Outcomes following surgical intervention for impending and gross instability caused by multiple myeloma in the spinal column

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OBJECT Multiple myeloma is the most common primary tumor of the spine and is the most common primary malignant tumor of bone. Although spinal myeloma is classically a radiosensitive lesion, clinical or radiographic signs of instability merit surgical intervention. The authors present the epidemiology, surgical indications, and outcome data of a series of consecutive cases involving 31 surgically treated patients with diagnoses of multiple myeloma and plasmacytoma of the spine (the largest such series reported to date).

METHODS Surgical instability was the criterion for operative intervention in this patient cohort. The Spinal Instability Neoplastic Score (SINS) was used to make this assessment of instability. The cases were analyzed using location of the lesion, spinal levels involved, Frankel score, adjuvant therapy, functional outcome, and patient survival.

RESULTS All patients undergoing surgical intervention were determined to have indeterminate or gross spinal column instability according to SINS criteria. The median survival was 78.9 months. No significant difference in survival was seen for patients with higher SINS scores or for older patients (> 55 years). There was a statistically significant difference in survival benefit observed for patients receiving chemotherapy and radiation versus radiation alone as an adjuvant to surgery (p = 0.02).

CONCLUSIONS In this 10-year analysis, the authors report outcomes of surgical intervention for patients with indeterminate or gross spinal instability due to multiple myeloma and plasmacytoma of the spine with improved neurological function following surgery and low rates of instrumentation failure.

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KEY WORDS epidemiology; multiple myeloma; plasmacytoma; spine; survival; oncology

MULTIPLE myeloma, also known as “plasma cell myeloma” and “Kahler’s disease,” is a systemic lymphoproliferative neoplasm involving the plasma cell. It is the most common primary bone malignancy, occurring frequently in the skull, ribs, vertebrae, and pelvis. Multiple myeloma develops in 5–10 per 100,000 people each year, and lesions are most commonly located in the spine, leading to profound morbidity. Solitary plasmacytoma, often considered the precursor lesion for multiple myeloma, may have similar clinical effects if the lesion causes vertebral body collapse and/or neurological compromise. Over 90% of cases occur in adults older than 40 years of age; the highest incidence is during the 7th decade, and African Americans are affected twice as often as white Americans.

The precise role that surgery plays in the management of these lesions is not very clear. In histologically proven cases of solitary plasmacytoma without neurological compromise or instability, radiotherapy is considered the treatment of choice. However, when a patient’s spine is determined to be unstable, surgical stabilization prior to radiotherapy or systemic therapy is appropriate. These bony tumors invade the spinal cord in 10% of patients, causing significant neurological impairment and further

ABBREVIATIONS IR = immediate release; NSAID = nonsteroidal anti-inflammatory drug; SINS = Spinal Instability Neoplastic Score; SR = sustained release.


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necessitating surgical intervention. Many patients present with a pathological vertebral body fracture causing acute onset of localized pain at the time of diagnosis and/or rapid neurological decline.

The indications for surgical treatment include decompression of neural elements and/or stabilizing the spinal column. Stabilization via anterior or posterior fixation may also provide support for patients with multiple myeloma who are scheduled to undergo nonsurgical treatments to control disease progression. When surgery is indicated, various options exist depending on the degree of instability, compression of neural elements, and overall general health of the patient. The literature has supported improvements in neurological function and quality of life with surgical management of this disease.

Previous studies suggest that patients may have reasonable long-term survival following spinal surgery for multiple myeloma and solitary plasmacytoma, but these studies relied on small cohorts of patients with short follow-up periods.

In this study, we report the outcomes for 31 consecutive patients receiving surgical treatment for multiple myeloma or solitary plasmacytoma of the spine over a 10-year period (2002–2012) at a single major academic medical center. This is the largest such series reported to date. Data analyzed include general patient demographics, functional status, adjuvant treatment, Spinal Instability Neoplastic Score (SINS), surgical approach and surgical instrumentation or reconstruction used, rate of instrumentation-related complications following surgery, pain medication use after surgery, and overall survival.

Methods

Study Population

Five hundred twenty patients underwent surgery for primary or metastatic tumors of the spine at our medical center from January 2002 to June 2012. Thirty-one patients underwent surgical treatment for multiple myeloma or plasmacytoma between 2002 and 2012 and met the criteria for inclusion in this study. We retrospectively reviewed demographic, treatment, and outcome data collected from the electronic medical record following protocols dictated by the university institutional review board (Protocols NA_00066200, NA_00067508). Vital statistics were recorded from the Social Security Death Master File, accessioned online. Survival data for non-US citizens was recorded as unknown. All vital statistics reflect the status of patients as of March 13, 2013.

Study Criteria

All patients included in this study presented with histologically confirmed multiple myeloma or solitary plasmacytoma of the spine diagnosed by either bone marrow or tumor biopsy. Six patients met the criteria for diagnosis of solitary spinal plasmacytoma alone at the time of surgical intervention. Solitary plasmacytoma was identified in cases in which skeletal survey showed no additional lesions, bone marrow aspiration showed no evidence of myeloma, and serum/urine electrophoresis showed no M-protein. Overall survival was recorded as the time from date of surgery to the last known vital status inquiry in March 2013. Four patients with solitary plasmacytoma experienced progression to multiple myeloma during the follow-up period. Progression from solitary spinal plasmacytoma was identified in patients who had initially met the criteria above for solitary plasmacytoma but upon follow-up no longer satisfied the requirements for solitary plasmacytoma alone. Given the overall similarities between these patients as well as the synchronous histological and pathological findings, data for multiple myeloma and spinal plasmacytoma patients were pooled and analyzed as a single cohort for demographic characteristics and outcomes.

Covariates identified were demographic and epidemiological data, such as age, sex, length of hospitalization, location of tumor, number of levels involved, surgical approach, pain medication use, pathological fracture at diagnosis, Frankel score, adjuvant treatment, instrumentation integrity, SINS, and overall survival. Six patients did not have the requisite preoperative imaging necessary for SINS assessment and their cases were excluded from analysis.

The surgical approach and procedure performed were recorded from the surgeon’s operative notes. Patients with spinal involvement of multiple myeloma or plasmacytoma were all medically stable for surgery and fulfilled the selection criteria for surgical intervention, which included rapidly progressive neurological deterioration and/or clinical or radiographic evidence of spinal mechanical instability. All patients had evidence of neurological compromise, an epidural tumor component, or vertebral body collapse with retropulsion of bone fragments into the spinal canal at the time of surgery. Fulfillment of criteria for surgical intervention was determined by at least 2 independent neurological surgeons’ interpretation of the radiographic and patient data. Patients were excluded if they were not medically stable for surgical intervention or if their life expectancy was less than 3 months. Life expectancy was determined by a multidisciplinary team using a variety of patient characteristics that included but were not limited to functional status, overall tumor burden, response to adjuvant therapy, histopathology, patient age, and other comorbidities. Patients who refused surgery were also not included. Patients who were not deemed surgical candidates then underwent radiation therapy and/or chemotherapy/hormonal therapy. Thirty-one patients met the criteria and constituted the study cohort for this analysis. The number of spinal levels involved and the presence or absence of a pathological fracture were determined from the radiology reports of preoperative CT and MRI examinations.

Inclusion criteria for the follow-up study included at least 6 months of clinical follow-up and a radiograph or clinical report of a radiograph specifically detailing the extent of instrumentation integrity, the state of alignment, and the degree of deformity correction present. Radiographs and CT scans were reviewed at 1, 3, and 6 months and 1 year after surgery, then at yearly intervals as available. Instrumentation-related complications were defined as loosening of the screws, breakage of any construct element, or loss of correction requiring reoperation. Primary images were reviewed and instrumentation failure was corroborated on the radiology reports.

Pain at diagnosis was self-reported by patients at any
preoperative clinic visit within 3 months of surgery. The type of pain medication used was classified from 1 (no medications) to 5 (intravenous narcotics), as previously reported.13 Patient medical records and prescribed medication records were reviewed to determine the dose and type of all pain medications. Complications were recorded from the discharge summaries of surgical patients. Early complications were defined as postoperative infections or wound dehiscence; postoperative ileus requiring prolonged hospitalization; coagulopathy, including deep venous thrombosis or pulmonary embolism; and construct failure with or without loss of correction occurring within 6 weeks of surgery. Late complications were defined as the above occurring more than 6 weeks after surgery.

Statistical Analysis
Survival statistics and Kaplan-Meier curves were calculated using GraphPad Prism 5.0. Undefined median survival indicates that greater than one-half of the patient cohort remained alive throughout the follow-up period; thus, median survival was never reached. The threshold for statistical significance was set at \( p < 0.05 \). Unpaired, 2-tailed, unequal variance t-tests were performed for statistical analyses in Microsoft Excel 2010. Confidence intervals were found using the Confidence Interval Calculator for Proportions (McCallum-Layton, 2010; https://www.mccallum-layton.co.uk/). ANOVA testing was calculated using the Analysis of Variance Calculator for Summary Data (Daniel Soper, 2013; http://www.danielsoper.com/+).

Results
Survival and Mortality
Thirty-one patients who underwent surgical treatment for multiple myeloma or solitary plasmacytoma between 2002 and 2012 at a major academic medical center were identified from the electronic medical record. Median follow-up was 12.5 months (range 1–120 months). The overall median survival of the pooled patient data set composed of patients with diagnoses of multiple myeloma or plasmacytoma was 78.9 months (Fig. 1 upper).

Five patients (16%) died within 1 year of surgery. The mean SINS was 8.5 ± 2.4 among patients who died within 1 year of surgery. The mean SINS for patients living more than 1 year after surgery was 11 ± 2.6. A 1-way ANOVA was used to test for differences in mean age and SINS between groups. Mean SINS was not significantly different between those patients surviving less than 1 year and those patients surviving more than 1 year (\( F[1, 29] = 3.958, \ p = 0.056 \)). Mean age did not significantly differ between the two groups (\( F[1, 29] = 1.438, \ p = 0.240 \)).

Clinical Characteristics
The median patient age at time of surgery was 58.5 years (range 37–89 years). There was no difference in median survival for patients younger than 55 years or older than 55 years at the time of surgery by log-rank test (\( p = 0.13 \)) (Fig. 1 lower). Twenty-two patients (71%) were male; 9 patients (29%) were female. The median length of stay in the hospital postsurgery was 6.5 days (range 1–40 days) (Table 1). Seventeen patients (55%) had tumor in the thoracic spine, 6 (19%) in the cervical spine, 6 (19%) in the lumbar spine, and 2 (6%) within the sacrum (Table 1).

Adjuvant Treatment
For analysis, patients were divided into groups based on exposure to adjuvant therapy: chemotherapy only without radiation at any time point (n = 4, 13%), radiation only without chemotherapy at any time point (n = 10, 32%), or both therapies (n = 16, 52%). One patient received neither chemotherapy nor radiation therapy and was excluded from comparative treatment analysis. (Table 1)

Median survival was 71.5 and 20.8 months for patients with chemotherapy only and radiation therapy only, respectively. The median survival of the radiotherapy-only versus dual-treatment group was statistically significant by log-rank test (\( p = 0.02 \)). There was no statistically significant survival difference for chemotherapy only versus dual treatment (\( p = 0.70 \)). (Fig. 2) A 1-way ANOVA was used to assess differences in mean SINS score and age between treatment groups. No difference
was found for mean SINS score between the three groups (F[2,21] = 0.093, p = 0.91); however, patient age varied significantly (F[1,24] = 9.554, p = 0.005). A significantly lower mean age of the patients (22 ± 11.1 years in the dual-treatment group). The mean age of the patients in the radiation-only group on post hoc analysis. The mean age of the patients was found to be older patient population was found in the radiation-only group (10%). One patient underwent surgery because previous biopsies of the lesion were non-diagnostic. One patient was eligible for radiation therapy alone but requested surgery. This patient was determined to be an appropriate surgical candidate.

**Indications for Surgery**

On review of the surgeon’s operative note describing the indications for surgery, epidural spinal cord compression was present in all cases due to an epidural component of the tumor or collapse of the vertebral body with retropulsion into the canal. Eight patients (26%, 95% CI: 11%–41%) were ambulatory (Frankel D or E) at presentation. Among patients with more than 6 months of follow-up, 79% were ambulatory (Frankel D or E) at presentation. One month postoperatively, 18 patients with more than 6 months of follow-up were ambulatory (Frankel D or E). Restoration of ambulation was durable in most patients; 88% of patients remained ambulatory (Frankel E) 1 year after surgery. Two patients (12%) were non-ambulatory (Frankel C) at 1 year after surgery.

Preoperatively, among patients with at least 6 months of clinical follow-up, 11% were taking morphine or oxycodone sustained release (SR) or immediate release (IR) or fentanyl via transdermal patch, 47% of patients were taking codeine, hydrocodone, or oxycodone, 5% of patients were taking nonsteroidal anti-inflammatory drugs (NSAIDs), and 37% of patients reported no pain medication use (Table 3). One month postoperatively, 89% of patients were taking opioids for pain control. Only 12% of patients reported only NSAID use at 1 month after surgery. Six months postoperatively, 71% of patients were taking narcotic medications, and at 1 year after surgery, 9% of patients were taking nonsteroidal anti-inflammatory drugs (NSAIDs), and 37% of patients reported no pain medication use (Table 3). One month postoperatively, 89% of patients were taking opioids for pain control. Only 12% of patients reported only NSAID use at 1 month after surgery. Six months postoperatively, 71% of patients were taking narcotic medications, and at 1 year after surgery.

**Functional and Pain Outcomes**

Among all patients, 74% were ambulatory (Frankel D or E) at presentation (Table 2). Among patients with more than 6 months of clinical follow-up, 79% were ambulatory (Frankel D or E) at presentation. One month postoperatively, 18 patients with more than 6 months of follow-up were ambulatory (Frankel D or E). Restoration of ambulation was durable in most patients; 88% of patients remained ambulatory (Frankel E) 1 year after surgery. Two patients (12%) were non-ambulatory (Frankel C) at 1 year after surgery.

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45% of patients reported regular use of narcotics for pain control.

Six months postoperatively, 59% of patients maintained their pain medication score, 24% decreased medication use, and 18% reported increased use of pain medications.

One year after surgery, 62% of patients maintained their pain medication score, 23% decreased their narcotic use, and 15% reported increased narcotic use.

**Instrumentation and Surgical Reconstruction**

The median number of instrumented levels in the patients who underwent anterior instrumentation placement was 3 (range 3–6) and the median number in those who underwent posterior instrumentation placement was 7 (range 4–12). Almost half (48%) of all patients underwent anterior reconstruction with allograft bone and cage con-

<table>
<thead>
<tr>
<th>TABLE 2. Functional outcomes following surgery</th>
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<tbody>
<tr>
<td>Frankel Grade</td>
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<tr>
<td></td>
</tr>
<tr>
<td>E</td>
</tr>
<tr>
<td>D</td>
</tr>
<tr>
<td>C</td>
</tr>
<tr>
<td>B</td>
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<tr>
<td>A</td>
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</table>
TABLE 3. Pain medication scores for patients with at least 6 months of clinical follow-up*

<table>
<thead>
<tr>
<th>Score</th>
<th>Preop</th>
<th>1 Mo Postop</th>
<th>6 Mos Postop</th>
<th>1 Yr Postop</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>11%</td>
<td>18%</td>
<td>12%</td>
<td>27%</td>
</tr>
<tr>
<td>3</td>
<td>47%</td>
<td>71%</td>
<td>59%</td>
<td>18%</td>
</tr>
<tr>
<td>2</td>
<td>5%</td>
<td>12%</td>
<td>0%</td>
<td>9%</td>
</tr>
<tr>
<td>1</td>
<td>37%</td>
<td>0%</td>
<td>29%</td>
<td>45%</td>
</tr>
</tbody>
</table>

* Values represent percentages of patients. Pain medication scores: 1 = no medication; 2 = NSAIDs; 3 = codeine, hydromorphone, oxycodone; 4 = morphine SR/IR, fentanyl via transdermal patch, oxycodone SR/IR; 5 = intravenous narcotics.

Complications of Spinal Instrumentation

Four patients experienced instrumentation complications. Three of the 4 patients with complications underwent posterior fixation only (Table 5). One patient experienced rod fracture 24 months after surgery with no loss of correction, 2 patients experienced loosening of screws with no loss of correction, and 1 patient had loss of correction for a lumbopelvic reconstruction requiring construct revision. Of note, this last patient had a sacral plasmacytoma. All patients with complications of spinal instrumentation had exposure to radiation—postoperatively in 3 cases and preoperatively in 1 case.

Postoperative Medical and Surgical Complications

Six patients had postoperative complications not directly related to spinal instrumentation, with 14 such complications recorded in total (Table 6). Two patients had pulmonary embolus and 2 had deep venous thrombosis. One patient experienced a pressure sore, 1 patient experienced a pneumothorax, 1 patient had pneumonia, 1 patient had a myocardial infarction, and 1 patient had a wound infection, which was treated conservatively. One patient also had wound dehiscence both within 6 weeks of surgery and more than 6 weeks postoperatively, and both occurrences required operative intervention in conjunction with plastic surgery. This patient was the only one who required operative intervention within the first 6 weeks postoperatively, and this same patient and the patient who underwent lumbopelvic reconstruction were the only patients who required reoperation more than 6 weeks after the index procedure.

Discussion

Multiple myeloma and solitary plasmacytoma of the spine are most commonly treated nonsurgically with a combination of radiotherapy and/or chemotherapy. When patients present with spinal instability or neurological deficits in the setting of a compressive lesion, surgical intervention is considered. As advances and improvements in adjunctive therapies continue to improve survival, the number of patients presenting with spinal lesions is expected to increase. With greater control of the systemic disease burden, an increased understanding of the surgical outcomes of patients diagnosed with multiple myeloma and solitary plasmacytoma of the spine is required. The benefits of surgical intervention and surgical outcomes for patients diagnosed with multiple myeloma and solitary plasmacytoma of the spine are largely unknown. Furthermore, guidelines are lacking to help direct clinicians in the optimal surgical management of patients with plasmacytoma and multiple myeloma of the spine. The purpose of this study was to present the surgical indications and outcome data from our experience in the operative management of patients with solitary spinal plasmacytoma and multiple myeloma over a 10-year period at a single academic medical center.

The Primary Spine Tumor Database at our institution is a retrospective collaborative database to monitor patients with diagnoses of primary spine tumors. Tumor registries and databases have been in use since 1929. They allow for the collection, assimilation, and analysis of information sometimes used for general cancer statistics or, more often, to evaluate a specific cancer subtype. Cancer registries and databases for spinal plasmacytoma and multiple myeloma are sparse. Our understanding of the epidemiological features and outcomes are largely derived from compilations of cases reported in the literature and small clinical series.1–5,11,12,17,19,22,23,25,26,29 The Surveillance, Epidemiology,
and End Results (SEER) database from 1973 through 2003 presents valuable population epidemiological data regarding solitary plasmacytoma and multiple myeloma.15 Our data are in agreement with the SEER data including age and sex, indicating that this disease, even when found in the spine, usually occurs in middle aged males.

All patients in this series with preoperative CT or MRI were subjected to SINS analysis. The SINS, proposed by the Spine Oncology Study Group incorporates tumor location, patient pain, the degree of osteosclerosis, spinal alignment, vertebral body collapse, and posterolateral involvement of the spinal elements in the determination of spinal instability from a neoplastic process.9 This scoring system has been validated in a recent study that demonstrated high inter- and intraobserver reliability and predictability for identifying spinal instability.10 In this case series, no patient underwent surgery with a SINS predicting stability (score range 0–6). Among patients with indeterminate stability or gross instability, there was no difference in survival; however, patients with gross instability according to SINS (score range 13–18) maintained 100% survival. Data from this cohort suggest that while SINS predicts spinal instability and identifies surgical candidates, this score does not predict survival after surgery. An epidural component of the lesion was found in all patients undergoing surgical intervention in this cohort, and severe pain due to vertebral body collapse was a common indication for surgery. A small but significant subset of patients required surgery due to concerns for vertebral collapse with radiotherapy alone, further highlighting that radiotherapy is not always adequate as a sole therapy, even for radiosensitive lesions. Vertebroplasty and kyphoplasty are often given as options for patients with infiltrative bone tumors such as multiple myeloma or plasmacytoma of the spine. While this does provide some stability, it is more often used for palliative treatment of pain. In our retrospective series, the presence of neurological compromise, an epidural tumor component, or vertebral body collapse with retropulsion of bone fragments into the spinal canal at the time of surgery in the setting of indeterminate or gross instability (as characterized by SINS criteria) provided the rationale for patients to undergo surgical stabilization rather than treatment with kyphoplasty or vertebroplasty alone.

The use of adjuvant therapy in this patient cohort was widespread. The difference between the median survival of the radiation-only and dual-treatment groups was statistically significant (p = 0.02), with a greater proportion of patients surviving in the dual-treatment group. Of note, the mean SINSs for the 2 groups were not different on 1-way ANOVA, suggesting that patients in the radiotherapy and dual-treatment groups had similar spinal column destabilization secondary to the spinal tumor disease burden. However, significantly older patients received radiotherapy only, suggesting that age was a confounding variable in the assessment of dual treatment. Nevertheless, patient age alone (greater than or less than 55 years) was not found to predict survival. Thus, it is possible that younger patients were able to tolerate systemic toxicities associated with chemotherapeutic drugs, and the added adjuvant treatment improved survival. Although 1 patient in our series received neither chemotherapy nor radiation treatment, we expected that all patients would be treated with some form of adjunct therapy (especially if their condition had progressed to spinal instability from a previously known and initially treated spinal lesion), given that this disease is typically treated nonsurgically. This may help to explain the widespread and varied use of adjuvant therapies observed in our cohort. Yet, we feel that this does likely represent the most typical scenario for a patient with multiple myeloma of the spine who has maximized medical treatments before considering surgical intervention. Pain medication score, indicative of narcotic use, remained high for patients throughout the follow-up period, although maintenance of ambulation at 1 year after surgery was also high. From these data, it is evident that surgery for multiple myeloma provided substantial improvement in patients with neurological symptoms and only

### Table 5. Instrumentation complications in patients with multiple myeloma

<table>
<thead>
<tr>
<th>Levels of Instrumentation</th>
<th>Complication</th>
<th>Time to Complication</th>
<th>Exposure to Radiation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occiput–C6 (posterior)</td>
<td>Rod fracture; no loss of correction</td>
<td>24 mos</td>
<td>Postoperatively</td>
</tr>
<tr>
<td>L3–ileum (posterior)</td>
<td>Loss of correction</td>
<td>24 mos</td>
<td>Preoperatively</td>
</tr>
<tr>
<td>T5–10 (posterior)</td>
<td>Loosening of posterior screws; no loss of correction</td>
<td>18 mos</td>
<td>Postoperatively</td>
</tr>
<tr>
<td>L2–S1 posterior &amp; L3–5 anterior</td>
<td>Loosening of posterior screws; no loss of correction</td>
<td>9 mos</td>
<td>Postoperatively</td>
</tr>
</tbody>
</table>

* Four patients experienced instrumentation complications during the study period. Levels of instrumentation are reported as indicated from the surgeons’ operative notes. Time to complication was recorded as time from the date of surgery to the first radiographic evidence of loosening of screws, rod fracture, or loss of correction.

### Table 6. Medical and surgical complications in patients with multiple myeloma

<table>
<thead>
<tr>
<th>Complication</th>
<th>Early</th>
<th>Late</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pulmonary embolus</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>DVT</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Pressure sore</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Wound dehiscence</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Myocardial infarction</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Wound infection</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Reoperation</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

DVT = deep venous thrombosis.

* Six patients had postoperative complications, with 14 complications recorded in total. Early refers to complications diagnosed within 6 weeks of surgery, and late refers to complications diagnosed more than 6 weeks after surgery.
moderate improvements in pain outcomes. The authors acknowledge the limitations of the pain analysis of our study. First, the study was limited by the small sample size of patients (n = 20) with more than 6 months of follow-up. Further, the use of the pain medication score or subjective pain reporting methods is imprecise. Prospective, randomized controlled clinical trials with repeated use of visual analog scales or other pain instruments will be necessary to better quantitate pain outcomes following surgery for multiple myeloma and solitary plasmacytoma in the spine. In addition, we did not compare these surgical patients to a cohort of patients who were treated with radiation and/or chemotherapy alone, with regard to survival, neurological status, and pain control.

The surgical approach for a given patient was selected on the basis of pathology location, patient factors, and surgeon skill. A majority of the patients in this series underwent posterior fixation alone (rather than anterior or combined approaches). Several factors could explain this observation, including a greater percentage of lesions affecting the posterior columns, surgeon or patient preference, and/or patient-specific comorbidities. Of note, 75% of patients who experienced instrumentation complications underwent posterior fixation only. This suggests that combined approaches may protect against instrumentation complications in patients with multiple myeloma. Future studies with greater numbers of patients will be necessary to determine if this trend holds merit. Notably, there was a low rate of instrumentation complications overall in this cohort. Given the presumed overall poor bone quality and multiple lytic lesions in this patient population, the low rate of instrumentation complications suggests that, with appropriate patient selection, surgery can provide a durable solution for patients with multiple myeloma and neurological compromise and/or vertebral collapse. The only patient with loss of correction underwent complex lumbo-pelvic reconstruction, which is rare in multiple myeloma.

Limitations of our study include the small sample size, retrospective design, number of patients lost to clinical follow-up, and lack of a control radiation-only nonsurgical cohort. The small sample size may be related to the number of patients who present for surgical management both in the community and to academic referral centers. While our data may be biased because our institution is a large tertiary referral center, many patients who present for surgical management are often transferred to our institution for further care. The loss of patients to follow-up may be due to the distance some patients may have needed to travel to have adequate follow-up appointments with us, and further study with phone questionnaires may be necessary to capture the missing data for these cases. Further, as the study sample was quite small, no definitive conclusions can be made or translated to apply to all patients with multiple myeloma or solitary spinal plasmacytoma. With larger sample sizes, using a prospective controlled design, more definitive answers to the timing and role of chemotherapy and/or radiotherapy and its relationship to progression-free survival can be investigated. Finally, we elected to exclude a nonsurgical radiation-only cohort, so all patients in this series were judged to have spinal instability or impending instability by SINS criteria. Further, inclusion of a radiation-only cohort could be misleading, as 15 patients from our series (48%) were exposed to radiation preoperatively. In light of this fact, a radiation-only nonsurgical cohort may represent a group with a potential for future cross-over into surgical intervention. We therefore chose to focus our study on the indications for surgery and outcomes following surgical intervention.

Conclusions

Based on this cohort analysis examining the surgical management of patients with multiple myeloma and plasmacytoma of the spine, we determined that there was no statistically significant difference in the survival of patients who presented with gross instability versus indeterminate stability. The overall median survival was 79 months, supporting the use of surgery for this patient population, when indicated, in addition to maximal nonsurgical therapies. Pain medication use remained high for patients following surgery. Rates of instrumentation failure were low and recovery of ambulation was durable throughout the follow-up period. It is hoped that this study may help guide physicians and patients regarding management and prognosis and may provide baseline data to study ongoing methods of improving treatment of patients with multiple myeloma and solitary plasmacytoma of the spine.

References


Author Contributions

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