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Review

Identifying a standard set of outcome parameters for the evaluation of orthogeriatric co-management for hip fractures

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SUMMARY

Background and purpose: Osteoporotic fractures are an increasing problem in the world due to the ageing of the population. Different models of orthogeriatric co-management are currently in use worldwide. These models differ for instance by the health-care professional who has the responsibility for care in the acute and early rehabilitation phases. There is no international consensus regarding the best model of care and which outcome parameters should be used to evaluate these models. The goal of this project was to identify which outcome parameters and assessment tools should be used to measure and compare outcome changes that can be made by the implementation of orthogeriatric co-management models and to develop recommendations about how and when these outcome parameters should be measured. It was not the purpose of this study to describe items that might have an impact on the outcome but cannot be influenced such as age, co-morbidities and cognitive impairment at admission.
Methods: Based on a review of the literature on existing orthogeriatric co-management evaluation studies, 14 outcome parameters were evaluated and discussed in a 2-day meeting with panellists. These panellists were selected based on research and/or clinical expertise in hip fracture management and a common interest in measuring outcome in hip fracture care.
Results: We defined 12 objective and subjective outcome parameters and how they should be measured: mortality, length of stay, time to surgery, complications, re-admission rate, mobility, quality of life, pain, activities of daily living, medication use, place of residence and costs. We could not recommend an appropriate tool to measure patients' satisfaction and falls.

We defined the time points at which these outcome parameters should be collected to be at admission and discharge, 30 days, 90 days and 1 year after admission.
Conclusion: Twelve objective and patient-reported outcome parameters were selected to form a standard set for the measurement of influenceable outcome of patients treated in different models of orthogeriatric co-managed care.

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Contents

Introduction

Osteoporotic fractures are an increasing problem in the world due to the ageing of the population. Older adults with osteoporotic fractures frequently have one or more co-morbidities, making the treatment of these patients complex. These fractures can lead to an increased risk of mortality, disability, complications and high health-care costs [1–3]. Due to the unsatisfactory treatment outcomes often seen in patients with osteoporotic fractures, multidisciplinary treatment approaches have been implemented to improve outcome [4].

A common multidisciplinary approach is a highly focussed team: orthopaedic surgeons, anaesthesiologists and geriatricians work together to reduce the number and severity of complications often seen in the usual treatment of patients with osteoporotic fractures. Other 'team members' such as physiotherapists, study nurses and nutritional care and physician assistants can contribute to the multidisciplinary treatment approach. Different models of orthogeriatric co-management are well described by Giusti et al. [5] and can be distinguished by the health-care professional who has the responsibility of care in the acute and early rehabilitation phases. These orthogeriatric models have been implemented in many institutions, have different key elements and use different outcome parameters [4,6].

Some of the models have proven to be effective [7], but there is no consensus about the best possible treatment model. In order to compare the different models, it is important to agree on which outcome parameters should be measured and how they should be measured [6,8].

Although no consensus about the goals of an orthogeriatric co-management exists yet in the literature, some primary targets have already been suggested [9–11]. The main goals of an orthogeriatric co-management are:

- return to pre-fracture status as soon as possible,
- improvement of patient and family satisfaction,
- reduce complication, re-admission and mortality rates,
- provide best value of care to the health system and
- initiate secondary fracture prevention.

Our goal was to propose a definition of a standard set of outcome parameters which could be used in evaluation and comparison research studies of different models of orthogeriatric co-management used in hip fracture treatment. We also wanted to define time points for the evaluation of these parameters. These outcome parameters should be relatively easy to assess and should be able to evaluate the degree of achievement of the main goals of an orthogeriatric co-management.

Methods

List of outcome parameters

In order to establish a list of outcome parameters that should be considered in the evaluation of orthogeriatric co-management, the existing literature was reviewed. The systematic review of Kammerlander et al. [4] was used to identify studies comparing standard care and orthogeriatric co-management. The most-used outcome parameters based on frequency from the different studies

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presented in the review paper were selected. The following outcomes were further analysed:

- mortality,
- length of stay,
- time to surgery,
- complications,
- re-admission rate,
- mobility,
- quality of life,
- pain,
- satisfaction,
- activities of daily living,
- falls,
- medication use,
  - inappropriate medication and
  - osteoporosis medication
- place of residence and
- costs.

Literature search

A systematic literature search was conducted, using MEDLINE and Google Scholar, in order to find studies evaluating the use of the outcome parameters in general and specifically for osteoporotic fractures. The search was conducted between April 2011 and November 2011. The search terms are listed in Appendix A. Epidemiology studies on osteoporotic fractures, studies that evaluated orthogeriatric co-management and validation studies of the outcome parameters were used for this evaluation.

Evaluation of outcome parameters

Every outcome parameter was evaluated using the following items:

- Background: evaluation of the outcome parameter and specific information in relation to hip fractures and orthogeriatric care.
- Acquisition: evaluation about how this outcome parameter should be collected and measured (e.g., which questionnaire of score should be used).
- Follow-up: at which time points the outcome parameter should be assessed.
- Relevance from several perspectives:
  - patient: the importance of the outcome parameter from a patient's point of view,
  - health-care professionals: the outcome parameter from the point of view of the health-care professionals (e.g., orthopaedic surgeon and geriatrician) and
  - health-care systems: the outcome measure from the point of view of the community and government.

An appropriate instrument was selected using the following four considerations: respondent (patient, family member and caregiver) burden, examiner burden, score distribution and format compatibility [12]. A practical instrument would be of minimal burden to the respondent and examiner, have an adequate score distribution and have a format that is compatible with the respondents' age, culture, language and abilities [13].

Multidisciplinary meeting

In August 2011, a 2-day interdisciplinary meeting was organised in Rochester, NY, USA, using a non-structured consensus development conference method, where a panel of experts come together in a face-to-face meeting, discuss key questions and seek to reach consensus [14]. The main goal of this meeting was to generate a consensus among our group regarding which outcome parameters should be used for the evaluation of orthogeriatric co-management. Orthopaedic surgeons, trauma surgeons and geriatricians from Europe, USA and Canada with clinical and scientific expertise in hip fracture management were selected to take part in the conference. Each member who participated is a well-known expert in some aspect of care of elderly fracture patients. Prior to this conference, the literature was reviewed as described above. These findings were presented and every outcome parameter was discussed separately until an agreement by majority was reached. The process was sponsored and supported by AOTrauma. After the meeting, the accepted parameters were reviewed by another group of seven experts in the field for review and comment.

Results

Mortality

Mortality is a common outcome parameter reported in the medical literature. It is known that mortality rates after osteoporotic fractures of the shoulder, hip and spine are increased in comparison to the age-matched population, but the reasons for this remains unclear [15–18]. Mortality is clearly an important outcome parameter to be measured.

In-hospital mortality is frequently used as an outcome parameter, but it is difficult to use in an international comparison study because of the different lengths of stay between countries (see Table 1). To evaluate short-term mortality, the 30-day mortality should be assessed and the 1-year mortality should be assessed as long-term mortality. The time frame for calculating mortality should be from admission up to 30 days and 1 year after admission, respectively.

Length of stay

In most health-care systems, length of stay (LOS) in the acute hospital has been reduced [19]. LOS varies greatly between health-care systems because it is dependent on public expectations, culture and values [20] and should therefore not be compared between countries. Table 1 gives an overview of the LOS before and after implementing an orthogeriatric co-management programme published in the last 10 years.

LOS has a direct correlation with costs and is therefore an important outcome parameter for the health-care system and the payers. LOS can also be a good reflection of the quality of the discharge process.

We agreed that LOS should be calculated using the midnight census method, counting the number of midnights spent during

Table 1
Length of stay before and after implementing orthogeriatric co-management programmes.

Study	Country	LOS (days)	
		Usual care	Orthogeriatric care
Naglie et al. [80]	Canada	20.9	29.2
Khan et al. [81]	UK	26.1	26.9
Roberts et al. [82]	UK	37.2	40.6
Koval et al. [83]	USA	21.6	13.7
Fisher et al. [84]	Australia	16.4	15.9
Cogan et al. [85]	Ireland	23.1	30.3
Adunsky et al. [86]	Israel	31.9	26.9
Stenvall et al. [87]	Sweden	40	30
Vidan et al. [88]	Spain	18	16
Khasraghi et al. [89]	USA	8.1	5.7
Shyu et al. [90]	Taiwan	9.7	10.1
Friedman et al. [91]	USA	8.3	4.6

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Table 2
Time to surgery before and after implementing an orthogeriatric co-management.

Study	Country	Time to surgery (days)	
		Usual care	Orthogeriatric care
Naglie et al. [80]	Canada	1.4	1.3
Cogan et al. [85]	Ireland	2.4	1.9
Adunsky et al. [86]	Israel	3.5	3.6
Vidan et al. [88]	Spain	3.27	3.16
Khasraghi et al. [89]	US	1.92	1.08
Friedman et al. [91]	US	1.56	1.00

admission in the acute hospital. We have chosen the acute hospital LOS because this can be influenced by a multidisciplinary treatment approach and is widely used in the literature. A reduction of LOS (before or after implementing an orthogeriatric co-management programme) is a more important factor than the absolute number LOS because of the differences between health-care systems.

Time to surgery

Time to surgery is one of the most discussed and investigated outcome parameters in hip fracture treatment. The influence of time to surgery on mortality is still unclear, but a shorter time to surgery is associated with a decrease in the complication rate and LOS [21]. Evidence about the maximum time to surgery is inconclusive, but some suggest that it is important to keep the time to surgery within 48 h to reduce major complications and better would be to keep the time to surgery within 24 h to reduce even minor complications [22]. Time to surgery can be reduced by effective collaboration between the orthopaedic surgeon, geriatrician and anaesthesiologist with the implementation of an orthogeriatric co-management programme (Table 2).

A significant difference is observed between the time from fracture to surgery and the time from admission to surgery, but this difference has no influence on the in-hospital mortality [23]. As the time of fracture is not always available and difficult to assess in cognitively impaired patients, the time to surgery should be calculated (in hours) from the time of admission on the emergency department until the time the patient enters the operating room/theatre.

Complications

Accurate and consistent reporting of complications is essential in clinical medicine since their nature and frequency gives us information about the quality and safety of care. Therefore, it is surprising that there is no prior consensus reported regarding the definition, classification and assessment of complications after hip fractures [24].

After reviewing the literature regarding the most common complications following osteoporotic fractures and discussing these complications, the definitions of complications presented in Tables 3 and 4 are recommended to assess outcomes.

We decided not to distinguish between minor and major complications or the severity of complications. This would make the assessment too complex and subjective.

Medical complications should be assessed at the time of patient discharge (from the acute hospital) to evaluate the in-hospital complications and at 30 days following hospital admission. Surgical complications should be assessed at the time of patient discharge, at 30 days and at 1 year following hospital admission.

Re-admission rate

Hospital re-admission rate is widely used as a measure of the quality of care and cost-effectiveness [25,26]. Hospital re-admission is an additional burden for patients. There is no consensus about the definition of re-admission rate and the time period of assessing re-admission rates in the literature [26]. Reported re-admissions in the literature following hip fractures are 18.3% and 32% after 30 days and 1 year after discharge, respectively [27–31].

We defined a re-admission as a non-elective hospital admission related to the initial fracture. The time-point classification of the re-admission is the same classification used to assess complications (medical and surgical).

Medical re-admissions should be assessed at 30 days and 90 days following the first admission. Surgical re-admissions should be assessed at 30 days, 90 days and 1 year following the first admission.

As not all re-admissions occur in the same initial hospital, the patient or proxy should be asked at the follow-up time points whether any re-admission has occurred. Additional data, if necessary, can be obtained from the attending physician, hospital data system or health-care system.

Table 3
Definitions of medical complications.

Medical complication	Definition
Cardiac complications	Any cardiac complication affecting the diagnosis or the management of the patient
Cerebral complications	Any cerebral complication affecting the diagnosis or the management of the patient
Thrombo-embolic complications	Any thrombo-embolic complication affecting the diagnosis or the management of the patient
Pulmonary complications	Any pulmonary complication affecting the diagnosis or the management of the patient
Renal failure	Threefold increase of serum creatinine concentration, or serum creatinine $\geq$4 mg/dL with an acute rise $>$0.5 mg/dL, or an urine output of $<$0.3 mL/kg/h $\times$ 24 h, or anuria $\times$ 12 h
Urinary tract infection (UTI)	Any UTI affecting the management or treatment of the patient
Delirium	Diagnosed with CAM-score or clinically diagnosed in the chart at any time during admission
Pressure ulcer	Any new pressure ulcer (stages I–IV)
Gastro-intestinal (GI) complications	Any GI complications affecting the management or treatment of the patient
Adverse drug reactions (ADR)	An ADR is harm directly caused by the drug at normal doses and during normal use, needing an intervention
Subsequent fracture	Any new fracture requiring treatment unrelated to the first fracture

Table 4
Definitions of surgical complications.

Surgical complication	Definition
Surgical site infection	Any surgical site infection requiring an additional surgery or readmission
Surgical complication	Any surgical complication related to treatment requiring surgery or readmission (including periprosthetic fractures)

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Mobility

The functional status of geriatric patients is known to be predictive of mortality and other outcomes, such as loss of independence, nursing home admission, onset of dementia and falls [32]. A reduced functional status has also an influence on quality of life and health-care costs [32].

Returning to pre-fracture status is one of the goals of orthogeriatric co-management; therefore, we felt that a measure that can assess pre-fracture mobility is mandatory. The literature suggests that the Parker Mobility Score (also known as the New Mobility Score) [33] is the most satisfactory instrument to assess pre-fracture mobility at admission and at post-discharge follow-up at 90 days and 1 year. We felt that it is important to assess objective mobility in addition to subjective mobility in order to get a more satisfactory overview of the patients' functional ability. The Timed Up and Go (TUG) test [34] is a commonly used mobility score and has shown to be valid and reliable [35]. The TUG test was chosen as it requires only a few minutes to perform and no specific resources other than provider time and a chair to accomplish. In order to get an objective assessment of the patient's mobility, we recommend that the TUG test should also be assessed at 90 days and 1 year after admission.

Quality of life

The importance of the patients' perception of their care in the literature has increased over the past few years [36]. In order to put a realistic value on osteoporosis and osteoporotic fracture treatment, it is important to understand the full impact of osteoporotic fractures on quality of life (QoL). Without QoL data, the burden of osteoporotic fractures is likely to be underestimated [37].

The EQ-5D is recommended in the literature to assess QoL in elderly patients [35,38,39]. Although the EQ-5D shows good psychometric properties in elderly patients, assessing QoL in cognitively impaired patients is difficult. In people with mild and moderate dementia, the EQ-5D shows good validity and good to average test–retest reliability for the descriptive system, but not for the Visual Analogue Scale (VAS). Proxy assessment is, in some cases, the only way to collect information about the QoL, when patients are unable to respond. Family caregivers have a tendency to overestimate health limitations for less visible items (pain and anxiety/depression). Health-care professionals more often rate the patients at the same level for all five domains (some problems with everything). No consensus has been reached about the most appropriate proxy, but proxy assessment of the EQ-5D seems in our judgement the best option to assess QoL in patients with severe dementia [40].

The QoL should be assessed using the EQ-5D at admission to determine the pre-fracture QoL and in the follow-up at 90 days and 1 year after admission. In patients with severe dementia, the EQ-5D should be completed by a proxy, if one is available.

Pain

Pain is originally assessed in the EQ-5D, but the VAS used in the EQ-5D is not reliable in cognitively impaired patients [40]. Thereby, the VAS within the EQ-5D rates the overall body pain and we are also interested in the fracture site pain.

The Verbal Rating Scale (VRS) performs well in patients with dementia [41–43]. We reached an agreement that the VRS should be assessed to evaluate fracture-site pain on the second day after surgery or in case of a conservative treatment, the second day after admission and at 90 days and 1 year after admission.

Satisfaction

Measuring and analysing satisfaction data are important in the consideration of how to improve the quality of care we provide to our patients. On an individual level, improved satisfaction with care could result in a greater patient compliance with care [44]. Although many satisfaction instruments are available, none have been designed or validated for surgical practice [44]. A majority of these instruments focus on interpersonal manner of health-care professionals, but only a few instruments assess satisfaction with process or outcomes of care [44].

As satisfaction is one of the main goals of an orthogeriatric co-management programme, our group thought that it should be assessed. We believe that the available instruments have a great respondent burden and are not applicable in elderly patients. In the absence of an appropriate and validated instrument, we cannot make a recommendation about the assessment of satisfaction and this outcome parameter.

Activities of daily living

Activities of daily living (ADLs) are an important health outcome in the geriatric population. Functional decline can lead to disability and may lead to a prolonged hospital stay, institutionalisation and even death [45–47]. Achieving pre-fracture health and functional level is one of the main goals in hip fracture management [48]. Therefore, assessing ADLs over time is important to monitor the improvement or deterioration in functional level.

The literature suggests a great variation of ADL measurement tools, but the Katz Activities of Daily Living Scale [49], the Barthel Index [50] and the Functional Independence Measure (FIM) [51] are the most widely used tools [35,52]. The FIM is the most objective tool but requires training in its use and has great examiner burden. The Barthel Index shows a better score distribution than the Katz Scale [52] and our group concluded that the Barthel Index is the most applicable instrument to assess ADL.

In many cases, it may prove difficult to assess pre-injury ADLs accurately at the time of admission. In such cases, the authors suggest that a proxy be consulted, who will typically be a family member, friend or caregiver.

The time points discussed at which ADLs should be assessed should be at admission to evaluate the pre-fracture status and at discharge from the acute hospital. In the patient follow-up, ADLs should be assessed after 90 days and 1 year after admission.

Falls

Falls are common in the elderly; 34% of community-dwelling older adults fall each year [53]. The incidence in the institutionalised elderly is even higher with an average of 43%. Accidents are the fifth leading cause of death in older adults, of which two-thirds are caused by falls [53]. Approximately 6% of the elderly above 60 years sustain a fracture after a fall [54].

Fall prevention is an important element of secondary fracture prevention, which is one of the main goals of an orthogeriatric co-management programme. Intervention programmes for the elderly to prevent falls have proven to be successful [55] and cost-effective [56].

Most studies examining falls or fall prevention programmes have assessed the number of falls by asking the patient [57–59]. This method of assessment can be unreliable in cognitively impaired patients, and no standardised and validated score or questionnaire is available in the literature.

Although fall assessment and prevention should play a more prominent role in fracture prevention [60], we feel that the

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assessment of falls is too unreliable, because of the lack of validated assessment tools. We cannot recommend a fall assessment tool, but major falls resulting in a new fracture will be recorded as a complication (subsequent fracture). For individual patients, a fall diary can be of use to assess the fall risk.

Medication use

Inappropriate medication

Drug-related problems and toxic effects of medications can have severe medical consequences for the elderly population and are costly to health-care systems. In ambulatory older adults, 35% experienced an adverse drug event and 29% required health-care services [61]. It is estimated that medication-related problems contributed to 106,000 deaths annually at a cost of $85 billion in the year 2000 in the US [61].

In 2008, new criteria were established to detect inappropriate medication and to make physicians aware of 'right treatment' [62]. The Screening Tool of Older Person's Prescriptions (STOPP) criteria consist of 65 clinically significant criteria for potentially inappropriate medications and the Screening Tool to Alert doctors to Right Treatment (START) criteria consist of 22 evidence-based prescribing indicators for commonly encountered diseases in older adults.

Our group felt that the START and STOPP criteria were too extensive to use as an outcome parameter and should be reduced in order to make them applicable in this setting. The outcome of inappropriate medication can also be assessed with the adverse drug reactions (ADRs) with the assessment of complications at discharge and 30 days (see Table 3). Until applicable criteria are available, we recommend that the ADRs should be assessed to evaluate inappropriate medication use.

Osteoporosis medication

The pathophysiology of osteoporosis is well understood and treatment is available, but most geriatric patients who suffer a hip fracture are not receiving adequate treatment [63]. Osteoporosis treatment has been proven to reduce the fracture risk, but compliance is poor [64,65].

Osteoporosis therapy should be carefully evaluated for every hip fracture patient and the consensus panel supports the use of osteoporosis treatment for hip fracture patients. The use of osteoporosis medication should be assessed at admission and discharge from the acute hospital with the following options:

- General medication:
  - calcium and
  - vitamin D
- Specific medication:
  - bisphosphonates,
  - selective oestrogen receptor modulators,
  - parathyroid hormone,
  - strontium ranelate and
  - denosumab.

To evaluate the continuation of the osteoporosis therapy, the treatment should also be assessed at 90 days and 1 year after admission.

Place of residence

Due to the decrease in hospital LOS, discharge destination may often shift from home to nursing homes [66]. Discharge destination and aftercare of patients with hip fractures are important components of costs. One of the primary goals of orthogeriatric co-management is help the patient to achieve their pre-fracture living status. Therefore, it is important to evaluate whether patients can return to their pre-fracture living situation. Any reduction in independence can result in extra health-care costs and is essential for cost-effectiveness analysis.

To assess the living situation in different countries, the list of possible living situations needs to be general and brief to make it applicable for different health-care systems. It is difficult to assess how much help people receive at home. The living situations and their definitions are presented in Table 5. The living situation should be assessed and recorded at hospital admission to determine the pre-fracture living situation. The discharge destination should not be assessed because this is often a temporary living situation. We recommend the reassessment of living situation at 90 days and 1 year.

Costs

Economic outcomes have become more important in clinical trials because the acceptance and use of new interventions may be determined by their cost as well as by their clinical value. Cost-effective analysis is a tool developed to assist decision makers to evaluate the expenditures made in alternative treatment programmes.

The economic costs of hip fractures include the costs of acute hospitalisation, aftercare including rehabilitation and costs attributable to the impact of fracture on daily life and on family members. Hip fractures have a large financial burden on health-care systems [67]. The estimated costs of hip fractures are $10.8 billion in the US and €36 billion in Europe annually [68,69].

We recommend that costs should be assessed as the acute hospital charges using a predefined spreadsheet where the following costs can be evaluated: cost of a regular hospital bed-day, cost of an intensive care bed-day, pharmacy cost, laboratory cost, diagnostic imaging cost, operation room costs, pre-operation room costs, cardiology cost, emergency department cost, medical supply cost and other costs not included in the list [7,9].

We chose to assess only the costs from the acute hospital because they are measurable in essentially all health-care systems. Different health-care systems have different post-discharge treatment options available for older adults. Unfortunately, we were unable to determine any method to measure post-discharge care costs that would apply broadly to most health-care systems. Additionally, the costs in the acute hospital are something we can directly influence with the multidisciplinary treatment approach.

Costs can differ between countries due to differences in health-care systems; the costs from the orthogeriatric co-management programme should be compared to the national expected or average costs from that country.

A summary of the discussed outcome parameters, the assessment tools and their follow-up period is presented in Table 6. The questionnaires and scores are presented in Appendix B.

Table 5
Possible living situations and definitions.

Living situation	Definition
Home	Patients who are living at home. This includes patients who live at home with newly acquired help
Residential home/assisted living	Patients who live in a residential home and need assistance with medications but minimal assistance with ADLs
Skilled nursing facility	Patients who live in a facility and need assistance with medications, ADLs and medical care
Other	This includes hospice and palliative care

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Table 6
Overview of the outcome parameters, the assessment tools and their follow-up.

Outcome parameter	Assessment tool	Admission[a]	Discharge[b]	30 days	90 days	1 year
Mortality	Mortality rate (%)			X		X
Length of stay	Midnight census method		X			
Time to surgery	Time from admission until arrival in operating room (h)		X			
Complications	Complication rate (%) using the complication list					
Medical			X	X		
Surgical			X	X		X
Readmission	Readmission rate (%) using the complication list					
Medical				X	X	
Surgical				X	X	X
Mobility	Parker mobility score	X			X	X
	Timed up and go				X	X
Quality of life	EQ-5D	X			X	X
Pain	Verbal rating scale	X[c]			X	X
Satisfaction	No appropriate tool available					
Activities of daily living	Barthel index	X	X		X	X
Falls	No appropriate tool available					
Medication use						
Inappropriate	Adverse Drug Reaction with Complications		X	X		
Osteoporosis	Medication list	X	X		X	X
Place of residence	Living situation list	X			X	X
Costs	% of expected national costs		X			

[a] Assessment of pre-fracture status.
[b] Discharge from the acute hospital.
[c] Two days post-operative.

Discussion

To evaluate the best possible treatment model in hip fracture management and allow for international comparison, a standard set of outcome parameters should be determined and defined. The authors were able to come to an agreement regarding which outcome parameters should be used in the evaluation and comparison of different orthogeriatric co-management models for the treatment of hip fractures. Further, the time points to record these outcome parameters are suggested as well as which score or tool should be used to measure these outcomes.

As a group, we felt the need to create a standard score set with outcome parameters to compare different models of orthogeriatric co-management. We thought that our literature evaluation and decisions, about what we think are the right outcome parameters to use, can be useful to others who also want to evaluate and measure hip fracture outcome. With this article, we have tried to summarise our thoughts and ideas about hip fracture management outcome. It is not our intention to make this collection of outcome parameters a fixed standard score set. It is important to re-evaluate these outcome parameters in the future and continuously discuss the process of hip fracture management.

Outcome parameters

For some outcome parameters, it was difficult to come to an agreement and it is important to address those difficult decisions here and to explain why we chose these outcome parameters as we did.

For the follow-up periods, we chose to use admission to the acute hospital as a starting point, so that all patients have the same number of follow-up days. Determination of the starting point of when the patient was injured proved to be troublesome because of the delay in diagnosis, delay in admission or transfer of patients from one facility to another. The number of days of follow-up was chosen instead of the period 1 month or 3 months as not every month has the same number of days. In some systems, the acute hospital LOS may be close to the 30-days follow-up point, but we believe that this will not happen frequently.

We discussed that when recording complications, the examiner may have a heightened awareness of problems and, therefore, the complication rate may be higher than the usual complication rates reported in the literature when protocols are not used. For example, delirium is a frequently under-reported complication due to its varied clinical presentations. We believe that by carefully looking for possible complications, an increase in the observed complication rate may result.

The reason we choose both a subjective and an objective score to measure mobility is that with a subjective score the pre-fracture mobility can be assessed. The TUG test as an objective score provides additional information as it can identify patients with a hip fracture at risk for new falls [70]. It cannot be used to assess pre-fracture mobility.

The outcome of the retrospectively assessed pre-fracture QoL at admission may be biased by the negative state of mind the patient is in after sustaining a serious fracture. However, the bias will be similar in all patient groups; hence, it will probably not influence the comparison of outcome between units or systems. Furthermore, in many cases, it may prove difficult to assess pre-injury ADLs accurately at the time of admission. In such cases, the authors suggest that a proxy be consulted, who will typically be a family member, friend or caregiver.

Assessing patient satisfaction and falls are important as they are direct and indirect goals of the orthogeriatric co-management programme. We concluded that available patient satisfaction tools were too extensive and had a great respondent and examiner burden, especially for this elderly population. For the assessment of falls, no tool is available. Although we recommend that patient satisfaction and falls should be assessed, we were unable to recommend which tools should be used. When validated and appropriate tools become available, these tools should be added to the outcome parameter set after careful evaluation.

Time points

Besides the agreement on tools used for outcome assessment, we believed that it was also important to define the time points at which the outcome parameters should be assessed. In order for outcome parameters to be comparable, they should be collected at the same time points. The time points were set at admission and discharge, at 30 and 90 days after admission and at 1 year after admission. A variation of 1 or 2 weeks for the assessment at 1 year

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after admission would probably be acceptable, but for the assessment at 30 days after admission, this variation should be reduced to a minimum in order to obtain comparable results between centres. Of course, it will not always be possible to collect data on the exact time point we set. We cannot define the acceptable variation times for the assessment of outcome parameters without testing the score set. A feasibility study has been initiated to test the score set and investigate the time points at which the outcome parameters will be collected.

Cognitive impairment

One major difficulty with assessing outcome in this patient population is the high rate of cognitive impairment. The estimated prevalence of dementia among older adults with hip fractures is 19% and the prevalence of cognitive impairment is 42% [71]. Many patient-reported outcome measures (PROMs) are thought to be unreliable in cognitively impaired patients. Although PROMs have been developed and validated for cognitively impaired patients, it is not feasible to create a different score set for this subset of patients. It is desirable for the geriatric population to be seen as one group of patients. Dividing these patients into groups would make the comparison of the different orthogeriatric co-management models more challenging. One possible solution to this problem would be to use proxy assessment for an important PROM, the EQ-5D. When answers cannot be provided by the patient, only the answers from the proxy should be incorporated to avoid mixed answers from patients and proxy in one score.

Health status

Patient characteristics such as age, sex, co-morbidities, cognitive status and frailty have a great influence on patient outcome [71–79]. We recognise that these patient characteristics are important to assess in order to compare different patient groups. The aim of this study was to create a score set that measures the changes that could be made in outcome after the implementation of a multidisciplinary treatment approach. These patient characteristics cannot be changed with a multidisciplinary treatment approach and were therefore not evaluated like the outcome parameters described in this paper.

Limitations

A limitation of this work is that our team is a relatively small group. However, these experts represent a multidisciplinary group and permit the benefits of a small group for structured discussions. Another disadvantage was a lack of representation from all regions of the world using orthogeriatric co-management. We tried to lessen this problem by inviting experts from all regions of the world to contribute to this project and have some diversity as a result.

A further limitation is that the combined set of outcome parameters has not been tested and validated in a clinical setting yet. Most of the questionnaires and scores have been tested and validated separately, but the use of the combined outcome parameters should be evaluated, in order to be certain that the score set does not contain redundant questions or parameters. It is not our intention to create a new combined score, but a set of individual outcome parameters. In addition, the score set must not place too much burden on clinicians, patients or caregivers; otherwise, compliance will be low and the parameters will lose validity. It is possible that parts of the score set will need to be revised after use in the clinical setting. A study to test the feasibility of this score set has already been planned.

Conclusion

We have come to an agreement about the outcome parameters that we think should be used to evaluate and compare different orthogeriatric clinical care models in the treatment of hip fractures. The parameters to be collected include length of hospital stay, mortality, time to surgery, complications both medical and surgical, 30-day re-admission rate, mobility, quality of life, pain levels, adverse drug reactions, activities of daily living, place of residence and costs of care. The time points at which each variable should be collected are described as well. We believe that these parameters will allow an accurate assessment of the efficacy of the different models of orthogeriatric care in current use in order to determine the safest and best-valued model of care for hip fracture patients.

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Conflict of interest

The authors declare that they have no conflict of interest.

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Appendix A

A combination of the following search terms was used for the literature search:

"hip fracture"
"osteoporotic fracture"
"osteoporosis"
"fragility fracture"
"elderly"
"geriatric"
"older"

"outcome"
"outcome parameter"
"outcome measure"
"assessment"
"tool"

"mortality"
"length of stay"
"time to surgery"
"complication"
"readmission rate"
"mobility"
"quality of life"
"pain"
"satisfaction"
"activities of daily living"

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"falls"
"inappropriate medication"
"osteoporosis medication"
"place of residence", "living situation"
"costs"

Appendix B. Supplementary data

Supplementary material related to this article can be found, in the online version, at http://dx.doi.org/10.1016/j.injury.2013.06.018.

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