revision surgery.
  - 12-month NDI scores were better for the pro**disc** C Vivo group.
  - 12-month VAS Neck scores were also better for the pro**disc** C Vivo group.
  - 12 -month VAS Arm scores were also better for the pro**disc** C Vivo group.

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[i] Search performed on Pubmed, Embase, Ovid Medline® covering 1988 – 2023.

[ii] Zigler J, et al., Results of the Prospective, Randomized, Multicenter FDA IDE Study of the pro**disc** L TDR versus Circumferential Fusion for the Treatment of 1-level Degenerative Disc Disease, SPINE vol 32, Number 11, pp 1155-1162.

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[iv] Radcliff K et al, Five-Year Reoperation Rates of 2-Level Lumbar Total Disk Replacement Versus Fusion, Clin Spine Surg, Volume 31, Number 1, February 2018, 37-42.

[v] Janssen ME, ProDisc-C Total Disc Replacement Versus Anterior Cervical Discectomy and Fusion for Single-Level Symptomatic Cervical Disc Disease, J Bone Joint Surg Am. 2015;97:1738-47.

[vi] Siepe CJ., et al., Mid- to long-term results of total lumbar disc replacement: a prospective analysis with 5- to 10- year follow-up. Spine J, 2014 Aug 1: 14(8):1417-31.

[vii] Marnay, Thierry. "Mobility Parameters in Two-Level Lumbar TDR vs Hybrid Construct: Clinical Results in 235 Patients", NASS 2022 Annual Meeting, Thursday, October 13, 2022, Chicago, Illinois

[viii] Zigler, J, and Ohnmeiss, D, Comparison of 2-Level Versus 1-Level Total Disc Replacement: Results From a Prospective FDA-Regulated Trial. SAS Journal, 2008. Summer, Vol 2, Issue 9 p. 140-144.

[ix] Tumialan, L.M., et al., Arthroplasty in the military: a preliminary experience with pro**disc** C and pro**disc** L. Neurosurgical focus, 2010. 28(5): p. E18.

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[xii] Yulong Ma, Wenhao Want, Zhiping Guan, Yongcan Huagn, Limin Yu. Comparison of short-term effectiveness of Prodisc-C Vivo artificial disc replacement and Zero-P fusion for treatment of single-segment cervical spondylosis. 2022 Sep 15;36(9):1132-1143. doi: 10.7507/1002-1892.202204103.

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