

- load-sharing score -

**Survival Analysis of Posterior Short Fusion
in Thoracolumbar Fracture
- Significance of Load-Sharing Score and Bone Mineral Density -**

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– Abstract –

Study design : A retrospective study.

Objectives : To evaluate the fixation survival rate and the radiologic prognostic factors of posterior short fusion in thoracolumbar fracture.

Summary of background data : Posterior short fusion has the advantage of saving motion segments in spite of high fixation failure rate. The high load-sharing score is well known as a cause of fixation failure, but the effect of osteopenia is not evaluated.

Materials and Methods : Authors evaluated 27 patients treated surgically with posterior short fusion using pedicle screws as thoracolumbar fractures from 1995 to 1999. The median follow-up was 20.5 months (6- 54). The survivorship using Kaplan-Meier method and the radiologic prognostic factors were evaluated.

Results : The sagittal index was preoperatively 16.7 (± 7.9 SD), immediate postoperatively 6.9 (± 4.6), and at last follow-up 10.6 (± 6.9). The fixation failures were detected in 4 patients, and the failure time was ranged from 6 months to 11 (median 7.5). The overall survival rate was 82.3% at the last follow-up. The significant prognostic variables were load-sharing score, Jikei grade, compression percent and age in uni-variate analysis, but the load-sharing score and Jikei grade were significant prognostic factors in multi-variate analysis.

Conclusions : In decision to perform posterior short fusion, the load-sharing score and evidence of osteopenia should be considered as a prognostic factors to avoid fixation failure in thoracolumbar fracture.

Key words : Thoracolumbar fracture, Posterior short fusion, Survival rate, Prognostic factors

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*

2000 17

1995. 3 1999. 7
27
가 , 6~54 20.5 가
9) . ()
가
17 64 36
9) . (1 1)
(posterior short 18 가 9 ,
fusion) (TLSO) . , T10
가 . L2 ,
5,12,13) 2 ,
1994 McCormack 12) Load-
sharing classification . (2) 11 1 , 12
7 , 1 12 , 2 7 ,
load-sharing score 1 , 8 ,
4 , 9
5 . 1 40% 12
3,14) ,
9
, 18
(fixation failure) , load-sharing score 4 3 , 5
9 , 6 7 , 7 6 8 9 1
Jikei grade grade 0가 21 , grade

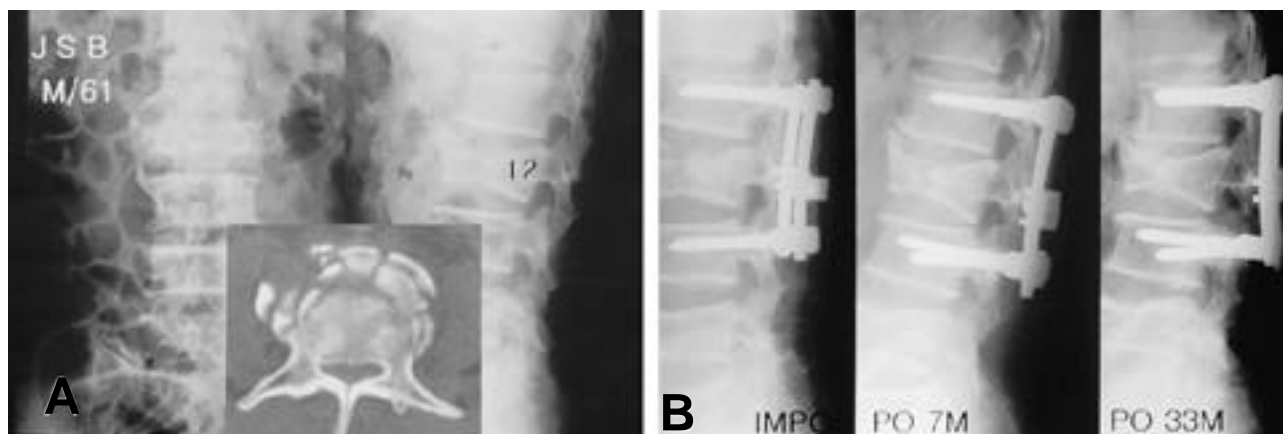


Fig. 1-A. Preoperative radiographs of 61 years-old male showed L2 stable burstfracture with more than 40% compression, load-sharing score 8 point and Jikei grade 1.
B. Immediate postoperative, 7 and 33 months follow-up lateral radiographs showed acceptable correction and fixation failure, but radiologic bone union.

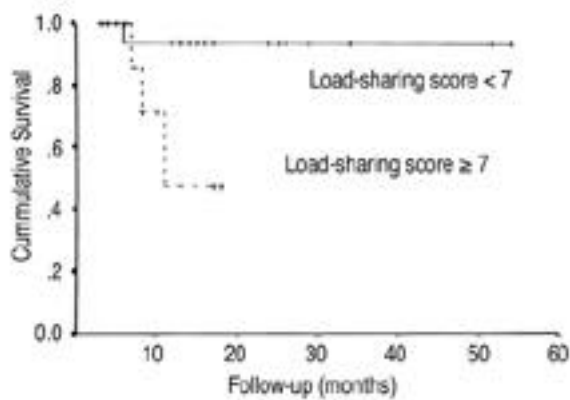


Fig. 2. The fixation survival rates according to load-sharing scores. The survival rate of less than 7 score was higher than 7 or more score ($p < 0.05$).

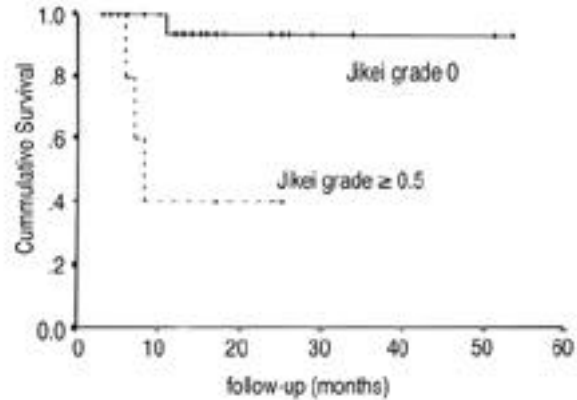


Fig. 3. The fixation survival rates according to Jikei grades. Jikei grade 0.5 or more showed significantly lower survival rate ($p < 0.05$).

Table 1. Jikei grading scale

Grade 0	Normal trabecular pattern
Grade 0.5	Decreased bone density, thin trabeculars
Grade 1	Decreased transverse trabeculars, prominent vertical trabeculars and end plates
Grade 2	More decreased transverse trabeculars, decreased vertical trabeculars
Grade 3	Almost disappeared transverse trabeculars, unclear vertical trabeculars like a ground glass image

0.5, 4, grade 1, 2
 Modified Frankel 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 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619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000, 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014, 1015, 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1514, 1515, 1516, 1517, 1518, 1519, 1520, 1521, 1522, 1523, 1524, 1525, 1526, 1527, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1544, 1545, 1546, 1547, 1548, 1549, 1550, 1551, 1552, 1553, 1554, 1555, 1556, 1557, 1558, 1559, 1560, 1561, 1562, 1563, 1564, 1565, 1566, 1567, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1575, 1576, 1577, 1578, 1579, 1580, 1581, 1582, 1583, 1584, 1585, 1586, 1587, 1588, 1589, 1590, 1591, 1592, 1593, 1594, 1595, 1596, 1597, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1606, 1607, 1608, 1609, 1610, 1611, 1612, 1613, 1614, 1615, 1616, 1617, 1618, 1619, 1620, 1621, 1622, 1623, 1624, 1625, 1626, 1627, 1628, 1629, 1630, 1631, 1632, 1633, 1634, 1635, 1636, 1637, 1638, 1639, 1640, 1641, 1642, 1643, 1644, 1645, 1646, 1647, 1648, 1649, 1650, 1651, 1652, 1653, 1654, 1655, 1656, 1657, 1658, 1659, 1660, 1661, 1662, 1663, 1664, 1665, 1666, 1667, 1668, 1669, 1670, 1671, 1672, 1673, 1674, 1675, 1676, 1677, 1678, 1679, 1680, 1681, 1682, 1683, 1684, 1685, 1686, 1687, 1688, 1689, 1690, 1691, 1692, 1693, 1694, 1695, 1696, 1697, 1698, 1699, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1711, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 1730, 1731, 1732, 1733, 1734, 1735, 1736, 1737, 1738, 1739, 1740, 1741, 1742, 1743, 1744, 1745, 1746, 1747, 1748, 1749, 1750, 1751, 1752, 1753, 1754, 1755, 1756, 1757, 1758, 1759, 1760, 1761, 1762, 1763, 1764, 1765, 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1775, 1776, 1777, 1778, 1779, 1780, 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1790, 1791, 1792, 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802, 1803, 1804, 1805, 1806, 1807, 1808, 1809, 1810, 1811, 1812, 1813, 1814, 1815, 1816, 1817, 1818, 1819, 1820, 1821, 1822, 1823, 1824, 1825, 1826, 1827, 1828, 1829, 1830, 1831, 1832, 1833, 1834, 1835, 1836, 1837, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1845, 1846, 1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127,

Table 2. Summary of sagittal parameters at peri-operative and last follow-up

Parameters	preoperative	immediate pop*	last follow-up
Sagittal index (°)	16.7	6.9	10.6
Fused angle (°)	18.6	7.9	12.3
Vertebral compression %	38.5	19.5	23.7

*pop = postoperative

Table 3. The survivorships of statistically non-significant factors

Factors (No. of Cases)	Survival(%)	p-value
Farcy instability grade	4 (22)	84.4
	>4 (5)	75.0
Sagittal index (°)	<15 (12)	78.8
	15 (15)	85.1
Correction of	<20 (15)	76.9
vert.* compression (%)	20 (12)	88.9
Correction of SI [†] (°)	<10 (12)	78.8
	10 (15)	85.1
Bone graft	autograft (9)	87.1
	allograft (18)	80.3
Fraccture level	T11,T12(8)	75.0
	L1,L2(19)	86.7

*vert. = vertebral, [†]SI = Sagittal Index

SPSSwin 8.0
log-rank test
tional hazard model
p- 0.05

Kaplan-Meier
, Cox's propor-
27 4 가 ,
6 11 7.5

(locking system failure)가 CCD
1 (Fig. 1), AO Fixa-
ture Interne 1 ,
8 가 Synergy
1 , Dipason 1 .
4

16.7 (± 7.9) 6.9 (±
4.6) 58.7% , Kaplan-Meier 82.3%
10.6 (± 6.9) 37.8%
18.6 (± 9.9), 7.9 (± 8.2),
12.3 (± 9.0) 57.5% 41.1%
38.5%(±
22.1), 19.5%(± 13.0), 23.7%(±
14.5) 19.0% 4.2%
(Table 2).

3. Load-sharing score 3~6 (19) 93.8%
, 7~9 (8) 47.6%
load-sharing
score가 (p=0.032)
(Fig. 2). Jikei grade

Jikei grade 0 (21) 93.8%, 0.5
 (6) 40.0%
 (p=0.0013)(Fig. 3). 4
 가 35%
 (35% 16
 70.2%; 35% 11 , 100%,
 p=0.031). 4 3 가 50
 . 50 (18) 92.9% 가 ,
 , 50 (9) 58.3%
 (p=0.028).

18
 9 , , 가
 (%), , load-sharing score,
 (Mann-Whitney test, p>0.05),
 81.3% 85.7% 가
 (p=0.69).
 (11,12 1,2), Farcy ,
 , 가 가

(가) 가
 가 가
 (p>0.05)(Table 3). . Carl ²⁾
 50%

4. 가
 Cox's proportional hazard model forward conditional
 (enter 0.05, removal 0.1)
 load-sharing score Jikei grade
 ,
 (%) Jikei grade load-sharing score
 .

5. (ligamentotaxis),
 Load-sharing McCormack ¹²⁾ 1994
 1 ,
 1 ,
 (amount of comminution/involvement),
 (amount of apposition/displacement of fracture fragments),
 (amount of correction of kyphotic deformity) 3가 1, 2, 3
 3 9 . 가
 (transition zone)
 ,
 가
 .

9).
 6,10-12),
 (Fig. 2).

11,12) .

, TLSO 가 . Dvorak 4) 가

가

(Fig. 3).

, Katonis 10)

CD

30 4 가

, McLain 13) 19 10

가 . McLain 13)

McCormack 12), Carl 2)

(Fig. 3).

가 Jikei

16)(Table 1).

1 , load-sharing score, Jikei grade, (%),

가

2 , (%) 가

load-sharing score

Jikei grade

. McAfee가

(stable bursting fracture) Dennis ,

(mechanical stability)

(stability) . McAfee

가

가

Carl 2) 12 2

90%

27 2 17).

1 7 가 ,

3 1 가 (facet fusion) , 가 (gauge)

85.7% ,

27 가

. Graziano⁸⁾가

가

가

11) , 가

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3).

9), McLain

27
4
82.3% . Load-sharing score
Jikei grade가 . Load-sharing score가 가

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20.5 (6~54) . Kaplan-Meier ,

, Jikei grade, load-sharing score

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4 , 16.7 (± 7.9 SD), 6.9 (± 4.6) 10.6 (± 6.9) .

6 11 (7.5) . 82.3% . load-sharing

score, Jikei grade, , load-sharing

score, Jikei grade

:

load-sharing score 17.7% .

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