

Minimally-Invasive Percutaneous Pedicle Screw Fixation for Spinal Metastatic Disease

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Background

- Optimal surgical management of spinal metastatic disease (SMD) remains controversial
- Complicating factors include:
 - Skip and diffuse spinal lesions
 - Patient frailty
 - Need for timely adjuvant chemoradiation
- **Minimally-Invasive Percutaneous Pedicle Screw Fixation (MIPSF)** confers stability and allows for early post-operative mobilization



Fig. 1 Intra-operative picture showing long percutaneous pedicle screw fixation construct and rod passage under fluoroscopy (T1-Pelvis) in a patient with SMD.

Purpose

- To demonstrate the safety, feasibility, and outcomes of the MIPSF technique in patients with neoplastic spinal instability and multilevel SMD
- To compare short (less than 6 vertebrae) vs. long (6 or more vertebrae) MIPSF based on various operative parameters and outcome measures

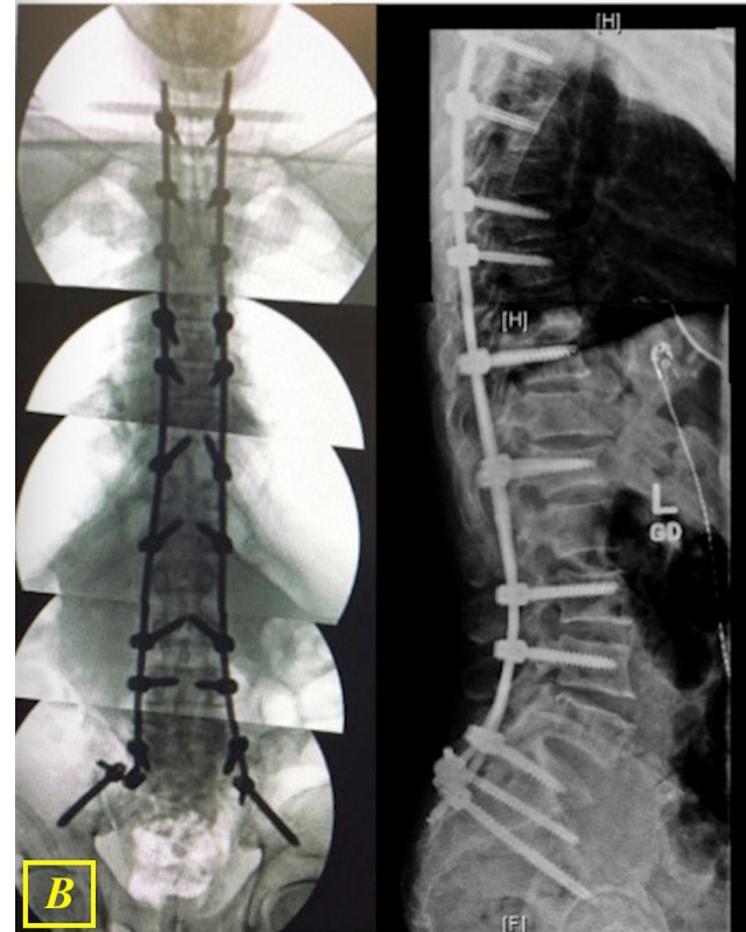


Fig.2 Post-operative AP and lateral radiographs of a 60-year-old male patient with multiple myeloma after a T1-Pelvis L-MIPPSF procedure. Patient had metastatic lesions in T2, T6, T9, T11 and L5.

Methods

- Single-center retrospective review of all patients who underwent only percutaneous instrumentation for multi-level SMD between 01/2012-10/2020
- Twenty-four patients (10 female, 14 male) were identified
- Variables collected:
 - Primary tumor diagnosis
 - Modified Tokuhashi score
 - Spinal Instability Neoplastic Score
 - Neurologic function (Frankel scale)
 - Patient-reported pain score (Visual Analogue Scale)
 - Operative variables (procedure type, blood loss, operative time)

Results

- 17 patients received L-MIPSF (6 or more spinal levels) & 7 patients underwent S-MIPSF (less than 6 levels)
- Mean age = 65.0 years (R: 30-85; SD: 11.7)
- Mean BMI = 26.5 (R: 17.8-36.0; SD: 4.7)
- Mean ASA status = 3.13 (R: 2-4; SD=0.61), all but 3 patients had score of III or IV
- Origin of metastatic cancer: prostate (6), multiple myeloma (6), breast (4), lung (3), kidney (1), rectum (1), cervix (1), and unidentified (2)

Table 1. Assorted data for long- and short-MIPPSF cohorts, reported as “average (SD)”

Cohort	Number of levels fixed	Modified Tokuhashi Score	Estimated Blood Loss (mL)	Incision to Closing Time (minutes)	Length of Follow-up (months)	% Requiring Additional Surgery	Spinal Instability Neoplastic Score (SINS)
L-MIPPSF n=17	12.5 (4.6)	8.2 (3.0)	494 (409)	149 (50)	5.1 (5.6)	17.6	12.53 (2.10)
S-MIPPSF n=7	4.6 (0.8)	7.7 (1.9)	140 (126)	85 (41)	4.8 (6.2)	0.0	10.43 (2.76)
Overall n=24	10.2 (5.3)	8.0 (2.7)	402 (388)	130 (55)	5.0 (5.7)	12.5	11.92 (2.45)



- Thoracic and Lumbar MRI of a patient with metastatic lesions at T3, T6, T10, L1 and L5 lesion (*left*)
- Post-operative AP and lateral radiographs of same patient after a T2-Pelvis L-MIPPSF procedure (*right*)

Pain and Neurologic Deficit

- L-MIPSF

- Visual analog pain scores (VAS) reduced by an average of 54% from pre-operative measurement (mean=8.47) to last available follow-up (mean=3.87)
- Of the 7 patients with pre-operative neurologic deficits, five improved by 1 Frankel grade after their surgery and two improved by 2 Frankel grades

- S-MIPSF

- VAS pain scores were reduced by 65% on average from pre-operative measurement (mean=8.14) to last available follow-up (mean=2.86)
- Two of these patients had pre-operative neurologic deficits and both improved by 1 Frankel grade after surgery

Reoperation and Revision

- Two patients receiving L-MIPSF (2/17=11.8%) required subsequent “minor” mini-open decompression laminectomy
 - Due to new epidural tumor mass expansion at different levels than the index pathology
 - No changes to the prior instrumentation were needed as spine was already stabilized from prior fixation
- One patient in the L-MIPSF group (1/17=5.9%) required “major” reoperation with hardware revision and re-instrumentation
 - Performed due to proximal loss of fixation at the T3 upper instrumented vertebra (UIV) secondary to progression of the destructive neoplastic process
 - Extension of fixation to T2 (UIV+1) with cement vertebral augmentation was performed uneventfully
- None of the patients that received S-MIPSF required reoperation.

Conclusions

- Although technically demanding, multilevel minimally-invasive spinal fixation is safe and feasible in patients with diffuse spinal metastasis
- Substantially limited muscle dissection, blood loss, and operative times render it applicable to patients with extensive metastatic disease burden
- Early outcome data demonstrate MIPSF's utility in avoiding multiple subsequent procedures in a cohort of already de-conditioned patients

Disclosures

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