A Single Institution's Experience with Carbon Fiber-Reinforced Polyether Ether Ketone (CF-PEEK) Based Screw System

Lawal A. Labaran MD, Ariaz Goudarzi BS, Francis H. Shen MD

Background:

Titanium pedicle screws are the standard for stabilizing neoplastic spinal instability but pose challenges for imaging and radiation planning due to their radiopacity. Carbon fiber-reinforced PEEK (CF-PEEK) implants, such as CarboFix system, offer radiolucency and biomechanical properties closely resembling those of cortical bone, potentially enhancing the accuracy of tumor monitoring and radiation treatment planning. While early data are promising, long-term clinical evidence remains limited.

Objective:
This study aimed to evaluate postoperative outcomes, complication rates, local recurrence, and survival in patients who underwent spinal tumor surgery using CF-PEEK based screw instrumentation.

Methods:
This retrospective study analyzed 38 adult patients who underwent spinal stabilization using CF-PEEK based screws from 2017 to 2024 under an experienced single surgeon at a tertiary academic center. Patient demographics, oncologic history, complications, radiation therapy data, and survival outcomes were collected and analyzed. Kaplan-Meier estimates were used for survival analysis.

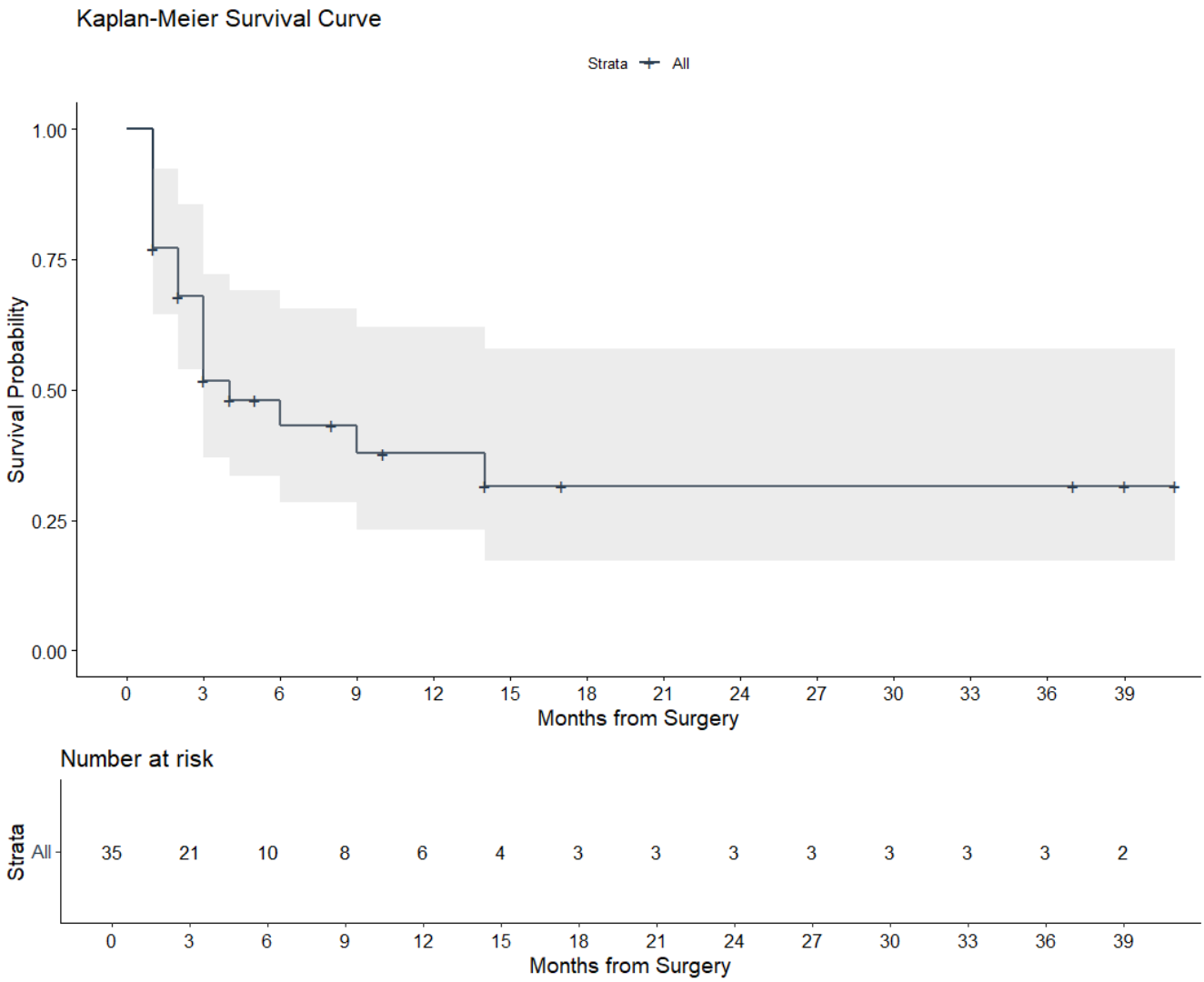
Results:
The cohort had a mean age of 61.1 years, with a mean of 4.3 spinal levels fused and 8.4 screws implanted per patient. No hardware-related complications were observed. Surgical complications occurred in 13.2% of patients, and medical complications in 15.8% of patients. Local recurrence was noted at 18.4% and postoperative radiation was administered to 44.7% of patients. Six- and twelve-month survival rates were 43.2% and 37.8%, respectively.

Conclusion:
Compared to historical titanium screw populations, patients who underwent pedicle fixation with CF-PEEK based screw system demonstrated mechanical reliability and a complication profile consistent with published rates. The elevated local recurrence rate may further reflect increased radiographic surveillance, though this requires further investigation. These findings are supportive of the safety of CF-PEEK based screw system in spine oncology, however more long-term studies are required to validate improved clinical efficacy and oncologic outcomes compared to traditional metal based pedicle screws and spine instrumentation systems.

Table 1: Baseline Characteristics	
Demographic:	Value:
Number of patients	38
Mean age at surgery, years	61.1 ± 17.0
Female sex, n (%)	15 (39.5%)
Mean BMI, kg/m²	25.8 ± 5.8
Smoking history, n (%)	10 (26.3%)
Diabetes mellitus, n (%)	5 (13.2%)
Mean number of levels fused	4.3 ± 1.4
Mean number of screws placed	8.4 ± 2.4
Postoperative radiation therapy, n (%)	17 (44.7%)
Mean radiation dose, Gy	26.9 ± 8.4
Mean follow-up duration, months	7.2 ± 10.7

Table 2: Postoperative Outcomes

Outcome:	Value:
Any complication, n (%)	10 (26.3%)
Hardware complication, n (%)	0 (0.0%)
Surgical complication, n (%)	5 (13.2%)
Medical complication, n (%)	6 (15.8%)
Local recurrence, n (%)	7 (18.4%)
Received postoperative radiation, n (%)	17 (44.7%)
6-month survival, %	43.2% (95% CI: 28.5–65.6%)
12-month survival, %	37.8% (95% CI: 23.1–61.9%)



Supplemental 1.

Subject	Age at surgery	sex	path/history
1	66	Male	METASTATIC COLORECTAL ADENOCARCINOMA
2	73	Male	BONE WITH ATYPICAL LYMPHOID INFILTRATE AND EXTENSIVE NECROSIS CONSISTENT WITH INVOLVEMENT BY B-CELL LYMPHOMA.
3	70	Male	INVOLVED BY PLASMA CELL NEOPLASM.

4	52	Female	METASTATIC ADENOCARCINOMA CONSISTENT WITH LUNG PRIMARY.
5	74	Female	INVOLVED BY METASTATIC SARCOMATOID RENAL CELL CARCINOMA
6	77	Male	METASTATIC CARCINOMA CONSISTENT WITH RENAL PRIMARY
7	63	Male	EXTENSIVE NECROSIS AND SCATTERED ATYPICAL CELLS
8	59	Female	HEMANGIOMA
9	79	Female	METASTATIC ADENOCARCINOMA
10	71	Male	MANTLE CELL LYMPHOMA.
11	77	Female	SPINDLE CELL NEOPLASM
12	53	Male	METASTATIC RENAL CELL CARCINOMA.
13	58	Male	METASTATIC SQUAMOUS CELL CARCINOMA
14	70	Male	T6=METASTATIC ADENOCARCINOMA, L1=FIBROOSSEOUS AND CHONDROID TISSUE WITH NO EVIDENCE OF MALIGNANCY
15	37	Female	N/A
16	76	Female	MYELOMA
17	56	Female	PREDOMINANTLY BLOOD, CELLULAR MATERIAL NOT IDENTIFIED.
18	36	Male	METASTATIC SINONASAL UNDIFFERENTIATED CARCINOMA
19	59	Male	METASTATIC SQUAMOUS CELL CARCINOMA
20	28	Female	LOW GRADE SPINDLE CELL LESION
21	14	Male	OSTEOSARCOMA WITH CHONDROBLASTIC DIFFERENTIATION.
22	62	Male	METASTATIC CARCINOMA, CONSISTENT WITH SARCOMATOID UROTHELIAL CARCINOMA
23	21	Male	CHONDROBLASTIC OSTEOSARCOMA.
24	54	Male	PLASMACYTOMA
25	58	Female	EXTENSIVELY INVOLVED BY HPV-ASSOCIATED BASALOID SQUAMOUS CELL CARCINOMA.

26	51	Male	METASTATIC ADENOCARCINOMA
27	70	Female	ATYPICAL LYMPHOID PROCES
30	67	Male	BONE AND FIBROCARTILAGE WITH NO PATHOLOGIC ABNORMALITY.
31	68	Female	METASTATIC ADENOCARCINOMA
33	73	Female	DEDIFFERENTIATED/UNDIFFERENTIATED MELANOMA
34	75	Male	METASTATIC CARCINOMA, WITH UROTHELIAL DIFFERENTIATION
35	63	Male	METASTATIC HIGH GRADE PROSTATIC ADENOCARCINOMA
36	80	Male	DIFFUSE LARGE B-CELL LYMPHOMA
37	69	Male	METASTATIC CARCINOMA, CONSISTENT WITH PROSTATE PRIMARY
38	85	Male	METASTATIC HIGH-GRADE UROTHELIAL CARCINOMA
39	74	Female	METASTATIC MAMMARY DUCTAL CARCINOMA
40	32	Female	METASTATIC CARCINOMA CONSISTENT WITH BREAST PRIMARY.
41	70	Male	METASTATIC PROSTATIC ADENOCARCINOMA