SHORT REPORT

Acceptability and compliance with wearing energy-shunting hip protectors: a 6-month prospective follow-up in a Finnish nursing home

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Abstract

Objectives: to assess the acceptability and compliance with use of an energy-shunting hip protector in institutionalized elderly people.

Design and setting: a 6-month prospective follow-up in a Finnish nursing home.

Participants: 19 ambulatory nursing home residents with a high risk of hip fracture.

Main outcome measures: the proportion of the residents who were willing to use the device, the number of hours of wearing the protector and the attitudes of the study subjects and the caregivers towards the appearance, comfort, fit, efficacy and laundering of the protector.

Results: 12 of the 19 ambulatory residents (63%) agreed to use the protector. During the study period, these subjects wore the protector on average for more than 90% of their active days, i.e. the days they were mobile. Two subjects wore the protectors at night time; the rest only during waking hours. Mean wearing time during waking hours exceeded 90%.

Conclusion: external hip joint protectors are a feasible strategy to prevent hip fractures in institutionalized elderly people. The attitude, education and motivation of the staff may be a factor in achieving good user compliance. Further community-based studies on acceptability and compliance in wearing external hip joint protectors are needed for verification of benefits to the general population of older people.

Keywords: elderly, hip fracture, hip protector, prevention

Introduction

Hip fractures are an important public health problem in economic terms [1, 2] and because of their association with high morbidity and disability, high risk for long-term institutionalization and increased risk of death in older people [3–8].

In the pathogenesis of the hip fractures, falling, the impact energy created by the fall and the energy-absorption capacity of trochanteric soft tissue are the main determinants of hip fracture [9–16], although bone mineral density also plays an independent role in the pathogenesis of this injury [16, 17]. Most hip fractures relate to a direct impact on the trochanteric area of the hip [9, 10, 13, 17]: approximately 25% of such falls cause hip fracture [18] while less than 2% of all falls lead to this injury [19, 20].

Thus, it seems reasonable to consider that a well-designed external hip protector could prevent some hip fractures, even in those older people in whom bone quality and propensity to fall would remain unaltered. A randomized study indicated that the use of external hip protectors could reduce the risk of hip fracture [18]. However, only 24% of the nursing home residents participating in this study wore hip protectors regularly [18].
A passive injury prevention strategy, such as an external hip joint protector, requires evidence on protector efficacy as well as evidence of acceptance and compliance of the device by potential users before any population-level benefit can be expected. The efficacy of an external hip protector in prevention of hip fractures has been provisionally shown in both biomechanical and clinical studies [18, 21, 22]; however, the acceptability and compliance in older subjects is not well studied.

Previous studies on hip protector compliance among elderly people have identified factors that relate to a positive attitude to wearing hip protectors. These include: female sex, living alone, having mobility problems, experiencing previous falls and injuries, perceived intrinsic cause of falls and dissatisfaction with social contacts [23, 24]. The most often mentioned protector-related factors indicating acceptability include: appearance, comfort, fit and efficacy, easy laundering and low cost [23, 25]. Cameron and Quine [25] reported that the main factors for compliance are perception of personal risk of fall and fracture and belief that the fracture is preventable. Also, awareness of the prevalence, causes and consequences of hip fracture might increase the motivation to buy and wear a hip protector, despite some extra effort and slight discomfort caused by protector usage [25].

A recent study gives preliminary evidence of the increased compliance if additional support is given when starting to wear an external hip joint protector [26].

The purpose of the present study was to investigate prospectively the acceptability and compliance for the use of an energy-shunting hip protector in institutionalized elderly people. Our research question was: what will the protector acceptability and compliance be if information and education is given to the nursing home caregivers only? This relatively low-effort approach was thought to approximate the real-life situation in nursing homes. The main outcome measures were the proportion of the residents who agreed to use the device, the number of hours of wearing the protector and the attitudes of the study subjects and the caregivers about the appearance, comfort, fit, efficacy and laundering of the protector.

**Materials and methods**

**Study subjects**

The voluntary ambulatory elderly subjects for this 6-month follow-up study were recruited from the Himinkoto nursing home, Lempäälä, Finland. At the time of the study, the home had 57 elderly residents, 26 of whom were mobile and thus potential study subjects.

The caregivers of the nursing home were given an introductory talk, where they received information on hip fractures and a list of the risk factors for hip fracture. After this session, the authors did not influence the selection of the study subjects; the caregivers independently selected 19 people who they felt had a high risk for a fall and fracture of the hip. The caregivers regarded the remaining seven residents as having a low risk of falling because of their independent walking ability. The selected 19 residents all needed a walking aid.

The carers were then asked to list all residents to whom they offered the protector and to note reasons for negative responses. Also, during the 6-month follow-up, the possible interruptions in the use of the protector and the reasons for these were recorded. Wherever possible, any subject who stopped wearing the protector...
the protectors was replaced by a same-gender, same-aged new resident. One of the authors (JP) determined the mental status of the study subjects, grading the status on 4-point scale (cognitively intact, mild dementia, moderate dementia and severe dementia) [27, 28] and recorded their medical conditions and medications.

KPH hip protector
The detailed description and the force attenuation capacity of the selected hip protector (Figure 1) has been reported in the previous biomechanical studies [22, 29, 30]. The protector was designed to cover the greater trochanter, to shunt the impact energy away from the greater trochanter to the soft tissues lying anterior, posterior and superior to the proximal femur and to absorb partially the fall-induced impact energy from the hip. The inferior contact of the protector was on the femoral shaft.

The height of the protector was 19.0 cm and the width 10.5 cm. Maximum depth in the middle of the device was 4.0 cm. The outer shield was made of semi-flexible 3-mm-thick high-density polyethylene and the inner, energy-absorbing part of 12-mm-thick Plastazote (Fagerdala World Foams, Termonova Inc., Inkoo, Finland) [22].

The protectors were placed in the pockets of a specially designed undergarment made of 80% polyamide and 20% Lycra (Figure 1).

6-month compliance intervention
Before intervention, all subjects gave verbal or signed informed consent. In the five subjects with severe dementia, the informed consent was signed by his or her representative.

Caregivers were asked to record the wearing times to the nearest half hour in the research diary. Data on waking hour use were recorded daily. A separate fall recording form was also completed. After 6 months, the study subjects without severe dementia and the caregivers were asked which factors might have influenced compliance.

Finally, the number of the patients who accepted and who did not accept the protector, the wearing hours (±SD) of the protector and the attitudes of the study subjects and the caregivers on the protector and its usage were noted.

Results
Twelve of the 19 residents (63%) accepted the protector. Nine of these were women and three were men (mean age 82 ± 7 years). Two study subjects became bedridden during the 6-month follow-up and they were replaced by two new subjects. According to the caregivers' report, three out of the seven residents who declined refused immediately after the introduction to wear "that kind of device" or said "I am so old that I do not need any protector". The remaining four subjects wore the protectors for a few days and then refused to continue in the study: one said that she was not going to fall, the second that the protector was pressing on her operated hip, the other two (demented) residents gave no verbal comment but took the protectors off after they were dressed.

The 12 subjects accepting them wore the protectors without any problems. The total wearing times of the protector are shown in Table 1. During the study period, subjects wore the protector on average more than 90% of their active days (i.e. the days they were mobile). During these active days two subjects wore the protectors also at night time, while the other 10 subjects wore the protectors mostly during their waking hours (Table 1). Mean wearing time during waking hours exceeded 90%. After the 6-month study period, six subjects wanted to continue using the protector and four severely demented patients continued protector wearing since their caregivers believed that the protectors might be important for them.

The study subjects' and caregivers' general comments on the protectors and their use were mostly positive. Some subjects complained that the undergarments were too tight, preventing independent toilet visits. This same concern was reported by some of the caregivers. Neither study subjects nor caregivers complained about the appearance, comfort, or fit of the protectors. The protectors were removed from the

<table>
<thead>
<tr>
<th>Subject no.</th>
<th>Days worn (% of active days)*</th>
<th>Mean wearing day (h)</th>
<th>Wearing time on active day (h)</th>
<th>% of waking hours</th>
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<tr>
<td>1</td>
<td>93</td>
<td>19 (6)</td>
<td>85</td>
<td></td>
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<td>2</td>
<td>82</td>
<td>8 (4)</td>
<td>54</td>
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<td>3</td>
<td>97</td>
<td>11 (1)</td>
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<td>Total</td>
<td>93</td>
<td>11 (4)</td>
<td>91</td>
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</table>

*Days when the study subject was ambulatory (the number of nonambulatory days for each subject was minimal).
undergarments during laundering but this caused no problems.

During the 6-month intervention, there were 19 falls among the 12 study subjects and no fracture was reported. Six of these falls were reported directly on the hip (on the protector) and eight onto the buttocks.

Discussion

In this study the acceptability and compliance of the use of the energy-shunting external hip joint protector was assessed among institutionalized elderly people. The experience of the study subjects, nursing home staff and the authors were generally positive. The results indicate that hip protectors are an acceptable and feasible strategy for the prevention of hip fracture.

We found that a 1 h introductory lesson for the nursing home staff on the incidence, causes, consequences and prevention of the hip fracture is easy to organize and might be appropriate when starting hip fracture prevention programmes with hip joint protectors in institutions. We believe that elderly people living at home who may use hip protectors might also benefit from a lesson on hip fractures and their prevention.

The strength of the present study is that the hip protector was actually worn by the study subjects—the study did not simply ascertain subjects' willingness to wear the protectors. The wearing of the protectors was carefully followed for 1800 days. Caregivers completed all diaries to within an accuracy of half an hour.

Our study had several limitations. First, the size of the nursing home and the number of the protector users was small. However, this size of nursing home is typical in Finland and the results give useful information for larger studies. Secondly, the subjects were informed about hip protection by caregivers only and thus the individual information and education of the study subjects were largely dependent on the caregivers' knowledge. We did not compare the different levels of effort required to increase user compliance, but the amount of education given was considered feasible for institutions where hip protectors might be used.

A question that arose during the study was whether nursing staff behaved differently toward the patients with protectors compared with those who declined or were not included in the study. In other words, were the caregivers more protective of patients with the protectors because they had a heightened awareness of the presence of risk factors of hip fracture in these residents? This issue is worth studying in future trials.

In this study with a relatively low effort, 63% of the residents agreed to use the hip protectors. This figure is similar to that reported by Lauritzen and co-workers in patients in orthopaedic departments in Denmark [32].

In our study, residents wore the protector for an average of 91% of their waking hours, a higher figure than in studies which have involved greater efforts to improve compliance [25, 26]. We found that the compliance of protector wearing was low at night—only two subjects wore the protectors while sleeping. It has been recommended that the hip protectors should be used 24 h a day if the person is getting up twice or more during the night [31].

With relatively little effort, external hip joint protectors can become a feasible strategy to prevent hip fractures in institutionalized elderly people. The attitude, education and motivation of staff may be a factor for achieving good user compliance. Further community-based studies on acceptability and compliance in wearing external hip joint protectors are now needed.

Key points

- This prospective follow-up study in a Finnish nursing home suggests that, with relatively little effort, external hip joint protectors can become a feasible strategy to prevent hip fractures in institutionalized elderly people.
- The attitude, education and motivation of staff may be a factor for achieving good user compliance.
- Further community-based studies on acceptability and compliance in wearing external hip joint protectors are needed.

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