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## Need for Higher Quality Evidence to Determine the Utility of Postoperative Radiography

An ongoing discussion exists regarding the utility and risk-to-benefit ratio of obtaining postoperative radiography as part of standard clinical practice. Studies suggest that routine radiography does not markedly change patient management after fracture fixation<sup>1-3</sup> and has little utility in immediate postoperative management for maxillofacial fractures,<sup>4</sup> total joint arthroplasty,<sup>5,6</sup> and spine surgery.<sup>7</sup> However, much practice variability and lack of consensus still exist, demonstrating a need to establish an evidence-based standard of care that optimizes patient outcomes while using hospital resources cost-effectively.

Routine radiographs can allow orthopaedic surgeons to preemptively identify complications before clinical symptoms arise to and provide objective reassurance when treating patients with ambiguous complaints.<sup>8</sup> However, diagnostic radiographs are the largest man-made radiation source within the general population and account for approximately 14% of total worldwide exposure.<sup>9</sup> Although a typical radiograph has a low effective radiation dose of 0.001 to 0.7 mSv,<sup>10</sup> repeated doses accumulate, accounting for 3.2% of the cumulative risk of cancer in developed countries.<sup>11</sup> Unfortunately, the long-term effects of radiation exposure of this sort are largely unknown, and concern exists that even small doses may be detrimental because they accumulate over the lifespan, with children particularly being nearly 10 times more sensitive than adults.<sup>12</sup> Radiographs also contribute to

healthcare expenditure, waiting times, and strains on personnel and resources.<sup>13</sup> Thus, if evidence is strong that routine radiography has minimal utility in patient management, restricting it to patients with clinical indications would not only help decrease radiation exposure but also free resources for other hospital needs.

Recently, we published a systematic review evaluating the role of immediate postoperative radiography in patient management after fracture fixation.<sup>14</sup> Results suggested that in patients with adequate intraoperative images and no clinical indications for radiography, immediate postoperative radiography does not markedly alter patient management. Although the effect sizes across studies were large, the overall evidence level was poor, with most being retrospective single-cohort studies, highlighting the need for higher quality prospective studies before definitive practice recommendations can be made. Although many studies reported relevant outcomes, no useful data could be retrieved because of a general lack of detail. Some articles reported complication rates but did not address management change, making it challenging to determine the true effect on patient management. Others reviewed outcomes without separating radiography performed at different follow-up time points, making it difficult to determine whether management changes were performed as a result of radiography taken immediately postoperatively or during subsequent follow-up. Finally, the heterogeneity of study

populations made it challenging to separate effects for different fracture types and surgical methods.

Looking forward, the current evidence will benefit from prospective comparative research examining management changes in patients who do or do not undergo radiography at each of several specific postoperative time points. Types of management change should be documented in detail, and studies should be specific to separate outcomes for different fracture types and treatment methods. In addition, longer term follow-up over a minimum of 1 year will facilitate exploration into the effect on patient functional outcomes. This research is particularly necessary for children, given their greater remodeling potential, which reduces the need for immediate reintervention after loss of reduction.

Ideally, the benchmark for future research in this area would be a noninferiority randomized controlled trial comparing management changes between patients undergoing immediate or 3- to 4-week postoperative radiography. The goal of a noninferiority design is to demonstrate that not obtaining radiography at specific postoperative time points is no worse at detecting the need for management change and thus ultimately does not affect complication rates and functional outcomes. For effective comparisons to be made, overall incidences of management change should be captured with detail on whether they were indicated by radiographic or clinical findings. However, challenges exist in im-

plementing such a trial. Because the absolute rates of management change are very small, differences between groups will likely be hard to detect, necessitating impractical sample sizes to achieve significance. Furthermore, because management change is a subjective outcome, determination of a meaningful noninferiority margin would be difficult. The next alternative would be a large, prospective observational study, which would entail prospective enrollment and collection of outcomes over a long follow-up period with documentation of all postoperative radiographs, management changes, complications, and functional outcomes in accordance with a standardized management plan. Such data would then provide insights for determining a noninferiority margin for future randomized trials with potential to inform clinical practice. Overall, higher quality prospective studies, along with more comprehensive reporting, are necessary to increase the strength of evidence in the literature.

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