Falling in the Netherlands: prevention, care, and follow-up of fall-related injury
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Discussion

Chapter 1: staircase falls

Staircase falls occurred in all age groups. A first analysis of the results revealed that there are many children involved in staircase falls. However, only when the data were compared with the age distribution in the Netherlands did we learn that staircase falls are indeed a problem in older people. There was another marked characteristic about the age distribution in this study. When the age and gender distribution were compared with other reports on falls in literature it seemed that this population is a mixture of falls from height (predominantly young adults) and low falls (predominantly female). This is why the image of staircase falls was chosen as a cover of this thesis.

The injuries involve mostly the extremities. This is not surprising because the extremities are likely to absorb most of the energy in a staircase fall. Young children, however, lack sufficient defense mechanisms of their arms and hands. Furthermore, their heads are relatively larger than that of adults. These two things may explain largely why head injuries are relatively more common in young children. This may be affirmed by the idea that parents are inclined to take their child to the Emergency Department more easily then after extremity injury. Despite the fact that this study was done in an Academic Hospital the data were in line with national data on staircase falls.

Although staircase falls in general may be difficult to prevent, the very young and the very old may be the most easy groups to approach for prevention of falls. Falls in the youngest age group are best prevented by stair gates at the top and the bottom of the stairs. Falls in the older people may be prevented by stimulating those with walking difficulties or recurrent falls to move to apartments without stairs.

Chapter 2: u-shaped sacral fractures

These sacral fractures are rare and severe injuries. They result from a high-energy impact. In our cohort this was a free fall from height. The patients most likely landed on their feet, absorbing most of the energy with their spine. The high-energy impact meant that all patients had severe associated injuries. These associated injuries caused considerable heterogeneity in this small cohort. For example, four types of fracture stabilization were used in the eight patients. Moreover, the associated injuries obscured the analysis of the postoperative mobilization and quality of life.

As might be expected in polytraumatized patients, pain and mobility problems were frequent complaints in the follow-up. Despite this all patients
were alive. Furthermore, the (severe) neurological status tended to improve over the years. Therefore, the authors believe that aggressive and optimal care and support are important and rewarding in these patients. Because the injury pattern is rare and highly complex, these patients should be referred to (academic) medical centers who have a wide expertise in both pelvic and spinal surgery.

Chapter 3: calcaneal fractures
Calcaneal fractures are also relatively rare and severe injuries. Much like the sacral fractures they result from high-energy impact. The most common cause is a fall from height. Because the calcaneus has a complex structure and fractures are difficult to assess, we classified the fractures in consensus meetings with an experienced trauma surgeon and trauma radiologist. An unexpected finding was the absence of a correlation between the fracture characteristics and the quality of life. We believe that the effect of fracture characteristics is neutralized by the open reduction and internal fixation. However, proper prospective assessment is required to determine this. Despite the fact that these patients participate less in sports and activities, their daily activities seem little effected. Furthermore, the quality of life is only slightly less than the general Dutch population. This is another expression of support for aggressive and optimal care for these severely injured patients. Because of the complexity of the calcaneus with its many articular surfaces, the operative treatment should preferably be performed in high volume expert centers.

Chapter 4: prevention of Venous Thrombo-Embolisms (VTE) in trauma patients
There are multiple ways in which the prophylaxis of VTE can take place. However, it is beyond debate that medicinal prophylaxis is the most effective. The Low Molecular Weight Heparins (LMWH) and fondaparinux are the most effective medicines. There are largely four categories of trauma patients from a VTE prophylaxis point of view. The first category concerns the lower extremity injuries. LMWH significantly reduce the asymptomatic Deep Venous Thrombosis (DVT). However, the clinical significance of this asymptomatic VTE is subject of international debate. The second category concerns the patients with a hip fracture. The effectiveness of LMWH and fondaparinux in these patients is universally recognized. Category three concerns the polytraumatized and neurotrauma patients. The prevalence of VTE in these patients is high and they would certainly benefit from VTE prophylaxis. However, the problem in these patients is the equilibrium
between the increased risk of VTE from the systemic reaction to the injuries, and the increased risk of bleeding from the injuries themselves. The final category concerns the burn patients. Although they are likely to benefit from VTE prophylaxis, the evidence is currently lacking. Based on the rules of ‘Evidence Based Medicine’ (scientific evidence with a twist of common sense) there seems to be a trend towards an expending use of VTE prophylaxis, even in the polytraumatized and neurotrauma patients. A strategy for VTE prophylaxis must be made in every trauma patient. New medicines are being developed and subjected to trials as this thesis is finished. In the future, the availability of reliable and effective oral anticoagulants will likely cause a more liberal use in most (ambulant) patient groups. Especially the prophylaxis in ambulant patients with lower extremity immobilization or after hip fractures will be implemented and carried out easier.

Chapter 5: abdominal injuries in free falls from height
Serious injury or even death can happen after any fall, independent of the height. However, the higher the fall the smaller the chance of survival. In this study we arbitrarily set the threshold at five meters or more. By eliminating the people who fell or leaped from one story high, we aimed at the patients who sustained a free fall from great height. The assessment and resuscitation of trauma patients in our hospital is aided by the Focused Abdominal Sonography for Trauma (FAST). In addition we have a CT scanner available in the resuscitation room. Therefore, early and complete imaging was done in all patients. In addition, the injury scoring was done by the trauma surgeons that were responsible for the resuscitation. In doing so we tried to make sure we missed as few injuries as possible. Another important diagnostic as well as therapeutic tool was the intervention radiology (intravascular coiling). This was used to detect and stop arterial bleeding in 1/6th of the patients with abdominal injuries. In most of these the intravascular coiling was enough to stop the bleeding. Only two patients had to be transferred on to the operating room. The mortality in this cohort was lower than in other reports. However, abdominal injuries were a significant predictor for mortality. The falls described in this Chapter may be difficult to prevent, especially because one in four falls is intentional. However, many work-related falls may be preventable by stricter safety rules for professionals working at height.

Chapter 6: temporary closure of the open abdomen
The poor quality of the available studies for this systematic review presented a challenge to the authors. The absence of comparative trials caused an overall lack of proper methodology. Few articles described how they selected
patients. In addition, the severity of the underlying condition was infrequently and heterogeneously reported. Another difficulty was that not all techniques were used in all patient groups. Furthermore, the choice of technique was often left to the discretion of the operating surgeon and techniques were not standardized. Despite the heterogeneity a good effort was made to collect all the data. Thanks to a good calculation method by one of the authors (MGWD) we were able to analyze the data and draw some very careful conclusions. The main conclusion is that the techniques with the highest fascial closure rate also have the lowest mortality rate. However, the severity of the underlying condition may be a major confounder. More, and preferably prospective, research is needed to determine the best technique for temporary closure of the abdomen. However, the authors have experienced firsthand that the methodology and feasibility of such trials are difficult.

Chapter 7: the construction and validation of the CAREFALL Triage Instrument (CTI)
After constructing the CTI, the construct validity, clinical validity, and test-retest reliability were tested. First the construct validity: would the CTI be able to identify more risk factors in patients with a higher risk of recurrent falls? The CTI did indeed identify these differences. Furthermore, it was able to correlate age, gender, risk factors and recurrent falls. Secondly, we tested the clinical validity. How would the CTI correlate with the clinical assessment at the Fall-Prevention Clinic? This correlation turned out to be fair to good depending for the different risk factors. Given the difference in assessment, this result was considered good. Thirdly, we tested the test-retest reliability. Depending on the risk factors, this reliability was poor to substantial. In this population of older patients, this was an acceptable result. Strikingly, the behavior of most of the risk factors was the same in the clinical validity and in the test-retest reliability. The CTI is a valuable tool for assessing risk factors for recurrent falls. It is an evidence base self assessment questionnaire to aid secondary falls prevention. The authors recommend the use of the CTI for all older patients who visit the ED after a fall from standing height.

Chapter 8: the extended use of the CTI
The CTI was developed for secondary fall-prevention in older people who came to the ED after a fall. However, there are also community-dwelling older people who fell before. They might benefit from secondary fall-prevention too. Therefore we extended the use of the CTI. The objective was to establish the value of the CTI in community-dwelling older people. A cohort of community-dwelling older people were matched and compared
with a cohort of older patients who came to the ED after a fall. Although the prevalence of risk factors was higher in the ED cohort, there was a significant association between the number of risk factors and recurrent falls in the cohort of community-dwelling older people. The more risk factors, the higher the risk of recurrent falls. This is in line with literature. Multiple studies have shown that it is the number of risk factors rather than the individual risk factors that increase the risk of falling. Therefore, community-dwelling older people may benefit from the CTI to reduce the risk of recurrent falling. Secondary fall-prevention in community-dwelling older people is important in reducing the number of people with fall related injury. The CTI is recommended for secondary fall-prevention in community-dwelling older people.

Chapter 9: the osteoporosis and fracture risk
This Chapter is the link between fall-prevention, osteoporosis and fracture risk. Thanks to the set up of the mobile, touring fall-prevention program, we were able to contact many older people close to their home. Thereby, we allowed more people to join the program. However, the results may indicate that the people with severe immobility were still missed by the program. The distribution of risk factors in this cohort differs from our previous reports on this population. This may indicate that, although these were relatively large samples, it is difficult to get a representative picture of this population. In this cohort, the DXL Calscan proved to be a valuable tool for assessing osteoporosis. It is often stated that we should screen all older people who present with a fracture (regardless of the cause) for osteoporosis. The relatively small dimensions of the devise allow it to be used in the ED or at any Osteoporosis outpatient clinic. In addition, more hospitals should start Fall-Prevention Clinics or cooperate with nearby hospitals that already have Fall-Prevention Clinics. The CTI is recommended as a tool for selecting patients that may benefit from these Fall-Prevention Clinics. That is the way forward in secondary fall and fracture prevention.