Prophylactic Carbon Fiber Nail Fixation in Patients with Musculoskeletal Lesions Requiring Postoperative Surveillance Imaging

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**Background**

Prophylactic long bone fixation is routinely performed in patients at high risk for pathologic fracture following the resection of bone or soft tissue lesions, especially when local adjuvant therapy is indicated. Traditional fixation constructs made of titanium or stainless steel can obstruct postoperative surveillance imaging secondary to artifact seen on both computed tomography (CT) and magnetic resonance imaging (MR). The advent of carbon fiber reinforced polyetheretherketone (CFR-PEEK) fixation introduced an alternative construct material with equivalent mechanical stability to titanium, but with distinct radiolucent properties. We hypothesized that a carbon fiber intramedullary nail can achieve equally effective prophylactic long bone fixation and minimize the obstructive artifact seen on CT or MR surveillance images required to monitor for recurrent disease.

**Patients & Methods**

- IRB-approved (WA0552-13) retrospective review from 2012-2014: 8 patients with tibial or femoral prophylactic fixation with a CarboFix™ CFR-PEEK intramedullary nail (CarboFix Orthopedics, Israel).
- All patients had post-op surveillance imaging by MR, CT, or X-ray.
- Median follow-up was 12 months [range 6-19 months].
- Surveillance imaging performed at 3- and 6-month intervals per NCCN Guidelines.
- For image analysis, the control group was comprised of patients with a femoral titanium intramedullary nail and a postoperative MR or CT.
- Image analysis performed by a single MSK-trained radiologist who assessed the percentage of cortex, corticomedullary junction, and bone-muscle interface visualized on axial images using a 5-point scale.

**Table 1: Carbon Fiber Patient Demographics**

<table>
<thead>
<tr>
<th>Age (yr)</th>
<th>Sex</th>
<th>Diagnostic Pathology</th>
<th>Location</th>
<th>Nail Type</th>
<th>XRT</th>
<th>Surgical Fixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;40</td>
<td>M</td>
<td>High grade fibrosarcoma</td>
<td>Femoral</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>40-60</td>
<td>F</td>
<td>Myxofibrosarcoma</td>
<td>Femoral</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>&gt;60</td>
<td>M</td>
<td>Chondrosarcoma</td>
<td>Femoral</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

**Table 2: MR Image Analysis Results**

<table>
<thead>
<tr>
<th>T1-weighted STIR T1 post-contrast fat saturated</th>
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<tbody>
<tr>
<td>Control</td>
</tr>
<tr>
<td>Cortex</td>
</tr>
<tr>
<td>Corticomedullary junction</td>
</tr>
<tr>
<td>Bone-muscle interface</td>
</tr>
<tr>
<td>Degree of artifact visibility</td>
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**Results**

- CFR-PEEK nails have significantly less MR and CT artifact, allowing for greater visualization of the cortex, corticomedullary junction, and bone-muscle interface.
- On CT images of CFR-PEEK nails, the beam hardening artifact was substantially less than that seen with titanium nails, allowing for near complete visualization of the cortex, corticomedullary junction, and bone-muscle interface.
- At last follow-up [mean 12 months, range 6-19 months], no patient developed a pathologic fracture, infection, or other complication related to the CFR-PEEK intramedullary nail.
- All patients had Good or Excellent MSTS functional assessment scores.

**Conclusion**

Carbon fiber reinforced PEEK intramedullary nail fixation is a novel and superior alternative to titanium for patients requiring prophylactic fixation and future surveillance MR or CT imaging of bone and soft tissue pathological lesions.

**References**

10. The Authors Have No Financial Conflicts of Interest.