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The added value of routine radiographs in wrist and ankle fractures

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General introduction and outline of the thesis

INTRODUCTION

Epidemiology

Distal radius and ankle fractures are the two most encountered skeletal injuries. Distal radius fractures represent approximately 18% of all fractures worldwide, whereas ankle fractures represent approximately 9% of all fractures.[1, 2] The incidence of distal radius fractures lies between 160 and 320 per 100,000 per annum[3] and between 101 and 187 per 100,000 per annum for ankle fractures.[4, 5] In the Netherlands, with a population around 17 million, 55,000 and 30,000 patients sustain a fracture to their distal radius or ankle, respectively. These incidences are expected to rise in the coming decades because of aging of the population, and an increased participation in athletic activities.[6, 7]

Treatment

Both fractures of the distal radius and the ankle are in close proximity to an articulating joint and can affect its functioning. Anatomical reduction, especially of the joint surface, is critical for optimal recovery and to minimalize the risk of osteoarthritis. Treatment is aimed at optimizing functional recovery. Maintaining anatomical reduction until the fracture is fully healed while reducing the risk of a complication are essential in this recovery process.[8-10]

After a fracture has been adequately reduced, this reduction can be maintained either operatively, by means of internal or external fixation, or nonoperative with use of a cast or brace immobilization. Both treatment options have their associated risk of secondary dislocation and complications. In the Netherlands, operative management is performed in approximately 20% of patients with a distal radius fracture, and approximately 50% of patients with an ankle fracture.[11, 12]

Follow-up

Following the initial treatment, whether it be operative or nonoperative, patients are monitored to examine the healing process. Follow-up in the Netherlands typically consists of outpatient clinic visits, which include routine multi-view x-ray radiography until the fracture has healed. Usually, a patient is discharged following 12-16 weeks of follow-up, which requires four visits (on average) to the outpatient clinic.[13]

Routine radiographs are common practice both for nonoperatively and operatively treated patients worldwide.[7, 13-16] The main reason to obtain follow-up radiographs is to screen for secondary dislocation of the fracture fragments that might lead to incongruity of the joint. Other reasons include monitoring of bone-healing, identification of

potential complications, reassurance to patients or to physicians, education of residents, or medicolegal motives.[15]

The current follow-up regimen for ankle and distal radius fractures arose empirically, and was, therefore, not based upon studies with a high level of evidence. Recent publications have debated the usefulness of routine follow-up radiographs in patients with distal radius and ankle fractures.[11, 17-23] These radiographs did, however, add to radiation exposure for patients and cost for the healthcare system.

When a patient with a distal radius fracture shows uncomplicated fracture healing, health-related quality of life is reported to return to its pre-fracture value after 6 months.[24] Patient-reported functional outcomes do not significantly increase after a year.[25, 26] For ankle fractures, patients reported to regain functionality between 6 to 12 months after injury.[27] One study shows that functional outcome does not improve after more than two years of follow-up.[28]

Cost-effectiveness

In the past decades, healthcare costs have risen, mostly due to increased demand for care and aging of the population.[6] As a result, more attention has been directed towards cost-effectiveness. A cost-effectiveness analysis compares the difference in costs between an intervention and a comparator with the difference in effects.[29] Effects are typically expressed as quality-adjusted life-years (QALYs). This generic utility outcome makes it possible to compare costs of interventions to one another. Policymakers can use these data, together with a budget impact analysis, to assess where to allocate funds, or what interventions are worth implementing.

One way to improve cost-effectiveness of clinical practice is to reduce low-value care. The "Choosing Wisely" campaign was initiated in 2012 with the aim to reduce low value care. That is to reduce the use of procedures, treatments and diagnostic tests if there are signs of overuse, potential harm, or significant and unjustifiable costs.[30] Routine radiography during the follow-up of distal radius and ankle fractures might be an example of a diagnostic test with questionable value, i.e., low value care.

Routine radiographs of the distal radius and ankle present a significant burdening to both healthcare and socio-economic systems.[31, 32] In the Netherlands, the cost for obtaining a multi view radiograph is €52.[33] The total amount spent on radiography for distal

radius and ankle fractures is estimated to be €19.2 million annually.* A reduction in the number of routine radiographs, therefore, could have a significant impact on healthcare expenditures.

In addition to this economic burden, the follow-up regimen encumbers both patients and physicians. Time and effort are wasted by patients traveling to the outpatient clinic, which is additionally cumbersome for those suffering from a reduced mobility as a result of their fracture. It would appear evident that follow-up regimens should, therefore, be diminished if they have no added clinical benefit.

In short, the aim of this thesis was to investigate the effectiveness and cost-effectiveness of routine radiography during follow-up in those with ankle and distal radius fractures.

OUTLINE OF THE THESIS

A systematic review was performed to evaluate the current use as well as the added value of follow-up radiography and the impact of routine radiography on extremity fractures. The results of this review are presented in **Chapter 2.**

To create insight in the current use of routine radiography in standard care, and to determine its impact on the treatment strategy two retrospective studies were conducted. One study on the use of routine radiography in patients with a distal radius fractures was published prior to the onset of this doctorate by a fellow researcher.[11] The second study regarding the use of routine radiography in ankle fracture patients is discussed in detail in **Chapter 3.**

The retrospective design makes both these studies susceptible to bias. In order to provide more definitive evidence, a prospective trial was required: The WARRIOR trial. A multi-center randomized controlled trial with a four-armed design.

One of the arms of the trial was aimed at patients with an ankle fracture. Participants were randomized between the current standard of care routine follow-up regimen and a reduced imaging follow-up regimen. The clinical and functional outcomes for both groups are presented in **Chapter 4.** The results on cost and resource usage, and cost-effectiveness of the intervention are presented in **Chapter 5.**

* Based on an annual incidence of 55,000 distal radius fractures, 30,000 ankle fractures and a median number of 4 and 5 radiographs per patient during the treatment of these fractures respectively

The second trial arm concerning patients with a distal radius fracture was similar in setting and design to the ankle fracture arm. Findings and conclusions concerning the functional outcomes of these patients are reported in **Chapter 6**, whereas results on cost-effectiveness are reported in **Chapter 7.**

Finally, for our trials' findings to be incorporated into daily clinical practice, insight on what barriers and facilitators of patients and physicians hinder or aid the implementation these results is required. **Chapter 8** reports on our study into these barriers and facilitators, and by what means and strategies our research finding may best be used by policy makers.

All studies and how to proceed with follow-up radiography are discussed in **chapter 9**. An English summary is given in **Chapter 10.** A Dutch translation and further information of the author are presented in **Chapter 11** and the subsequent **appendices**.

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