Low value Injury Care in the Adult Orthopaedic Trauma Population: A Systematic Review

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August 4, 2021

Abstract

Objectives. Fifteen potentially low value practices in adult orthopaedic trauma care were previously identified in a scoping review. The aim of this study was to synthesize the evidence on these practices. Methods. We searched four databases for systematic reviews, randomized controlled trials (RCTs), cohort studies and case series that assessed the effectiveness of selected practices. Methodological quality was evaluated using the Measurement Tool to Assess Systematic Reviews version 2 (AMSTAR-2) for systematic reviews and the Critical Appraisal Checklist for Case Series. We evaluated risk of bias with the Cochrane revised tool for RCTs and the risk of bias in non-randomized studies of interventions tool for observational studies. We summarized findings with measures of frequency and association for primary outcomes. Results. Of the 30,670 records screened, 70 studies were retained. We identified high-level evidence of lack of effectiveness or harm for routine initial imaging of ankle injury, orthosis for A0-A3 thoracolumbar burst fracture in patients $<$ 60 years of age, cast or splint immobilization for suspected scaphoid fracture negative on MRI or confirmed fifth metacarpal neck fracture, and routine follow-up imaging for distal radius and ankles fractures. However, evidence was mostly based on studies of low methodological quality or high risk of bias. Conclusion. In this review, we identified clinical practices in orthopedic injury care which are not supported by current evidence and whose use may be questioned. In future research we should measure their frequency, assess practice variations and evaluate root causes to identify practices that could be targeted for de-implementation.

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Results. Of the 30,670 records screened, 70 studies were retained. We identified high-level evidence of lack of effectiveness or harm for routine initial imaging of ankle injury, orthosis for A0-A3 thoracolumbar burst fracture in patients $<$ 60 years of age, cast or splint immobilization for suspected scaphoid fracture negative

on MRI or confirmed fifth metacarpal neck fracture, and routine follow-up imaging for distal radius and ankles fractures. However, evidence was mostly based on studies of low methodological quality or high risk of bias.

Conclusion. In this review, we identified clinical practices in orthopedic injury care which are not supported by current evidence and whose use may be questioned. In future research we should measure their frequency, assess practice variations and evaluate root causes to identify practices that could be targeted for de-implementation.

Key words. Low value care, orthopaedics, trauma, imaging, systematic review

Review criteria

We searched MEDLINE, EMBASE, Epistemonikos and the Cochrane Central Register of Controlled Trials from inception to April 2020. Pairs of reviewers independently screened all identified records with titles, abstracts and full texts using EndNote and Covidence software. We reported the number of eligible studies according to design, sample size, methodological quality / risk of bias, and proportions and measures of association for primary outcomes for each low value practice.

Message for the clinic:

In this systematic review, we found high-level evidence of lack of effectiveness or harm for 6 of these practices: routine initial imaging of ankle injury, orthosis for A0-A3 thoracolumbar burst fracture in patients < 60 years of age, cast or splint immobilization for suspected scaphoid fracture negative on MRI or confirmed fifth metacarpal neck fracture, and routine follow-up imaging for distal radius and ankles fractures.

Introduction

Close to 90% of adult trauma patients present with orthopeadic injury.[1] These injuries represent the most expensive nonfatal injury with costs totaling $456 billion per year in the US.[2,3] These high costs are due to multiple radiologic imaging for initial and follow-up management, consultations and interventions performed by specialized human resources, and the loss of productivity associated with treatments.[4-8]

Alarmingly, up to 30% of healthcare budgets are estimated to be spent on low value care.[9] Low value practices are defined as "the common use of a particular intervention when the benefits don't justify the potential harm or cost".[10] Organizations such as Choosing Wisely emit recommendations on clinical practices that should be questioned.[11] However, to date, no recommendations have been made by Choosing Wisely nor by professional societies regarding low value practices for the adult orthopeadic trauma population. In a recent scoping review and survey, 15 potentially low value practices in adult orthopedic trauma care were identified (Table 1); practices were considered low-value if they were identified as such in at least one observational study and at least 75% of experts rated them as clearly or potentially low value.[12,13] Experts were 36 clinicians from Canada, the UK, the US and Australia specialized in trauma care and actively involved in injury research including 8 orthopedic or spine surgeons; the response rate was 92%. No attempt to summarize the benefits & harms of practices was made at this stage.[12] Given the high volume of patients hospitalized following orthopaedic injury annually, reducing low value practices in this population may free up considerable resources and to optimize the quality and efficiency of health care services. However, we need to appraise available evidence for these practices before recommendations can be made. The aim of this study was therefore to synthesize evidence on clinical practices in orthopaedic injury care that were previously identified as potentially low value.

Methods

We conducted this systematic review using rapid review methodology to "synthesize a large body of evidence in a timely and credible manner".[14-15] We followed the Cochrane Handbook for Systematic Reviews of Interventions[16] and the review is presented according to the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) checklist (Supplementary Digital File 1).[17] As per recommendations

on rapid review methodology, we limited the review to studies with the highest available level of evidence and restricted the search to published literature.[14,15]

Eligibility Criteria

Eligibility criteria were developed for each clinical practice using PICO elements (Supplemental Digital File 2) by the steering committee including orthopaedic surgeons, a spine surgeon, a trauma team leader, a trauma nurse practitioner, and a trauma care coordinator, all practicing in level I trauma centers. Post-treatment diagnostic interventions and consultations originally targeted specific fractures (e.g. isolated closed Mason-Johnson type 1 radial head/neck fracture, non-displaced and minimally displaced fractures). However, upon consultation of the literature that provided information on many other types of fractures, we decided to expand our inclusion criteria for these practices (Supplemental Digital File 3). Using rapid review methodology[15], we applied successive inclusion criteria using recognized levels of evidence based on study type, i.e. systematic reviews, RCTs, prospective observational, retrospective observational, and case series. We did not use study quality as an eligibility criterion because of the low quality of studies overall. No restrictions on date or language were applied.

Outcomes

Primary and secondary outcomes were identified for each practice by the project steering committee on consultation with the literature (Supplemental Digital File 2). Primary outcomes included missed injuries (e.g. fracture or luxation/subluxation), complications (e.g. neurological deficits, fracture mal-union or non-union), change in clinical management (e.g. surgery, change in immobilization status), and functional recovery measured with validated tools. Secondary outcomes included pain, quality of life measured using validated tools, healthcare service utilization, and return to work.

Search Strategy

With the help of an information specialist, we developed search strategies for each clinical practice. We searched MEDLINE, EMBASE, Epistemonikos and the Cochrane Central Register of Controlled Trials from inception to April 2020. We also checked the reference lists of reviews and retrieved articles for additional studies. Since this rapid review aimed to synthesize the evidence based on published studies, we did not search the grey literature. An example of a search strategy for a specific practice in Medline is presented in the Supplementary Digital File 4.

Selection Process

We managed all citations with EndNote software. We identified and removed duplicates using electronic and manual screening. To ensure reliability in study selection, all reviewers screened multiple series of 100 titles in rounds until we achieved acceptable agreement.[16] Pairs of reviewers (MB, LM; CC, PAT) then independently screened all identified records with titles, abstracts and full texts using EndNote and Covidence software.

Data Extraction and Management

The same pairs of reviewers independently extracted data on study year, setting and design, study population, intervention(s), comparator(s) and outcome(s). Clinical practices were classified as follows: routine initial diagnostic interventions, initial consultation or therapeutic interventions, and routine post-treatment imaging and follow-up consultations (Table 1). Routine initial and follow-up imaging was defined as that occurring at pre-defined time points and not based on clinical indication.

Quality Assessment

Pairs of reviewers (MB, PAT; LM, PAT) critically appraised quality using the Measurement Tool to Assess Systematic Reviews version 2 (AMSTAR-2)[18] and the Critical Appraisal Checklist for Case Series of the Joanna Briggs Institute.[19] Risk of bias in original studies was assessed with the Cochrane tool for RCTs (RoB2)[20] and the risk of bias in non-randomized studies of interventions (ROBINS-I) tool[21] for cohort studies.

Any disagreements on eligibility, extracted data or quality were resolved through discussion between reviewers and on consultation with a senior reviewer when necessary.

Synthesis

We reported the number of eligible studies according to design, sample size, methodological quality / risk of bias, and proportions and measures of association for primary outcomes for each practice. We did not report results for secondary outcomes considering the large number of retained studies and the fact that results on secondary outcomes led to the same conclusions. Similarly, we did not conduct meta-analysis or assess the credibility of evidence because identified studies on the same practice were either all case series (no measures of association) or evaluated different outcomes.

Results

The searches identified 39,696 citations, including 9426 duplicates (Figure 1). A total of 476/546 studies were excluded after the full-text review (n=34; Supplementary Digital File 5). After final screening, we included 70 studies[22-91], but no data on primary outcomes were reported in three of these.[26,67,91]

Study Characteristics According to Categories of Low value Practices

Most studies were based on case series (n=33)[22,31,33,34,36,38,41,43-50,56,57,60-64,66,68-72,74,75,7785,89,90]followed by systematic reviews with or without meta-analysis (n=12)[23-25,28,29,39,53,59,67,78,83,86,88,91], prospective cohorts (n=9)[30,32,35,37,42,51,54,79,87], RCTs (n= 9)[27,55,65,73,80-82,84] and retrospective cohorts (n=2; Supplemental Digital File 6).[52,58]

Methodological Quality of the Studies

Studies focusing on initial diagnostic imaging were mostly of low to moderate quality or had serious to critical risk of bias (Table 2). One study on preoperative blood tests in ASA grade I patients respected 9/10 cases series quality criteria[22], while another met half of these criteria.[38] Among studies on initial consultation and therapeutic interventions (Table 3), those on spine consultation after a thoracolumbar transverse process fracture had serious risk of bias. Among studies evaluating immobilization, RCTs had serious risk of bias or some concerns were identified, while systematic reviews were of low to critically low quality. Similarly, for post-treatment imaging and follow-up consultations (Table 4), systematic reviews were of critically low quality, RCTs had high risk of bias, retrospective studies had moderate to critical risk of bias and only 17 of 32 case series (n=17/32) met at least 70% of methodological quality criteria (Table 4).

Evidence on Initial Diagnostic Interventions

We identified eight systematic reviews (five with meta-analysis) of prospective studies[24-26,28,29,53,59,86,91] and seven prospective studies[35,37,40,51,54,79,87] evaluating routine initial imaging (i.e. X-ray or CT). We also identified two case series[22,38] evaluating routine pre-operative blood tests in American Society of Anaesthesiologist (ASA) grade I patients. Studies reported injuries would have been missed in [?] 2.0% of patients who were negative on a validated clinical decision rule for spine, knee or ankle injury, or had a negative physical exam for pelvic injury (Table 2).[25,35,51,86] One prospective study in patients $>$ 65 years old[37] reported 2.0% (95% CI 0.1 to 12.0%) of clinically relevant missed injuries (e.g. displaced fractures, subluxation) when the National Emergency X-Radiography Utilization Study (NEXUS) decision rule was used. X-rays to detect wrist injury in patients negative on a validated clinical decision rule or physical exam were associated with more divergent findings with one prospective study reporting 0% missed injuries (range: 0 to 11.4)[54] and another 10% (range 1.0 to 19.0).[87] Preoperative blood tests in ASA grade I patients requiring minor orthopaedic surgery did not lead to changes in patient management.[22,38]

Evidence on Initial Consultation and Therapeutic Interventions

We identified three systematic reviews of RCTs (one with meta-analysis)[23,39,88], six RCTs[27,55,65,73,80,81], two retrospective cohort studies[30,32] and one economic evaluation[67] evaluating consultation with a spine surgeon for isolated thoracolumbar fracture and immobilization for thoracolumbar burst fracture, scaphoid fracture

or fifth metacarpal neck fracture (Table 3). Prospective studies[30,32]identified no neurological deficit up to 6 months post-injury in patients who were not evaluated by a spine surgeon in the context of an isolated T1 to L5 transverse process fracture, mostly localized in the lumbar region. Systematic reviews[23,88] and RCTs[27,73,80] showed either no difference or less favorable physical functioning in in patients < 60 years of age who were immobilized with an orthosis for a A0-A3 thoracolumbar burst fracture compared to controls. The same was true for patients with suspected scaphoid fracture immobilized with a cast compared to those not immobilized based on magnetic resonance imaging (MRI) findings[55,65] and for patients with fifth metacarpal neck fracture immobilized with a cast or a splint compared to those in which a less restrictive approach was used (i.e. wrap).[39,81]

Evidence on Post-Treatment Imaging and Follow-Up Consultations

We identified two systematic reviews of retrospective studies (one with meta-analysis)[78,83], two RCTs[82,84], three cohort studies (one prospective)[42,52,58] and 32 case series[31,33,34,36,41,43-50,56,57,60-64,66,68-72,74-77,85,89,90]evaluating routine post-treatment imaging and follow-up consultations.

Most case series on post-treatment follow-up (Table 4) showed that [?] 5.0% of patients with a fracture of the clavicle, upper or lower extremities required a change from non-operative to operative management or had complications based on routine X-ray findings. However, a few studies conducted in the context of radius shaft or head and/or neck fractures as well as metacarpal fractures observed changes in management for 10% to 32% of patients based on such findings.[49,64] Two RCTs showed no difference in functional recovery of patients with routine follow-up imaging or consultation for distal radius[82] or ankle[84] fracture compared to those with selective approaches.

Discussion

In this rapid review, designed to synthetize the published evidence on potentially low value practices in orthopeadic trauma, we found consistent evidence of lack of effectiveness or harm for the following practices: routine initial imaging of the spine (<65 years of age), pelvis, knee and ankle in patients negative on a validated clinical decision rules or physical exam; preoperative blood tests in ASA grade I patients; spine consultation for isolated thoracolumbar transverse process fracture; immobilization with an orthosis in patients <60 years of age with A0-A3 thoracolumbar burst fractures; immobilization with a cast or splint for suspected scaphoid fracture negative on MRI or confirmed fifth metacarpal neck fracture; and routine follow-up X-ray in patients with clavicle, hip, femur, tibia, ankle or metatarsal fractures.

Studies on initial imaging of the cervical spine, pelvis, knee and ankle, consistently observed very small proportions of missed fractures in patients at low risk on validated decision rules. In addition, performing preoperative blood tests in ASA grade I patients did not lead to any adjustment in therapies. However, these results were largely based on systematic reviews of observational studies. Thus, high quality RCTs may be needed to confirm that these practices are low-value. Evidence for wrist imaging was less consistent with one study observing 10% of missed injuries.[87] However, this evidence was based on three prospective studies conducted in patients with similar types of fractures but using different decision rules.[40,54,87] This suggests that more rigorous research is needed to identify the most accurate clinical decision rule for initial imaging of the wrist.

Studies on initial consultation and therapeutic interventions provided consistent evidence of low-value care. Lack of spine surgeon consultation for isolated T1 to L5 transverse process fracture was not associated with neurological deficit. Importantly, none of the patients in these studies required either surgery or an orthosis up to 6 months post-injury, which are two treatments overseen by spine surgeons. Thus, these patients could potentially be discharged with recommendations for pain management and return to activities without a spinal surgery consultation in the presence of sufficient expertise in radiological interpretation. We found high-level evidence from systematic reviews of RCTs and RCTs suggesting that orthosis in patients <60 years of age with a A0-A3 thoracolumbar burst fracture and no neurological symptoms is associated either with no benefit or with harm. Orthosis is often prescribed to improve patient comfort but restricts patients'

movements causing discomfort and compromising sleep, which may explain why patients with no orthosis had less or equivalent disability. Similarly, we found high-level evidence from RCTs that immobilization of the fifth metacarpal neck fractures leads to greater or equivalent disability while immobilizing suspected scaphoid fractures is associated with greater disability. Thus, evidence suggests that limiting the mobility of patients with these injuries is not beneficial and may even cause harm.

Some inconsistencies in evidence were observed for post-treatment routine imaging and follow-up consultations. Fractures to the upper extremities, particularly fractures to the radius shaft and metacarpal were associated with high rates of immobilization prolongation in two studies in which routine imaging was performed.[46,64]Also, except for the clavicle, high proportions of conversion to operative management were observed for upper extremity fractures. However, these findings were based on case series in which it wasn't always clear whether included patients had no clinical indication for post-treatment imaging, such as persistent pain. One RCT conducted in patients with distal radius fractures did not show a difference in complications or functional recovery in patients with a reduced imaging approach.[82] We found consistent evidence for routine follow-up X-rays and consultations for lower extremity fractures (i.e., hip, femur, tibia, ankle, metatarsal); these practices were not associated with important changes in management or significant differences in complications or functional recovery when compared to selective use. However, apart from one RCT conducted in patients with ankle fractures[84], these findings were mainly observed in case series. Globally, these results suggest that the number of follow-up X-rays should be questioned.

Limitations

This study has some limitations. First, we may have missed important low value practices that were not identified in the scoping review or suggested by clinical experts. For example, no practices related to surgical procedures were identified although significant variability in orthopedic surgical intensity among trauma centres was reported in a recent study.[92] Second, by using a staged approach for the inclusion of studies with the most rigorous evidence, we may have missed some relevant studies. However, for practices with associated systematic reviews or RCTs, we also included studies with a lower level of evidence that were published more recently. Lastly, studies with a high level of evidence were not found for all practices and most studies were of low methodological quality or had a high risk of bias.

Conclusions

We found high-level evidence that the following clinical practices for orthopeadic injury care should be questioned: routine initial imaging of ankle injury; orthosis for A0-A3 thoracolumbar burst fracture in patients <60 years of age; cast or splint immobilization for suspected scaphoid fracture negative on MRI or confirmed fifth metacarpal neck fracture, and routine follow-up imaging for distal radius and ankles fractures. In future research, we should measure their frequency, assess practice variations, and evaluate root causes to identify those for which de-implementation interventions would be associated with the greatest benefit. If interventions targeting de-adoption are deemed appropriate, they will need to be developed with all stakeholders including clinical experts and patient partners to account for the full complexity of orthopeadic trauma, such as fracture characteristics, concomitant injuries and patient characteristics affecting healing. The reduction of low value clinical practices in the orthopaedic trauma population has the potential to reduce strain on health care systems, to improve accessibility to services and to accelerate return to daily life activities following injury.

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