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Practice development in orthopaedics and trauma

Community rehabilitation interventions after hip fracture: Pragmatic evidence-based practice recommendations

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Practice development enables practitioners to develop their knowledge and allows the application of evidence-based care for their patients. It happens within the practitioner's own clinical practice area and enhances personal and professional growth whilst focusing on patients' specific needs. This is important when working with patients in the rehabilitation phase following fragility hip fracture whose care should be provided by practitioners knowledgeable about the best way to approach their needs.

This article, which followed the methods for a scoping review, aims to provide the practitioner with an overview of rehabilitation interventions for patients following hip fracture discussed in the literature. There is an introduction to the nature of rehabilitation and the issues raised for the patient with a hip fracture, a discussion of the existing literature, and recommendations for practice based on both that evidence and a pragmatic approach to care.

Scoping reviews provide overviews of broad topic areas (Peterson et al., 2017). This gives the reader the opportunity to consider how other factors, besides research evidence, can contribute to best practice and to reflect on how their own practice needs to develop. At the end of the discussion, an overview of pragmatic recommendations for practice is provided based on the findings of the literature considered. Some points for individual reflection are also provided to help the practitioner to consider how the contents of the paper might impact on their own practice.

Introduction and background

Rehabilitation

The objectives of rehabilitation include: preventing or slowing of the rate of functional loss; improving or restoring function; compensating for loss of function and maintaining current function (World Health Organisation, 2011). Each patient's goals should be individual and determined by an assessment of previous and current functional status (Maher et al., 2012). The intensity and frequency of rehabilitation should be increased as the patient's condition improves, along with consideration of their ability to tolerate activity and exercise (Beaupre, 2011). It has been shown that longer periods of rehabilitation improve function (Mears and Kates, 2015; Pedersen et al., 2017).

Box 1. Suggested reflective activity.

- What have you learned after reading this paper?
- What recommendations for your practice can you suggest after reading this paper?
- What is especially important about rehabilitation after a hip fracture?
- What are the barriers in rehabilitation in your setting and what could you do to address them?
- How well do you and your team perform in relation to the recommendations for good practice evident in this paper? What could be done differently in your locality?

Box 2. Recommended further reading.

- Hertz, K and Santy-Tomlinson, J. (Eds) (2018) Fragility Fracture Nursing. Holistic Care and Management of the Orthoeriatric Patient. Springer. (Open Access eBook https://www.springer.com/gp/book/9783319766805).
- Riemen AH, Hutchison JD. (2016) The multidisciplinary management of hip fractures in older patients. Orthop Trauma. 30(2):117-122.

For patients with hip fractures, the acute phase of rehabilitation begins at the time of the fracture and lasts up to 5–7 days post-operatively, depending on the patient's previous and existing health status and local practice. The sub-acute phase lasts up to 90 days postoperatively and the post-acute phase up to one year after the fracture. During sub-acute rehabilitation, the focus is on improving patients' independence in self-care, transfers, and ambulation (Beaupre, 2011). This may involve transition to a rehabilitation facility, discharge to their own home, or continuation of care in the original setting.

Rehabilitation may take place in a variety of settings including hospitals, institutional settings and the community. Community-based rehabilitation (i.e., interventions that are initiated after discharge from inpatient rehabilitation) is based at the individual's place of residence: e.g., home, residential care facility, long-term care institution, skilled

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nursing facility (Ghazipura, 2013). Maintaining continuity of care is always crucial in rehabilitation, especially for older people with hip fractures who are most at risk of deterioration during transitions in care. However, although liaison with services such as mental health, falls prevention, bone health, and social services is recognised as extremely important, this is not always effectively carried out (Barberi and Mielli, 2018).

There are many differences in practices around the world regarding rehabilitation of patients after hip fracture. For example, in Japan partial weight-bearing postoperatively is initiated later compared to the United States of America (Kondo et al., 2010). In Denmark, patients begin inpatient rehabilitation early and more than 95% of patients are referred for further rehabilitation (Kronborg et al., 2015). In Norway, most patients are transferred to rehabilitation facilities for short-term or long-term rehabilitation (Prestmo et al., 2015). Total hours and activities of physiotherapy and occupational therapy also differ among rehabilitation facilities (Davenport et al., 2015; Siebens et al., 2016) and patients with similar characteristics may be discharged to different settings (Pitzul et al., 2016).

Several barriers to optimal rehabilitation have been recognised including: lack of resources; variation in access (Pioli et al., 2012; Pan et al., 2018); delays in commencing intensive rehabilitation; inadequate communication across settings, and the need for education of healthcare professionals (Beaupre, 2011). The aim of this review was to provide an outline of rehabilitation interventions for patients after a hip fracture, using a scoping review approach to provide an overview of the broad topic area to guide pratice (Peterson et al., 2017).

Hip fracture rehabilitation

After a hip fracture only 40%–60% of patients recover their mobility and only 40%–70% regain their ability to perform basic Activities of Daily Living (ADL) (Dyer et al., 2016), suggesting a need for much more effective rehabilitation. Older people may have limited physical activity both during hospitalisation (Resnick et al., 2015) and during rehabilitation (Zusman et al., 2018).

Maximum functional improvement has been found to mainly occur during the first 6 months after the fracture (Mathew et al., 2013; Dyer et al.,. 2016). However, age seems to have an effect on this, as patients younger than 75 years appear to recover the most function between 3 and 6 months, while patients over 85 years may continue to improve from 6 to 12 months, and patients in the intermediate age group may demonstrate continued improvement after 12 months (Ortiz-Alonso et al., 2012). These findings underline the significance of rehabilitation for the first year after hospital discharge.

In a systematic review of hip fracture rehabilitation practices with older people, conducted by Chudyk et al. (2009), most studies considered practices in inpatient and not in community or outpatient settings. The interventions studied included: clinical pathways; early supported discharge; interdisciplinary care; physiotherapy/occupational therapy and exercise programmes. All studies about outpatient/community rehabilitation included physiotherapy and/or occupational therapy and exercise only. Exercise, which combined aerobic and progressive resistance training, led to improved: ambulation; functional recovery; lower-extremity strength and balance. Outpatient/community based programmes with home-based physiotherapy were also related to improvements in balance (Chudyk et al., 2009). A similar systematic review by Stolee et al. (2012) compared home-based rehabilitation to inpatient rehabilitation for older patients with musculoskeletal conditions in general. Patients who received home-based rehabilitation were found to have equal or higher gains in function, cognition, and quality of life than the inpatient group, as well as reporting higher satisfaction.

In a qualitative study of community-dwelling older adults' engagement in rehabilitation after a hip fracture, participants emphasised the value of physical activity (Sims-Gould et al., 2017). For participants older than 65 years with high pre-fracture mobility and without cognitive impairment, the total Functional Independence Measure improved most among patients receiving community-based rehabilitation when compared to inpatient rehabilitation (Ghazipura, 2013). However, in a study by Leland et al. (2015), only 57% of hip fracture patients achieved successful community discharge (defined as “patients who remain in the community at least 30 days after discharge”).

There is limited evidence about best strategies for rehabilitation, although there is a lot of information on extended treatment options and outcomes. In the present paper, the current research relating to community rehabilitation programmes for older people with hip fractures is explored. Earlier studies (i.e., published before 2012) were not considered, as they are now out of date and because they are included in previous systematic reviews. The most recently published studies about rehabilitation interventions for older people living in the community after a hip fracture involve: extended exercise; inpatient rehabilitation in the community; rehabilitation of patients with cognitive impairment; multidisciplinary and multicomponent rehabilitation and telerehabilitation.

Community rehabilitation practice

Extended exercise

A systematic review and meta-analysis compared extended exercise programmes (i.e., offered beyond the regular rehabilitation period) with the usual care for community-dwelling people after hip fracture. Extended exercise programmes demonstrated statistically significant positive effects on: knee extension strength for both legs; balance; physical performance tests; Timed Up & Go Test and fast gait. No effects were demonstrated on: normal gait; basic and instrumental ADL; Six-Minute Walk Test and the physical function subscale of the 36-Item Short-Form Health Survey (Auais et al., 2012).

Diong et al. (2016) undertook a meta-analysis and meta-regression of trials of moderate to high quality that examined overlapping combinations of structured exercise (e.g., high intensity, home-based, weight-bearing, resistance, combination of interventions - e.g., nutrition and/or resistance exercise). In some studies the exercise was supervised and in others it was not. Some studies contained a balance component, and some were delivered only in hospital while others took place in other settings (e.g., hospital and community, community only). Structured exercise was shown to significantly improve overall mobility, with greater effects after progressive resistance training and interventions in settings other than hospital alone; although the latter may have been confounded by the duration of interventions. Structured exercise also significantly improved gait speed, ADL, Timed Up & Go Test and the Berg Balance Scale measures. The benefits of progressive resistance training were in concordance with those of the meta-analysis by Lee et al. (2017); progressive resistance exercise significantly improved participants' physical function and it was particularly effective in improving mobility, ADL, balance and lower-limb strength/power.

In another meta-analysis, home-based rehabilitation programmes were associated with significantly increased mobility and improved ADL and balance; although there was no impact on walking outdoors, gait speed or emergency department visits. All the included studies were randomised controlled trials and of high-quality, with a total sample size of 887 participants who were living alone (home rehabilitation versus control groups) (Wu et al., 2018).

Kuijlaars et al. (2018) undertook a systematic review and meta-analysis considering whether supervised home-based exercise therapy after hospitalisation is more effective than a control intervention (e.g., usual care). They found limited evidence regarding the short-term (≤ 4 months) and long-term (> 4 months) positive effects of exercise on ADL and the long-term effects on endurance. There was no evidence of benefits to short-term balance, endurance and mobility and conflicting evidence for strength, long-term balance and long-term mobility.

The studies that were not included in these meta-analyses must also be considered. Lahtinen et al. (2015) found that, in patients living independently, mortality was significantly lower in a physical rehabilitation group than in a geriatric rehabilitation group or in a health centre hospital rehabilitation group. Physical and geriatric rehabilitation significantly improved the ability of independent living after 4 months, but the effects of intensified rehabilitation disappeared at 12 months. No impact on walking or ADL ability was observed. In the study by Overgaard and Kristensen (2013), a 6-week programme of progressive knee extension strength training (twice weekly sessions, 12 sessions in total), including progressive lower limb strength training in community-dwelling older patients, led to a significant increase in knee-extension strength and large improvements in the Six-Minute Walk Test.

van Ooijen et al. (2016), conducted a randomised controlled trial comparing adaptability treadmill training (practicing walking adjustments in response to the visual context projected), conventional treadmill training and usual physiotherapy (e.g., hip abduction/flexion/extension, knee extension, sitting/standing, balance, transfers (e.g., bed to chair), walking, ADL) in people drawn from residential and rehabilitation centers. Similar effects were found in walking ability, fear of falling and falls. In another randomised controlled trial, three months of resistance training for the lower limb reduced self-reported difficulties in ADL in older people with a hip fracture which had occurred, on average, three years earlier (Edgren et al., 2012).

After a combination of different types of training which lasted for 12 weeks and was initiated at 2–6 months after the hip fracture in community-dwelling older adults, the surgical leg extension power gains were large and physical function improved significantly (Briggs et al., 2018a). In a case-study, a Pilates-based rehabilitation programme led to increases in lower extremity strength, active range of motion, ambulation distance, speed, and transfer ability, along with a lower risk for falls (Stivala and Hartley, 2014).

A programme that combined counseling and exercise (balance and progressive resistance training) in patients attending a day hospital and continuing exercise at home led to improved Health Related Quality of Life (HRQoL); although participants in both the intervention and the control groups improved their physical function (Berg Balance Scale, Timed Up & Go Test, 5 times Sit-to-Stand, Six-Minute Walk Test, Activities Balance Confidence Scale) without statistically significant differences (Brovold et al., 2012).

Additional home-based physiotherapy sessions in combination with an information workbook and a goal-setting diary (interventions with both physical and psychological components) led to minimal differences in Barthel Index, a medium-sized improvement in the Extended Activities of Daily Living scale, and greater improvement in self-efficacy and mental health in comparison to the control group (Williams et al., 2016). A 6-month home-based exercise programme led to a significant improvement in basic mobility and ADL (Chang et al., 2015). In people older than 60 years who were discharged from aged care, rehabilitation, and orthopaedic wards, home exercise for 12 months led to significantly improved mobility, but significantly more falls than the control group (Sherrington et al., 2014).

Inpatient rehabilitation in the community

In a qualitative study involving a survey of members of multidisciplinary rehabilitation teams and focus groups with patients and carers, participants felt that rehabilitation should be focused on improving patient engagement by individualised interventions focused on reducing fear of falls, on improving self-efficacy to exercise and undertake ADLs and on coordinating rehabilitation delivery (Roberts et al., 2017).

Löfgren et al. (2015) studied an individualised rehabilitation programme administered by specially trained nursing staff in comparison to a control group treated according to the routine practice. Patients in the intervention group were more likely to return to their previous accommodation compared with the control group.

Ireland et al. (2016) compared the outcomes of community-dwelling patients with and without hospital rehabilitation. They found that in-hospital rehabilitation increased Length Of hospital Stay (LOS) and costs, but mortality at 90 days and at 2 years was statistically significantly lower. However, rehabilitation was not related to the likelihood of living independently for 2 years after the fracture. A hospital-at-home service presented better rehabilitation efficiency compared to the usual hospital-based rehabilitation in a study by Mas et al. (2016).

An occupational therapy and physiotherapy rehabilitation programme in an inpatient ward led to a decrease in emotional distress at 3 and 6 months. Although fatigue levels decreased in both the intervention and the usual care (control) groups, the most significant decline was reported by the intervention group at 6 months. There were no significant differences between groups regarding function (Martín-Martín et al., 2014). Physiatrists' (also known as physical medicine and rehabilitation physicians) participation in rehabilitation may also lead to improved functional independence and LOS (Momosaki et al., 2016). An inpatient rehabilitation programme based on task-specific balance training may be useful in improving physical function, pain, ADL and quality of life compared to standard physiotherapy (Monticone et al., 2018).

In rehabilitation units of nursing homes, a programme including dynamic weight loading (e.g., number of steps, walking) had a positive effect on gait and balance, which differed significantly between patients with short (less than 8 weeks), intermediate (8–12 weeks), and long (longer than 12 weeks) rehabilitation periods (Bakker et al., 2014).

In a qualitative study by Killington et al. (2016), both family members and nursing home staff described the importance of good communication of information from the hospital. Nursing home staff reported lack of confidence due to lack of information from the acute hospital setting and absence of specific training. Staff training is of greatest importance, as it can alter caring behaviours such as adherence to guidelines (Lindberg et al., 2017). The importance of communication and coordination has also been stressed in other studies (Mears and Kates, 2015).

With respect to differences in outcomes across three post-acute care settings, in the study by Mallinson et al. (2014) patients in inpatient rehabilitation facilities and home health agencies had lower self-care function at discharge compared to patients from skilled nursing facilities. Patients in inpatient rehabilitation and skilled nursing facilities received about the same total minutes of therapy, while patients in home health agencies received only a quarter of those minutes.

Rehabilitation of patients with cognitive impairment

There are several systematic reviews about rehabilitation of patients with cognitive impairment. Resnick et al. (2016) explored best practices with patients living in or transferred to long-term/post-acute settings after the fracture. The interventions varied and included exercise (e.g., weight-bearing, treadmill), team-based approaches, and functional activities (e.g., bathing, dressing). Although only limited evidence was found, all the included studies concluded that rehabilitation appears beneficial and feasible for patients with cognitive impairment.

Chu et al. (2016), in a systematic review, considered community-based rehabilitation. All the included studies examined interventions initiated during the participants' stay as inpatients and all included patient assessments, rehabilitation, home assessments, counseling and/or discharge planning. Although there was agreement among the studies' findings that outpatient rehabilitation should begin early and should include discharge planning, the authors concluded that the lack of high quality evidence makes it difficult to determine the feasibility, acceptability and effectiveness of the best interventions.

In a systematic review, Smith et al. (2015) evaluated

interdisciplinary rehabilitation (either for inpatients only or for inpatients and at home after discharge). There was low-quality evidence that in-hospital rehabilitation led to lower rates of some complications and that rehabilitation provided across hospital and home settings reduced the chance of being in institutional care at 3 months after discharge.

A systematic review by Allen et al. (2012) included studies reporting that mild to moderate dementia was not a barrier to rehabilitation and that patients with dementia exhibited similar levels of functional recovery to patients without cognitive impairment. However, participants with cognitive impairment who received specialised inpatient rehabilitation demonstrated a higher rate of return to independent living and less decline in ambulation and transfer ability than those who received usual postoperative care, demonstrating that such activity needs to be built into rehabilitation practice with patients with temporary or permanent cognitive decline.

Multidisciplinary rehabilitation

Multidisciplinary interventions are beneficial for older adults (Barberi and Mielli, 2018). The multidisciplinary team may consist of: geriatricians, general practitioners, geriatric nurse practitioners, geriatric nursing staff, occupational therapists, physical therapists, social workers, and neuropsychologists. Team interventions may include; assessment, accelerated rehabilitation and discharge planning in collaboration with the team, the patient, and caregivers. There should also be an assessment of the home environment, as well as long-term rehabilitation, at home or on an outpatient basis (Magaziner et al., 2015; Barberi and Mielli, 2018).

In a review by Magaziner et al. (2015), there were mixed results following early multidisciplinary interventions. There were positive effects on strength, gait speed and functional performance, as well as for the long-term interventions, with some studies showing improvements in strength, walking speed, and functional performance. Community-based programmes were usually more beneficial than home-based programmes because of their intensiveness.

Cheung et al. (2018) found that, after an 18-month multidisciplinary programme (orthogeriatric co-management, physician consultations, group-exercise), the re-fracture rate was significantly lower than in the control group, while results of Timed Up & Go Test, Elderly Mobility Scale and falls' risk were all better. The overall costs were also lower in the intervention group.

Shyu et al. (2016) compared an interdisciplinary intervention (geriatric consultation, discharge planning, 4-month home-based rehabilitation) to comprehensive care (interdisciplinary care plus 12-month home-based rehabilitation, management of malnutrition and depression, falls prevention) and usual care (in-hospital rehabilitation). The comprehensive care group demonstrated better ADL performance and fewer emergency department visits than the usual care group. The interdisciplinary care and usual care groups did not differ in self-care ability and service utilisation. The three groups did not differ in mortality during the 2-year follow-up. Using data from the same trial, it was demonstrated that comprehensive care and interdisciplinary care groups were more likely to experience good physical health than those who received usual care (Tseng et al., 2016a) and, compared to those who received usual care, participants in the interdisciplinary programme also had significantly lower risk of depression (Tseng et al., 2016b).

Twelve months of high-intensity weight-lifting exercise and targeted multidisciplinary interventions (for balance, osteoporosis, nutrition, depression, cognition, vision, home safety, polypharmacy, self-efficacy, social support) in an outpatient clinic led to reduced risk of death, less nursing home admissions, less decline in basic ADL ability and less use of assistive devices at 12 months compared with the control method. The targeted improvements (in upper body strength, nutrition, depression) were all related to improvements in the performance of ADL and this, in turn, was associated with reduced nursing home admissions (Singh et al., 2012).

Multicomponent rehabilitation

Due to the multifaceted nature of recovery after a hip fracture, multicomponent interventions may be the most appropriate. However, there is currently no evidence about which components are best and the best time of initiation (Magaziner et al., 2015). Multicomponent programmes in rehabilitation address not only physical impairments (e.g. with physiotherapy), but functional therapy (e.g., focused on ADLs) as well. Several studies have already been mentioned that consider overlapping interventions: e.g., combinations of different types of training (Briggs et al., 2018a), counseling and exercise (Brovold et al., 2012) and physical and psychological components (Williams et al., 2016)].

Such programmes were also included in the aforementioned meta-analysis by Wu et al. (2018) and their positive effects on mobility and activities have already been discussed. The most recently published studies in this meta-analysis examined multicomponent interventions such as the combination of modification of environmental hazards, guidance for safe walking, non-pharmacological pain management, exercise, physical activity, counseling (Salpakoski et al., 2014; Edgren et al., 2015; Turunen et al., 2017), early hospital discharge by an interdisciplinary team (including falls prevention, independence in ADL, walking) (Karlsson et al., 2016), and functional exercises (e.g., standing from a chair, climbing steps, cognitive/behavioral strategies) (Latham et al., 2014).

A one-year, multicomponent, home-based intervention had no additional benefit over usual care in hip fracture patients as the number of perceived entrance-related barriers and the difficulty in walking outdoors significantly decreased over time in both groups. The intervention included home visits for evaluation of modifiable environmental hazards, guidance for safe walking, pain relief strategies, progressive home exercise and individual motivational counseling (plus phone contact and face-to-face sessions). Overall adherence to the exercise programme was 54% (Portegijs et al., 2013).

In a study by Briggs et al. (2018b), twelve weeks of unilaterally high-intensity resistance training and protein supplementation led to improvements in muscle mass, muscle strength and muscle quality in the injured limb. In the study by McKenzie et al. (2017) exercise sessions with an emphasis on improving operated limb lean mass, muscle and physical function followed by a protein-rich drink led to increase in the limb's strength and distance covered during the Six-Minute Walk Test. However, there were no changes in power or muscle quality. The supplementation of protein in addition to bisphosphonates once weekly for 12 months led to improvement of handgrip strength and HRQoL in the study by Flodin et al. (2015). Stemmle et al., 2019 found a statistically significant interaction between vitamin D_3 dose and a home exercise program for Timed Up and Go test in patients older than 65 years at 12 months postoperatively, although there were no effects on knee flexor/extensor strength and self-reported physical function.

Telerehabilitation

Statistically significant improvements in exercise self-efficacy, mobility, quality of life, and patient satisfaction were shown after a home-based telerehabilitation programme (Bedra; Finkelstein, 2015). A telerehabilitation programme, based on video clips of rehabilitation exercises (as complementary treatment to standard physiotherapy), led to greater improvements in the Two-Minute Walk Test and walking speed than in the control group (Kalron et al., 2018). Watching a Digital Video Disc (DVD) with individualised home exercises led to increased levels of adherence and self-efficacy for exercise (Moran et al., 2015). An 8-week programme of motivational interviewing by telephone as an addition to a community rehabilitation programme (of either home- or centre-based therapy in an interdisciplinary setting) led to significantly more

Table 1
Summary of findings of the review and related recommendations for practice *(HRQoL: Health Related Quality of Life, ADL: Activities of Daily Living)*.

Topic	Findings of review	Pragmatic recommendations for practice
Extended exercise	• Statistically significant positive effects on: knee extension strength for both legs; balance; physical performance tests; Timed Up & Go Test; fast gait. No effects on: normal gait; basic and instrumental ADL; Six-Minute Walk Test and the physical function subscale of the 36-Item Short-Form Health Survey (Auais et al., 2012) • Significant improvement in mobility, gait speed, ADL, Timed Up & Go Test, Berg Balance Scale. Greater effects after progressive resistance training (Diong et al., 2016) • Significant improvement in physical function, mobility, ADL, balance, lower-limb strength (Lee et al., 2017) • Significant increase in mobility, ADL, balance (Wu et al., 2018) • Limited evidence for positive effects on ADL and endurance (Kuijlaars et al., 2018) • Significantly lower mortality (Lahtinen et al., 2015) • Significant increase in knee-extension strength, improvements in the Six-Minute Walk Test (Overgaard and Kristensen, 2013) • Similar effects of different types of training in walking ability, fear of falling and falls (van Ooijen et al., 2016) • Improved self-reported ADL (Edgren et al., 2012) • Extension power gains of the surgical leg, improved physical function (Briggs et al., 2018a) • Increase in: lower extremity strength; active range of motion; ambulation distance; speed; transfer ability, lower risk for falls (Stivala and Hartley, 2014) • Improved HRQoL (Brovold et al., 2012) • Minimal improvement in Barthel Index, medium-size improvement in the Extended Activities of Daily Living scale, greater improvement in self-efficacy and mental health (Williams et al., 2016) • Significant improvement in basic mobility and ADL (Chang et al., 2015)	• Extended exercise seems to be beneficial for the successful rehabilitation of patients after a hip fracture • As there seem to be greater effects after progressive resistance training, this type of extended exercise is perhaps the most suitable. However, all types of exercise (and combinations of them) seem to be beneficial as well
Inpatient rehabilitation in the community	• Individualised rehabilitation programme by trained nursing staff is more likely to allow patients to return to their previous accommodation compared with the control group (Löfgren et al., 2015) • In-hospital rehabilitation increases Length Of hospital Stay and costs, but reduces mortality (Ireland et al., 2016) • Better rehabilitation efficiency from a hospital-at-home service in comparison to usual hospital rehabilitation (Mas et al., 2016) • Occupational/physiotherapy rehabilitation decrease emotional distress and fatigue (Martín- Martín et al., 2014) • Physiatrists' participation in rehabilitation improves functional independence (Momosaki et al., 2016) • Task-specific balance training improves physical function/pain/ADL/quality of life compared to standard physiotherapy (Monticone et al., 2018) • Dynamic weight loading positively affects gait and balance (Bakker et al., 2014) • Great importance of good communication of information from hospital to rehabilitation setting (Killington et al., 2016) • Patients in inpatient rehabilitation and home health agencies had lower self-care function at discharge compared to patients from skilled nursing facilities (Mallinson et al., 2014)	• Rehabilitation should be focused on individualised interventions • Nursing staff should be well educated about current rehabilitation practices • In-patient rehabilitation or hospital-at-home rehabilitation are perhaps more efficient (although more costly); this may be due to the longer rehabilitation periods (total duration of exercise and therapy)
Rehabilitation of patients with cognitive impairment	• Limited evidence that rehabilitation is beneficial and feasible for patients with cognitive impairment (Resnick et al., 2016) • Outpatient rehabilitation should begin early and should include discharge planning (Chu et al., 2016) • Rehabilitation provided across hospital and home settings reduces the chance of being in institutional care after discharge (Smith et al., 2015) • Mild to moderate dementia is not a barrier to rehabilitation; specialised inpatient rehabilitation has a higher rate of return to independent living and less decline in ambulation/transfers (Allen et al., 2012)	• Patients with cognitive impairment should not be excluded from rehabilitation programmes • Outpatient rehabilitation should begin early and should include discharge planning • Specialised inpatient rehabilitation may be more effective for patients with cognitive impairment

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Table 1 (*continued*)

Topic	Findings of review	Pragmatic recommendations for practice
Multidisciplinary rehabilitation	• Positive effects on strength, gait speed, functional performance; community-based programmes more beneficial than home-based programmes (Magaziner et al., 2015) • Significantly lower re-fracture rate, better results in Timed Up & Go Test/Elderly Mobility Scale/falls' risk, lower costs (Cheung et al., 2018) • Interdisciplinary care plus other interventions (home-based rehabilitation, management of malnutrition/depression, falls' prevention) demonstrate better ADL performance and fewer emergency department visits (Shyu et al., 2016) • Multidisciplinary interventions and high-intensity exercise reduce risk of death, nursing home admissions, decline in basic ADL, and use of assistive devices (Singh et al., 2012)	• Multidisciplinary interventions are connected to many positive outcomes and therefore are recommended for rehabilitation
Multicomponent rehabilitation	• Positive effects on mobility and ADL (Wu et al., 2018) • No additional benefits over usual care (Portegijs et al., 2013) • High-intensity exercise and protein supplementation improve muscle mass/strength/quality in the fractured limb (Briggs et al., 2018b) • Exercise and protein supplementation increase limb's strength and distance covered in the Six-Minute Walk Test; no changes in power/muscle quality (McKenzie et al., 2017) • Protein supplementation and bisphosphonates improve handgrip strength and HRQoL (Flodin et al., 2015) • A combination of simple home exercise with 800 IU vitamin D3 is superior to no home exercise or 2000 IU vitamin D3 (Stemmle et al., 2019)	• Multicomponent interventions could be incorporated in the rehabilitation process, e.g., combinations of different types of exercise, or combinations of counseling and exercise, physical and psychological support
Tele-rehabilitation	• Statistically significant improvements in exercise self-efficacy, mobility, quality of life, and patient satisfaction (Bedra; Finkelstein, 2015) • Improvements in the Two-Minute Walk Test and walking speed (Kalron et al., 2018) • Increased levels of adherence and self-efficacy for exercise (Moran et al., 2015) • Significant increases in steps per day, walking periods, self-efficacy about walking, HRQoL, improved mental health (O'Halloran et al., 2016)	• Telerehabilitation programmes (educational videos, telephone support) could be used in rehabilitation

steps per day, longer walking periods, improved self-efficacy about walking, better HRQoL, and improved mental health (O'Halloran et al., 2016).

Conclusions

Table 1 provides a summary of the findings of the review of the literature and demonstrates how each relates to recommendations for practice. It is evident that extended rehabilitation following discharge is worthwhile as it continues to improve function following hip fracture. In most studies, the effects of exercise are the focus, as exercise is one of the most effective strategies in rehabilitation. However, more studies are needed about the effectiveness of other strategies to address individual preferences holistically such as: education, support, counseling, environment modifications, provision of resources, and assistive technology.

Similarly, most of the rehabilitation outcomes in the studies are focused on functional measures (e.g., Barthel Index, Functional Inventory Measure, ADL), gait, balance, walking ability, speed, muscle strength, discharge location, LOS, and use of healthcare resources, while there is a lack of studies about cognitive, psychological, and social outcomes or the burden of care for informal carers.

There are contradictory findings about the effects of extended exercise, as there are studies in which mobility, physical function, strength, balance and walking ability are improved with exercise, while there are others in which there is limited or no evidence in favour of exercise for the same outcomes compared to the usual rehabilitation. There is also conflicting evidence about the optimal intensity of the interventions, with other studies reporting that the beneficial effects disappear over time with others demonstrating that the positive effects differ significantly between patients undergoing short and long rehabilitation.

This pattern is repeated in the results regarding inpatient rehabilitation, as there are contradictory findings about its effect on patients' function and likelihood of living independently after the fracture. Multicomponent rehabilitation has also been linked to positive effects on mobility and activities or, conversely, to no additional benefit over usual care. On the contrary, rehabilitation of patients with cognitive impairment appears feasible and beneficial and it should start as soon as possible postoperatively. It has been also been shown that multidisciplinary programmes lead to lower re-fracture rates, better walking ability and physical health, less nursing home admissions, and less decline in ADL. Tele-rehabilitation may work effectively as an additional treatment by increasing patients' self-efficacy, satisfaction, and adherence.

However, there is large heterogeneity in interventions (e.g., type, intensity, duration, timing of initiation, assessments, settings, outcomes), and the results may have been confounded by duration of interventions, so no concrete suggestions can be made at this point for the best rehabilitation strategies. There are several studies in progress (Heiberg et al., 2017; Orwig et al., 2017; Pol et al., 2017).

It is important that practitioners, when considering the findings of this literature review, do not conclude that rehabilitation interventions are not evidence-based. An important principle of evidence-based care is that, just because the evidence is weak, this does not mean that interventions are pointless, simply that further, better quality research is needed to clearly demonstrate the benefits of one intervention against another. What often matters is that it is logical that supported exercise and other rehabilitation activities help patient to achieve their potential following fragility fracture.

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