

# Analysis of Lumbar Interbody Fusion Procedural Costs and the Financial Impact of Graft Material Selection

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## INTRODUCTION

- Lumbar fusion is the third most costly surgical expenditure in the Medicare system.<sup>1</sup>
- Prior costs analyses suggest instrumentation and operating room costs drive procedural costs but fail to account for of all intraoperative supplies.<sup>2</sup>
- Commercial graft products are efficacious in promoting fusion but are accompanied by high unit costs.<sup>3</sup>
- Existing comparative analyses of cost-effectiveness between graft types are methodologically heterogeneous and inconclusive.<sup>4</sup>

## AIMS

- Identify modifiable drivers of procedural costs in lumbar interbody fusions.
- Compare procedural costs and postoperative outcomes between iliac crest autograft (ICBG), local autograft, and bone morphogenetic protein (BMP), and viable cellular allograft (VCA)

## METHODS

- Inclusion:**
  - Ages 18-89 years old
  - March 2015 and July 2023
  - Degenerative pathology
- 955 1- and 2-level lumbar interbody fusions**
  - 111 (11.6%) ICBG
  - 257 (26.9%) Local autograft
  - 263 (27.5%) VCA
  - 324 (33.9%) BMP
- Pareto analysis** to identify contributors to pooled cost of all fusions.
- Total Procedural Cost** = (OR minutes × OR cost/minute, \$32.48) + Σ(item units × 2023 USD unit price)
- Postoperative Outcomes:**
  - Inpatient:** Opioid consumption, length of hospital stay
  - Post-discharge:** complication, readmission, revision rates
  - Patient-reported outcomes:** 90-day and 1-year ODI and EQ5D
- Outcomes assessed with multivariable regression adjusted for demographics, approach, spine levels, approach, concomitant laminectomy, and fixation instrumentation.

## RESULTS

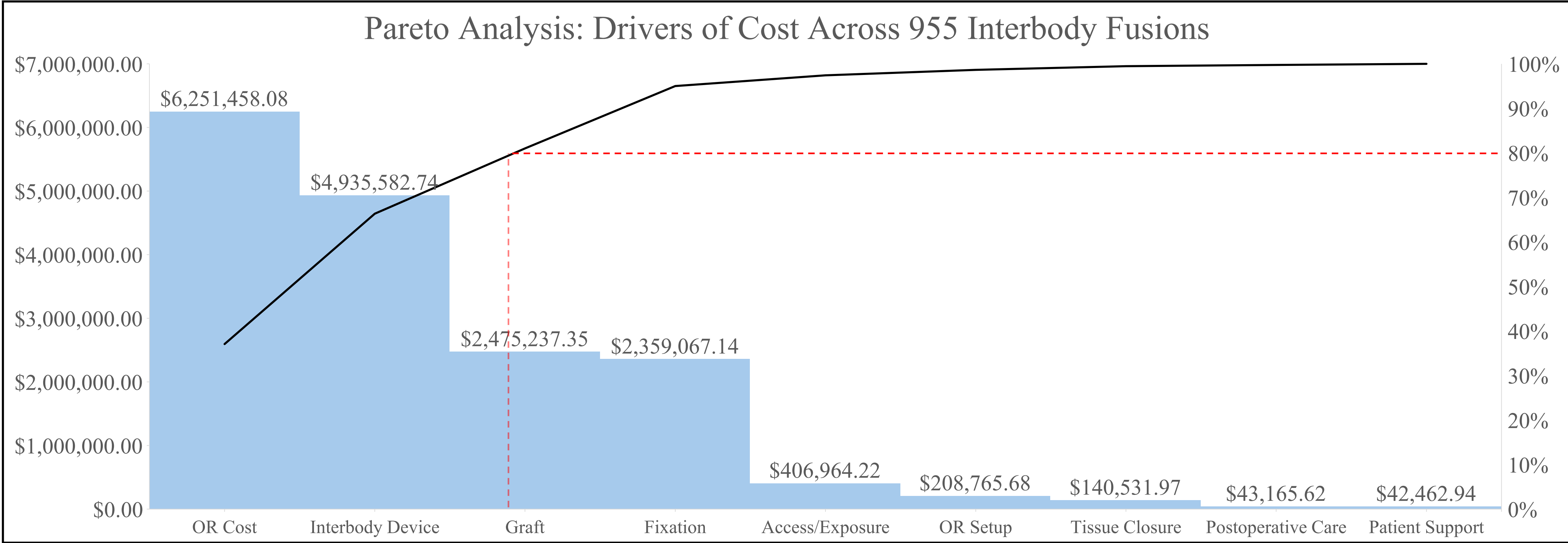
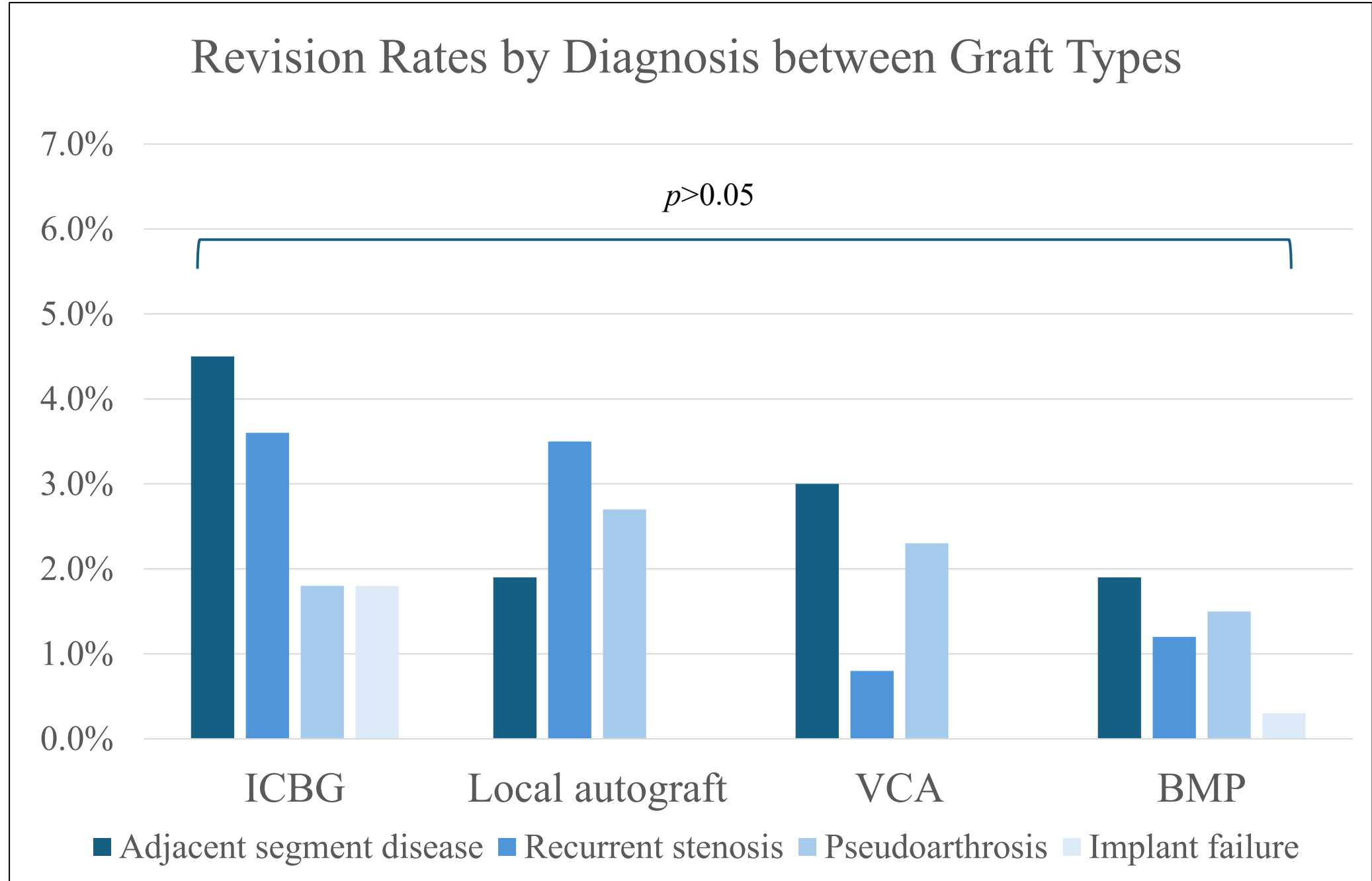
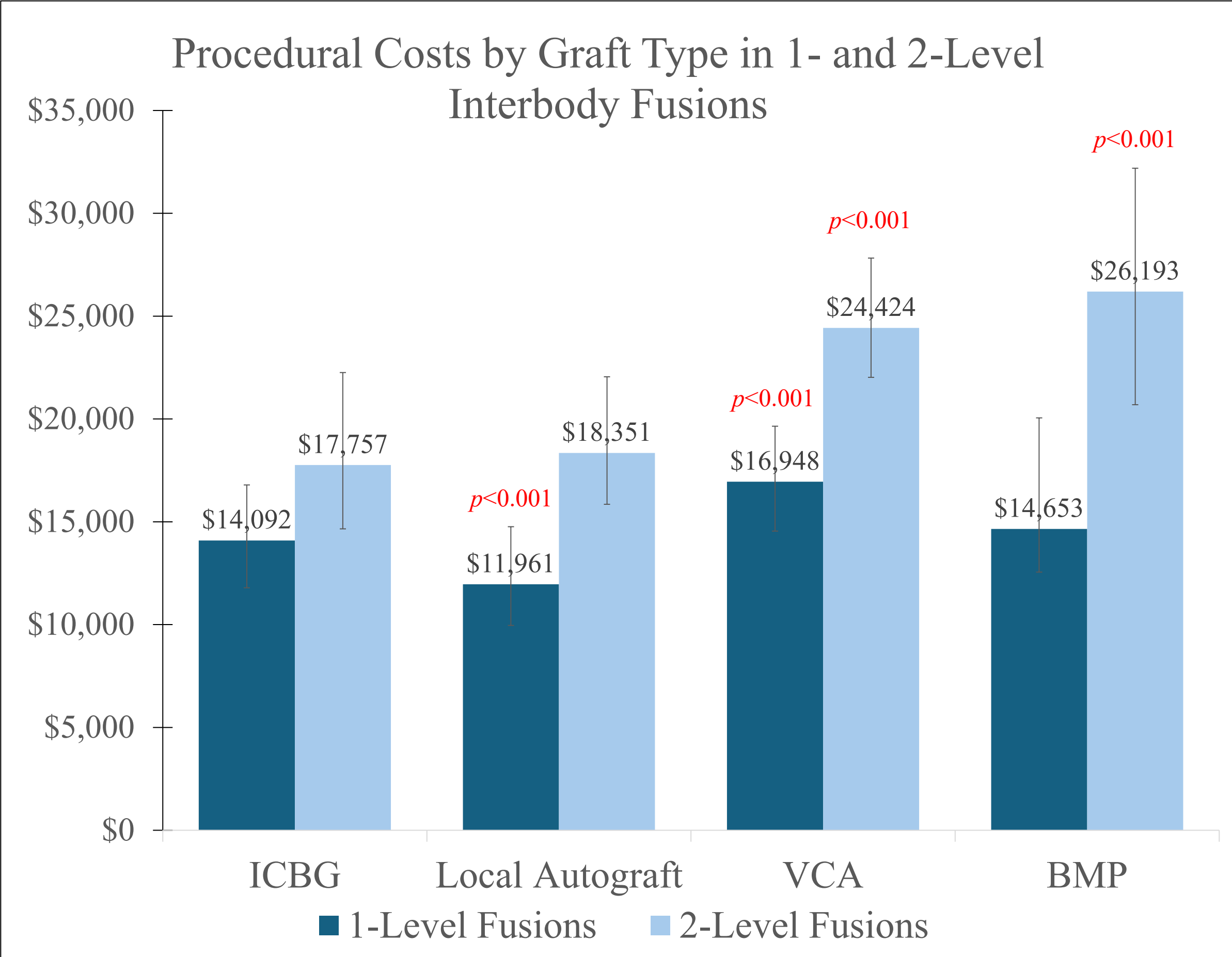


Table 1: Demographic and Procedural Variables

|                            |                                  | Total<br>(n=955)       | ICBG<br>(n=111)                     | Local<br>Autograft<br>(n=257)       | VCA<br>(n=263)                      | BMP<br>(n=324)                      | Omnibus<br>Sig. (p) |
|----------------------------|----------------------------------|------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|---------------------|
| Age                        |                                  | 57.00<br>[47.00-67.00] | 60.00<br>[52.00-69.00] <sup>a</sup> | 60.00<br>[52.00-68.00] <sup>a</sup> | 56.00<br>[46.00-67.00] <sup>b</sup> | 55.00<br>[44.00-63.25] <sup>b</sup> | <0.001              |
| BMI (kg/m <sup>2</sup> )   |                                  | 29.30<br>[25.80-33.20] | 30.30<br>[27.20-33.55]              | 29.50<br>[25.70-33.60]              | 29.40<br>[26.25-33.60]              | 28.60<br>[25.08-32.60]              | 0.055               |
| Sex                        | Male                             | 554 (47.5)             | 55 (49.5)                           | 114 (44.4)                          | 136 (51.7)                          | 149 (46.0)                          | 0.338               |
|                            | Female                           | 601 (52.5)             | 56 (50.5)                           | 143 (55.6)                          | 127 (48.3)                          | 175 (54.0)                          |                     |
| CCI                        |                                  | 2.00<br>[1.00-3.00]    | 2.00<br>[1.00-3.00] <sup>a</sup>    | 2.00<br>[1.00-3.00] <sup>a</sup>    | 2.00<br>[1.00-3.00] <sup>a</sup>    | 1.00<br>[0.00-2.25] <sup>b</sup>    | <0.001              |
| Smoking<br>Status          | Never                            | 407 (42.6)             | 43 (38.7)                           | 109 (42.4)                          | 115 (43.7)                          | 140 (43.2)                          | 0.760               |
|                            | Former                           | 404 (42.3)             | 55 (49.5)                           | 109 (42.4)                          | 105 (39.9)                          | 135 (41.7)                          |                     |
|                            | Active                           | 144 (15.1)             | 13 (11.7)                           | 39 (15.2)                           | 43 (16.3)                           | 49 (15.1)                           |                     |
| Levels                     | 1                                | 679 (71.1)             | 74 (66.7) <sup>b</sup>              | 209 (81.3) <sup>a</sup>             | 174 (66.2) <sup>b</sup>             | 222 (68.5) <sup>b</sup>             | <0.001              |
|                            | Fused<br>2                       | 276 (28.9)             | 37 (33.3) <sup>b</sup>              | 48 (18.7) <sup>a</sup>              | 89 (33.8) <sup>b</sup>              | 102 (31.5) <sup>b</sup>             |                     |
| Concomitant Laminectomy    |                                  | 474 (49.6)             | 74 (66.7) <sup>a</sup>              | 150 (58.4) <sup>a</sup>             | 142 (54.0) <sup>a</sup>             | 108 (33.3) <sup>b</sup>             | <0.001              |
| Approach                   | Posterior                        | 33 (3.5)               | 16 (14.4) <sup>a</sup>              | 14 (5.4) <sup>b</sup>               | 2 (0.8) <sup>c</sup>                | 1 (0.3) <sup>c</sup>                | <0.001              |
|                            | Transforaminal                   | 441 (46.2)             | 74 (66.7) <sup>b</sup>              | 181 (70.4) <sup>a</sup>             | 155 (58.9) <sup>c</sup>             | 31 (9.6) <sup>d</sup>               |                     |
|                            | Anterior                         | 369 (38.6)             | 18 (16.2) <sup>b</sup>              | 41 (16.0) <sup>b</sup>              | 81 (30.8) <sup>b</sup>              | 229 (70.7) <sup>a</sup>             |                     |
|                            | Direct Lateral                   | 112 (11.7)             | 3 (2.7) <sup>b</sup>                | 21 (8.2) <sup>b</sup>               | 25 (9.5) <sup>b</sup>               | 63 (19.4) <sup>a</sup>              |                     |
| Pedicule Screw Fixation    |                                  | 709 (74.2)             | 103 (92.8) <sup>a</sup>             | 199 (77.4) <sup>c</sup>             | 224 (85.2) <sup>b</sup>             | 183 (56.5) <sup>d</sup>             | <0.001              |
| Vertebral Plate            |                                  | 283 (29.6)             | 13 (11.7) <sup>b</sup>              | 44 (17.1) <sup>b</sup>              | 83 (31.6) <sup>a</sup>              | 143 (44.1) <sup>a</sup>             | <0.001              |
| Integrated Interbody Screw |                                  | 54 (5.7)               | 2 (1.8)                             | 15 (5.8)                            | 11 (4.2)                            | 26 (8.0)                            | 0.052               |
| Supplement<br>Graft        | Local<br>Autograft               | 293 (30.7)             | 95 (85.6) <sup>a</sup>              | -                                   | 54 (20.5) <sup>b</sup>              | 27 (8.3) <sup>c</sup>               | <0.001              |
|                            | Cancellous<br>Allograft          | 394 (42.3)             | 83 (74.8) <sup>a</sup>              | 73 (28.4) <sup>c</sup>              | 128 (48.7) <sup>b</sup>             | 110 (34.0) <sup>c</sup>             | <0.001              |
|                            | Cortical Bone<br>Fiber Allograft | 33 (3.5)               | 1 (0.9) <sup>c</sup>                | 18 (7.0) <sup>a</sup>               | 10 (3.8) <sup>b</sup>               | 4 (1.2) <sup>c</sup>                | 0.001               |
|                            | Demineralized<br>Bone Matrix     | 255 (26.7)             | 27 (24.3) <sup>b</sup>              | 102 (39.7) <sup>a</sup>             | 29 (11.0) <sup>c</sup>              | 97 (29.9) <sup>b</sup>              | <0.001              |

Note: Values displayed as median [IQR], or count (%)



- OR time, interbody devices, and graft selection comprised 95% of the cost of 955 fusions**
- Use of BMP and VCA significantly increased procedural cost**
- All postoperative outcomes were comparable across graft type including:**
  - Opioid use ( $p=0.766$ )
  - Length of stay ( $p=0.212$ )
  - Complications ( $p=0.327$ )
  - Readmissions ( $p=366$ )
  - Revisions ( $p=0.392$ )
  - Patient reported outcomes (ODI,  $p=0.806$ ; EQ5D,  $p=0.746$ )

## CONCLUSIONS

- Graft selection serves as a pragmatic procedural change in efforts to reduce cost.
- Autograft should be considered first, as the use of expensive commercial graft products is not clinically justified for routine spinal fusions.
- Graft selection should be evaluated on an individualized bases based on risk and practicality to maximize value-based care.

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