Supplementary Material

**Supplementary Table S1**. Functional relationships between rod-E and biomechanical indexes of TLIF.

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| Parameter | Regression equation | R2 |
| ROM |  |  |
| Extension | Y=0.394 – 0.003\*X + 4.532\*10-5\*X2 – 2.188\*10-7\*X3 | 0.915 |
| Flexion | Y=0.369 – 0.003\*X + 4.520\*10-5\*X2 – 2.191\*10-7\*X3 | 0.905 |
| Bending | Y=0.587 – 0.005\*X + 6.112\*10-5\*X2 – 2.777\*10-7\*X3 | 0.980 |
| Rotation | Y=0.439 – 0.011\*X + 1.772\*10-4\*X2 – 8.745\*10-7\*X3 | 0.831 |
| Central bone graft (Mean strain, με) |  |  |
| Extension | Y=1182 – 10.54\*X + 0.151\*X2 – 7.225\*10-4\*X3 | 0.934 |
| Flexion | Y=1117 – 5.176\*X + 0.084\*X2 – 4.135\*10-4\*X3 | 0.832 |
| Bending | Y=875 – 4.220\*X + 0.051\*X2 – 2.247\*10-4\*X3 | 0.982 |
| Rotation | Y=933 – 15.53\*X + 0.253\*X2 – 1.251\*10-3\*X3 | 0.829 |
| Peripheral bone graft (Mean strain, με) |  |  |
| Extension | Y=3124 – 24.61\*X + 0.334\*X2 – 1.573\*10-3\*X3 | 0.955 |
| Flexion | Y=2733 + 7.614\*X – 0.109\*X2 + 5.176\*10-4\*X3 | 0.941 |
| Bending | Y=4266 – 31.07\*X + 0.418\*X2 – 1.937\*10-3\*X3 | 0.962 |
| Rotation | Y=6965 – 157.2\*X + 2.564\*X2 – 1.266\*10-2\*X3 | 0.830 |
| Cage (Stress peak, MPa) |  |  |
| Extension | Y=3.605 – 0.031\*X + 4.216\*10-4\*X2 – 1.997\*10-6\*X3 | 0.951 |
| Flexion | Y=9.896 – 0.031\*X + 4.722\*10-4\*X2 – 2.258\*10-6\*X3 | 0.915 |
| Bending | Y=15.02 – 0.088\*X + 1.059\*10-3\*X2 – 4.606\*10-6\*X3 | 0.986 |
| Rotation | Y=13.51 – 0.244\*X + 4.038\*10-3\*X2 – 2.010\*10-5\*X3 | 0.792 |
| Endplate (Stress peak, MPa) |  |  |
| Extension | Y=13.02 – 0.214\*X + 3.266\*10-3\*X2 – 1.587\*10-5\*X3 | 0.894 |
| Flexion | Y=51.02 – 0.024\*X + 4.826\*10-4\*X2 – 2.864\*10-6\*X3 | 0.882 |
| Bending | Y=47.94 – 0.286\*X + 3.514\*10-3\*X2 – 1.575\*10-5\*X3 | 0.977 |
| Rotation | Y=33.70 – 0.672\*X + 1.089\*10-2\*X2 – 5.357\*10-5\*X3 | 0.843 |
| Screw (Stress peak, MPa) |  |  |
| Extension | Y=59.91 – 0.146\*X + 1.065\*10-3\*X2 – 3.794\*10-6\*X3 | 0.999 |
| Flexion | Y=46.01 + 0.274\*X – 4.412\*10-3\*X2 +2.166\*10-5\*X3 | 0.877 |
| Bending | Y=51.02 – 0.447\*X + 1.219\*10-2\*X2 – 6.217\*10-5\*X3 | 0.986 |
| Rotation | Y=43.59 + 0.954\*X – 1.432\*10-2\*X2 + 7.124\*10-5\*X3 | 0.927 |
| Rod (Stress peak, MPa) |  |  |
| Extension | Y=10.48 + 1.202\*X – 8.642\*10-3\*X2 + 2.878\*10-5\*X3 | 0.999 |
| Flexion | Y=9.26 + 0.574\*X – 7.175\*10-3\*X2 + 3.222\*10-5\*X3 | 0.982 |
| Bending | Y=9.89 + 2.080\*X – 1.896\*10-2\*X2 + 7.253\*10-5\*X3 | 0.999 |
| Rotation | Y=20.44 + 1.529\*X – 2.075\*10-2\*X2 + 9.559\*10-5\*X3 | 0.972 |
| Cancellous bone-screw interface (Stress peak, MPa) |  |  |
| Extension | Y=1.439 + 5.542\*10-3\*X – 8.100\*10-5\*X2 + 3.859\*10-7\*X3 | 0.933 |
| Flexion | Y=0.983 + 1.160\*10-3\*X – 1.583\*10-5\*X2 + 7.230\*10-8\*X3 | 0.968 |
| Bending | Y=1.362 – 3.728\*10-3\*X + 4.610\*10-5\*X2 – 2.131\*10-7\*X3 | 0.972 |
| Rotation | Y=1.113 – 9.239\*10-4\*X + 1.857\*10-5\*X2 – 1.259\*10-7\*X3 | 0.876 |
| Cortical bone-screw interface (Stress peak, MPa) |  |  |
| Extension | Y=28.57 – 0.080\*X + 1.028\*10-3\*X2 – 4.622\*10-6\*X3 | 0.973 |
| Flexion | Y=23.37 + 0.144\*X – 2.357\*10-3\*X2 + 1.182\*10-5\*X3 | 0.764 |
| Bending | Y=19.26 + 0.057\*X – 7.736\*10-4\*X2 + 3.572\*10-6\*X3 | 0.939 |
| Rotation | Y=16.74 + 0.351\*X – 5.014\*10-3\*X2 + 2.334\*10-5\*X3 | 0.970 |