

Reducing hip fractures in the elderly

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Clinical question: Is there evidence that hip protectors and vitamin D with calcium supplementation reduce hip fractures in the elderly?

Results: The results are that vitamin D and calcium supplementation reduce incidence of hip fractures. Hip protectors provide some benefit in reducing hip fractures in elderly patients in residential facilities.

Implementation: Primary care providers should assess patients for the risk of hip fracture and consider using hip protectors and nutritional supplementation in selected individuals to prevent fractures.

Keywords: hip fracture, hip protector, vitamin D, calcium

Hip fractures

Definition: The term ‘hip fractures’ encompasses five subtypes of fractures of the proximal femur: femoral head, femoral neck, intertrochanteric, trochanteric, and subtrochanteric. This is a common orthopedic emergency with ~1.7 million hip fractures occurring annually worldwide. Due to the aging population, it is estimated that by 2050, there will be 6.26 million hip fractures worldwide.¹

Etiology: The vast majority of hip fractures afflicts the elderly and generally occurs with low mechanism injuries, such as falls from standing. Osteoporosis is the predominant risk factor. However, the risk of hip fracture is also much higher for elders in residential dwellings when compared to those in the community. This is in part because more debilitated elders are both more likely to fall and more likely to have lost mechanisms to protect themselves during a fall. The term ‘residential’ elder refers to those elderly patients who are housed in nursing homes or assisted living facilities, in contradistinction to ‘community-dwelling’ elders who reside outside of such institutions.

Economics: Hip fractures are associated with significant morbidity and mortality and impose a large economic burden. In the United States, the average cost for inpatient hip fracture care is \$26,000 per episode. There is also significant cost attributable to the disability of hip fractures, largely related to skilled nursing care. Few patients regain their former level of independence after sustaining a hip fracture, and mortality rates at 1 year have been reported at 10%–20%.² The lifetime attributable cost of hip fractures has been estimated to be \$81,000 per person in the United States. The projected annual cost of hip fractures in the United States is \$16 billion in 2020. Worldwide, the direct and indirect costs of hip fractures are estimated to be US \$131 billion annually.³

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Level of evidence used in this summary: Systematic reviews, meta-analyses, and randomized controlled trials (RCTs) were analyzed.

Search sources: The search engines used for this study were PubMed, Cochrane library, NHS evidence, HTA database, and DARE.

Outcomes: From the patient perspective, the main outcomes are:

1. Decreased incidence of hip fractures
2. Compliance with intervention
3. Occurrence of complications with the intervention

Consumer summary: Hip fractures usually occur in the elderly after suffering a minor fall. Osteoporosis is the main risk factor for hip fractures. Therefore, prevention of hip fractures should naturally focus on prevention of falls and osteoporosis, as well as reducing the risk of fracture resultant from a fall. The two common recommended preventative measures are reviewed. There is good evidence that vitamin D plus calcium supplementation are preventative against hip fractures and some evidence that hip protectors can also be preventative in certain groups of high-risk elders. Although this article does not address other measures, such as bisphosphonates or estrogen replacement therapy, these may be beneficial and should also be considered for patients at risk for osteoporosis.

The evidence

Do hip protectors reduce the incidence of hip fractures after a fall?

Systematic reviews:	3
Meta-analysis:	1
RCTs:	2

In biomechanical studies, hip protectors (hard more so than soft) have been shown to reduce the peak pressure upon the hip during falls.^{4,5} However, in clinical trials, hip protectors have only been shown to be of modest benefit in the reduction of hip fractures. The more robust results come from data of nursing home residents and those at higher risk for fracture.

The Cochrane systematic review concluded that hip protectors marginally diminish the risk of hip fracture in nursing and residential care settings (4.2% vs 6.2%; relative risk [RR], 0.77; 95% confidence intervals [CI]: 0.62–0.97), but not in community-dwelling elders (3.5% vs 2.8%; RR, 1.16; 95% CI: 0.85–1.59).⁶ Two other systematic reviews reached

similar conclusions, namely, that hip protectors significantly reduce the risk of hip fracture in nursing homes. The authors recommended use of hip protectors for residential-dwelling elders.^{7,8}

The meta-analysis by Sawka et al reached similar conclusions regarding effectiveness of hip protectors and was later included in the 2010 systematic review by the same author.^{8,9}

The two most recent RCTs, with conflicting results, are shown in Table 1.^{10,11}

Lack of adherence to the therapy continues to be a limiting factor, and it is more pronounced outside of nursing home settings. Up to 70% of both community and residential elders are not compliant at follow-up, although the adherence figures are highly variable between studies. The most commonly reported complications with hip protectors are skin irritation and lack of comfort, as well as increased need for nursing care.

Table 1 The two most recent RCTs with conflicting results^{10,11}

Author	Population	No. enrolled	Compliance	Conclusion
Koike, et al ¹¹	High-risk residential elders	672	79.7%	Hip protectors effective at reducing hip fractures in high-risk patients
Kiel, et al ¹⁰	Nursing home residents	531	73.8%	Ineffective at preventing hip fractures

Conclusion

Hip protectors are helpful to reduce incidence of hip fractures in residential, high-risk patients. Community elders do not benefit from the use of hip protectors. Overall, there is poor adherence to this intervention. Most common complications are skin irritation and discomfort.

Does vitamin D and calcium supplementation reduce the risk of hip fracture?

Systematic reviews:	4
Meta-analysis:	3

Extensive analyses have been carried out examining the effect of vitamin D, with or without calcium supplementation, in prevention of hip fractures. Although the evidence is not consistent, there seems to be a beneficial effect to high-dose vitamin D supplementation, especially when combined with calcium. The current National Institutes of Health daily intake recommendations are 400 international units (IU) (51–70 years) or 600 IU (>70 years) of vitamin D and 1200 mg of calcium (>51 years).

The largest systematic review looked at 45 randomized trials in total. This systematic review concluded, on the basis of nine trials (24,749 participants), that vitamin D alone is not likely to be effective in preventing hip fractures. However, based on eight trials (445,658 participants), vitamin D plus calcium (when compared to placebo) demonstrated a significant reduction in the incidence of hip fractures. Similarly, regarding hip protectors, they also concluded that residential-dwelling elders derived the most benefit.¹²

The three other systematic reviews concluded that high-dose vitamin D was beneficial with greatest benefit derived when supplemented with calcium and in a residential elderly

population. No effect was found with low-dose vitamin D supplementation in any of the trials reviewed.^{8,13,14}

A high-powered meta-analysis of 29 randomized trials (63,897 participants) examining calcium supplementation found a 12% risk reduction of any type of fracture, including hip fractures.¹⁵ This effect was more pronounced in older patients (>70 years), those with lower body weight, and those elders in residential dwelling. The treatment effect was bigger with high-dose calcium supplementation (>1200 mg/day) and with high vitamin D doses (>800 IU/day). Interestingly, the treatment was shown to be similarly effective with use of calcium alone as with calcium in combination with vitamin D. The protective effect was found to be greater in studies with high compliance. Except for one recent meta-analysis, those that were reviewed concluded that vitamin D plus calcium was superior to vitamin D alone.^{15–18}

Table 2 summarizes the systematic reviews and recent meta-analyses of vitamin D alone versus vitamin and calcium supplementation for prevention of hip fractures.

The most commonly reported side effects from the use of vitamin D and calcium are gastrointestinal symptoms,

Table 2 Summary of systematic reviews and recent meta-analyses of vitamin D alone versus vitamin and calcium supplementation for prevention of hip fractures

Author	Type	Vitamin D alone	Vitamin D and Calcium	Conclusion
Avenell, et al ¹²	Review of 45 RTCs	Not beneficial	Beneficial	Recommend combined vitamin D and calcium supplementation in frail older people in institutions. Unclear effect on community dwellers
Izaks, et al ¹⁴	Review of 11 RCTs	Not beneficial (low dose)	Beneficial	Vitamin D (high dose) and calcium showed decreased fracture risk in institutionalized patients. Low dose vitamin D is ineffective, and there is not sufficient data on high dose vitamin D alone
MacLean, et al ¹³	Review of 7 RCTs	Beneficial	Beneficial	Vitamin D with or without calcium supplementation reduces risk of nonvertebral fractures. One study of calcium supplementation alone showed no effect
Sawka, et al ⁹	Review of 7 RCTs	Beneficial	Beneficial	High dose vitamin D supplementation with or without calcium reduces risk of hip fracture
Tang, et al ¹⁵	Meta-analysis of 29 RCTs	Not investigated	Beneficial	Calcium alone or in combination with vitamin D is effective at preventing fractures. Both are more effective in high doses
Bischoff-Ferrari, et al ¹⁶	Review of 7 RCTs	Unable to determine	Beneficial	High dose vitamin D supplementation with calcium reduces risk of hip and nonvertebral fracture in community and institutionalized settings
Jackson, et al ¹⁷	Meta-analysis of 9 RCTs	Not beneficial	Not beneficial	Though no statistically significant fracture reduction demonstrated, there was a trend toward reduced risk
Bergmana, et al ¹⁸	Meta-analysis of 8 RCTs	Not investigated	Beneficial	Vitamin D3 and calcium supplementation reduced hip fractures as compared to placebo

renal disease, and hypercalcemia. All of these were modestly but significantly increased in patients receiving treatment versus placebo. According to the systematic review by the Cochrane Collaboration, related vitamin D

Conclusion

High-dose vitamin D (800 IU) and calcium (1200 mg) in combination are effective at reducing risk of hip fracture,

compounds used do not seem to have advantages when compared to vitamin D, and calcitriol, specifically, may be deleterious through an increase of documented adverse events.

especially in institutionalized elderly patients. Adverse events, though rare, can include hypercalcemia and renal disease.

The practice

Potential pitfalls

- Monitor patients for side effects of treatments, such as skin irritation in the case of hip protectors or hypercalcemia and renal disease in the case of vitamin D and calcium supplementation.
- Monitor and control risk factors for osteoporosis.
- Do not fail to recognize reasons for fracture other than osteoporosis, such as elder abuse or pathologic fracture.
- Investigate cause of frequent falls.
- Recognize the high morbidity and mortality of osteoporotic fractures.

Management

Primary providers should screen for both risk factors for osteoporosis and the disease itself, including bone density screening. Consider vitamin D and calcium supplementation in high-risk individuals. Hip protectors should be considered for residential elders and those at high-risk of hip fracture.

Assessment

Screen for risk factors for osteoporosis (such as tobacco use, low body weight, high alcohol intake, use of steroids, and physical inactivity) and for falls (such as alcohol or substance abuse, underlying medical conditions, poor mobility, vision, cognition, and unsafe environments). Interventions should also be aimed at reduction of these risk factors.

Treatment

- Dose vitamin D at 800 IU per day and calcium at 1200 mg per day.
- Hip protectors may be obtained from numerous commercial vendors. They are available in a variety of styles and sizes, including specific models designed for elders with incontinence.

- In this article, we addressed two commonly utilized methods of hip fracture prevention. There are many more options available for prevention of osteoporosis and secondarily hip fractures, including bisphosphonates and estrogen modulators. These therapies were beyond the scope of this review; further reading on these topics is recommended below.

Indications for specialist referral

Preventative measures for osteoporosis and hip fractures can be instituted by primary care physicians and do not require specialist referral.

Further reading

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