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The added value of routine radiographs in wrist and ankle fractures

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SUMMARY

Ankle and distal radius fractures are two of the most common musculoskeletal injuries. Over the last decades their incidences have risen due to increasing participation in athletic activities and ageing of the population. Current national and international protocols recommend frequent outpatient clinic visits in which radiographs of the fractured extremity are obtained.

The general aim of this thesis was to evaluate the added value of routine radiography in the follow-up of ankle and distal radius fractures. Specifically, we were interested in investigating whether a follow-up protocol which focuses on reducing the number of routine follow-up radiographs was able to deliver care that was comparable to the current standard of care, but without sacrificing quality nor safety, whilst increasing cost-effectiveness.

Chapter 1 provides background information on the epidemiology of ankle and distal radius fractures. It also outlines the current standard of care during treatment and follow-up of the affected patients.

In **chapter 2** an overview of the current literature on routine radiography in extremity fractures is given. Despite the common occurrence of extremity fractures, limited data were available on the added value of routine radiography at the time that our systematic review was performed in 2018. We identified eleven studies; however, due to their retrospective design and thus incumbent biases, the resultant quality or certainty of the evidence was considered low. Despite this, the treatment plan was modified in a very small percentage of the cases (ranging from 0 to 2.6%); therefore, the added value of routine radiography seems limited.

Following our review in 2018, we conducted a retrospective analysis in four level 1 trauma centres in the Netherlands in order to determine the impact of routine radiographs on treatment strategy for patients with ankle fractures. **Chapter 3** illustrates that, in accordance with studies outlined in chapter 2, the use of routine radiographs in the follow-up of ankle fracture patients in the Netherlands was common. In total, 80% of radiographs obtained after more than three weeks of follow-up were considered routine, and only 1.2% of these radiographs resulted in a change of treatment strategy. However, due to its retrospective design, the strength of the evidence was also considered low given its limitations.

Chapters 4 and 5 report on the results of a multi-centre randomized controlled trial (RCT) in which participants with an ankle fracture were randomized between the current standard of care consisting of routine follow-up radiography (routine care) and a reduced imaging follow-up regimen. The clinical and functional outcomes outlined in **chapter 4** suggest that routine radiographs at week 6 and 12 can be omitted without compromising treatment outcomes. Specifically, functional outcome measured with the Olerud and Molander Ankle Score was non-inferior in the reduced imaging group, while secondary outcomes, such as American Association of Orthopedic Surgeons (AAOS) foot and ankle scores, Health-Related Quality of Life (HRQoL), pain, health perception and self-perceived recovery did not differ between groups. The median number of radiographs obtained was 4 in the reduced imaging group and 5 in the routine care group (a reduction of 20%). Similar numbers and types of complications were observed in both groups; therefore, modifying the current standard of care can be implemented without sacrificing quality nor safety. In **chapter 5** the results of the economic evaluation of the reduced-imaging follow-up strategy for ankle fracture patients are presented. Patients randomized to reduced imaging had a similar HRQoL in comparison with patients randomized to routine care. Costs for radiographic imaging were significantly lower in the reduced imaging group (a difference of €48 (95% CI: €-72 to €-28)). Other costs, including overall costs did not statistically differ between the groups. The probability of cost-effectiveness was 0.45 at a willingness-to-pay of €20,000 per QALY.

Chapters 6 and 7 report on the outcomes from the same RCT, but which focused on patients with a fracture of the distal radius. Similar to the results of the RCT on ankle fractures, functional outcome (measured with the Disabilities of Arm, Shoulder and Hand questionnaire [DASH]) was no worse than the reduced imaging group (**chapter 6**). Secondary outcomes such as HRQoL, pain and complications demonstrated similar outcomes between the groups. The number of radiographs obtained per patient decreased 25% to median 3 in the reduced imaging group from median 4 in the routine care group. The results of the economic evaluation described in **chapter 7** demonstrated similarities to the results of the study on ankle fractures. HRQoL was similar, and costs for radiographic imaging were significantly lower in the reduced imaging group (this reduction was €48 per patient (95% CI: -68 to -27)). The probability of cost-effectiveness was 0.8 to 0.9 at willingness-to-pay of €20,000 to €80,000 per QALY.

Following these analyses, we investigated which factors could encourage or discourage physicians to modify their practice behaviours, namely reduce their reliance on routine follow-up radiographs of extremities. These so-called “barriers and facilitators” were queried among orthopaedic trauma surgeons in the Netherlands (**chapter 8**). In total, 130 respondents (57%) completed the questionnaire, 71% indicated that they would

stop ordering routine radiographs if they demonstrated no added value. In short, we identified three facilitators which were found to be independent predictors for the intention to de-implement routine radiographs: 1) 'the reduced imaging follow-up protocol will lead to lower healthcare costs'; 2) 'incorporation of the reduced imaging follow-up in regional protocols'; and 3) 'reduced imaging will result in time-savings for the patient'. There was no barrier that was found to be an independent predictor for the intention to reduce the reliance on routine radiographs. With the three facilitators in mind, a proper de-implementation strategy can be drafted for the Netherlands, and other populations similar as ours.

In **chapter 9**, I present general conclusions and discuss the clinical implications and future perspectives regarding the effectiveness and cost-effectiveness of routine radiography in ankle and distal radius fractures. This large multi-center study demonstrates that the number of routine radiographs in those with ankle and distal radius fractures can be reduced without sacrificing quality nor safety, while resulting in more cost-effective care