

Percutaneous Versus Open Pedicle Screw Fixation for the Management of Metastatic Spine Disease: A Matched-Cohort Study

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INTRODUCTION:

Metastatic spine disease is increasing in prevalence in North America and can impact spinal stability as well neurological function. Patients with metastatic spine disease present with significant pain, spinal instability, and myelopathic symptoms secondary to spinal cord compression. There has been increased interest in applying minimally invasive fixation techniques to stabilize the spine in this physiologically frail population. Our hypothesis is that surgical outcomes and complications following Percutaneous pedicle screw fixation (PPSF) is very dissimilar to open pedicle screw fixation (OPSF) of metastatic spinal tumor (MST) reconstructions. The goal of this study is to assist clinician decisions on whether to perform percutaneous versus open pedicle screw fixation.

METHODS:

Patients with metastatic disease of the spine undergoing surgical intervention at a level I academic medical center were enrolled. Twenty-nine patients PPSF (Percutaneous pedicle screw fixation) between 2015-2022 were matched based on vertebral tumor location (Cervical, Thoracic, and Lumbar), number of vertebral segments instrumented, and number of segments decompressed to 29 patients undergoing open surgical management from 2005-2018. To compare PPSF therapeutic impact to open surgical intervention, examination of perioperative variables: blood loss, operative time, complications, length of hospital stay, and treatment outcomes: postop survival time, postop narcotic use, changes in patient-reported outcomes as assessed via PROMIS: pain interference (PI), physical function (PF), and depression. Qualitative statistical data and a two-sample t-test were used to examine the therapeutic impact of PPSF compared to OPSF of MST patients. Statistical significance set at $p < 0.05$.

RESULTS:

This is a matched cohort study that included 29 patients who underwent PPSF (age: 66.55 ± 10.1) with 12 (40%) female matched to 29 patients who underwent OPSF (age: 61.5 ± 15.6) with 11 (37.9%) female. Patients undergoing PPSF were older than those undergoing OPSF ($p < 0.001$). OPSF is associated with greater estimated blood loss (mean [SD]: $990.0[596.8]$) compared to PPSF ($390.5[372.2]$, $p < 0.001$). Further, OPSF had longer surgical time ($457[106.8]$) compared to PPSF ($221[78.6]$, $p < 0.001$). Perioperative complications among PPSF included: wound infection requiring I&D ($n=3$), aspiration pneumonia ($n=2$), and death ($n=2$) due to significant tumor burden; compared to OPSF: deep wound infection ($n=3$), DVT($n=2$), Dural tear ($n=1$), and death ($n=1$). Postoperative survival for PPSF and OPSF are similar ($405.9 [338.7]$ versus $366.75[332.0]$, $p=0.449$).

Patients undergoing PPSF and OPSF reported that they had a significant difference between average pre- and postoperative pain interference score ($p < 0.01$). Also, postoperatively patients undergoing PPSF and OPSF reported improvement in physical function score ($p=0.025$ and $p < 0.001$, respectively) and depression ($p=0.038$ and $p=0.020$, respectively). There is no statistical difference between PPSF and OPSF in their improvement of patient PROMIS score (PI, PF, and depression).

There is no statistical difference between pre- and postoperative oral morphine equivalent (OME) between PPSF and OPSF ($p=0.164$). Both palliative procedures were effective in reducing the OME used by the patient pre- and postoperatively at day 14 (OPSF: $57.7[20.6]$ versus $32.5[17.9]$, $p < 0.001$; and PPSF: $48.3[18.6]$ versus $36[19.8]$, $p < 0.001$).

DISCUSSION AND CONCLUSION:

This is one of the largest studies evaluating the clinical outcomes between PPSF and OPSF. Findings from the study indicate that percutaneous pedicle screw fixation is associated with less blood loss and shorter surgical time. Additionally, both palliative procedures are effective in improving physical function and reducing pain and depression. Both are also effective palliative procedures in reducing the amount of OME prescribed. Findings from this study indicate that PPSF is associated with less blood loss and shorter surgical time. Both palliative procedures are effective at improving physical function and reducing pain and depression, and the amount of OME prescribed.