Osteoarthritis and falls in the older person

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Abstract

Osteoarthritis and falls are common conditions affecting older individuals which are associated with disability and escalating health expenditure. It has been widely assumed that osteoarthritis is an established risk factor for falls in older people. The relationship between osteoarthritis and falls has, quite surprisingly, not been adequately elucidated, and published reports have been conflicting. Our review of the existing literature has found limited evidence supporting the current assumption that the presence of osteoarthritis is associated with increased risk of falls with suggestions that osteoarthritis may actually be protective against falls related fractures. In addition, joint arthroplasty appears to increase the risk of falls in individuals with osteoarthritis.

Keywords: osteoarthritis, accidental falls, fractures, older people

Introduction

Osteoarthritis (OA) is a degenerative joint disease characterized by progressive loss of articular cartilage, subchondral bone sclerosis, osteophyte formation, and synovial inflammation. In the USA, an estimated 27 million adults have clinical OA [1]. The knee joint is most commonly involved in lower extremity OA. According to the 1991–94 National Health and Nutrition Examination Survey, 12.1% of Americans aged 60 years above have symptomatic radiographic OA of the knee [2]. Knee pain is present in 31% of men and women aged 65 years and above in Hong Kong, and the presence of knee pain is associated with greater functional impairment and adverse psychological effects [3].

Falls in older people can result in physical injuries such as bony fractures and subdural haematoma, as well as the psychological consequences of fear of falling and depression. Fear of falling is associated with reduced functional status, reduced quality of life (QoL) and increased institutionalization rate. Numerous risk factors have been reported for falls in older people that include muscular weakness, medications, cognitive decline, cardiovascular disorders, stroke disease, visual impairment and environmental factors. While OA has been considered an established risk factor for falls among older people [4], the actual relationship between OA with falls and resultant fractures in the older population, remains unclear. This review article evaluates the published literature between OA and falls in older people, and rationalizes the conflicting evidence and caveats that exist between the two disorders.

Sources and selection criteria

We conducted Medline, Pubmed, Web of Knowledge and Cochrane Collaborative searches for English articles using the keywords ‘arthritis, OA, falls, accidental falls, home accidents and aged’. The abstracts of 226 articles were reviewed. Eighty-one articles were retrieved and read. We subsequently selected 25 papers for inclusion in this article. Further relevant papers were identified by cross-reference and from our personal archives. We also consulted published international guidelines on the management of osteoarthritis.

Falls and fractures in patients with OA

Physical changes associated with OA

OA is associated with mechanical stress and ageing. The joints become less well adapted. Several changes occur in the joint including fragility of the bones, loss of resilience in the cartilage, reduced skeletal muscle strength, reduced elasticity of the ligaments and redistribution of fat (Table 1). The
primary pathology of OA is focal cartilaginous lesions. At least in part, it is due to the reduced ability of chondrocytes to respond to growth factor stimulation. Chondrocytes in elderly patients and osteoarthritic cartilage are less responsive to transforming growth factor-beta and insulin-like growth factor-1 [5]. Ultimately, there is reduced joint space as a result of cartilage thinning. Where areas of cartilage erosion, fissuring and detachment have occurred, subchondral bone is exposed. Subchondral cysts develop, while the loose cartilage leads to synovial inflammation, followed by new bone or osteophyte formation.

### Joint pain and falls

The symptoms of OA include knee, hip and back pain. The presence of arthralgia will lead to avoidance of movement of the affected joint, leading to functional limitation and reduction of physical activity. As a result, muscle wasting occurs around the affected joint, and generalized physical deconditioning will also ensue. Using magnetic resonance imaging, only the presence of large joint effusions and osteophytes is associated with the symptoms of pain, whereas cartilaginous changes, subchondral cysts and meniscal tears were not significantly associated with pain [6]. The symptoms of joint pain, however, correlate poorly with X-ray evidence of OA [7]. The reason behind this remains unclear, but it is likely that the pathological changes associated with joint OA and the symptoms of joint pain are not always visible on radiological imaging. The prevalence of joint pain is therefore likely to be far higher than the prevalence of radiographic evidence of OA.

There appears to be a gender discrepancy in the context of arthralgia and falls, with studies suggesting an increase in incidence of falls in women but not men with joint pain. In a large general practice registry, only women with hip pain were three times more likely to report falls in the past 12 months, whereas there was no increased likelihood of falls in men with hip pain compared with control subjects (Table 2) [8]. A recent cross-sectional survey involving over 1,600 older Japanese also found that women with knee pain and back pain, with or without radiographic evidence of OA, had reported a higher incidence of falls over the past 12 months, but there was no significant association between falls and OA in older men in this population [9]. In a large cohort study involving 5,552 women aged 65 and older, 60.6% had self-reported, physician diagnosed arthritis, with only 11.6% having radiographic evidence of hip OA. Interestingly, the older women with radiographic evidence of hip OA had a 30–40% reduction in the risk of having two or more falls in 12 months, whereas those with self-reported arthritis had a 50% increase in risk of recurrent falls [10].

The statistical evidence for falls in older patients with OA summarized above therefore remains unclear. Older women with symptoms of hip pain, knee pain and clinical diagnosis of OA appear to have increased risk of falls. The evidence for falls in older men with symptoms or clinical diagnosis remains uncertain. The literature evaluating falls risk in older individuals with radiographic evidence of OA is conflicting with just one study reporting an increased risk of falls in older women with radiographic OA, whereas the remaining studies showed no increase or reduction in falls with radiographic OA. The relationship between falls and OA is further complicated by the large variations in criteria used to determine the presence of OA.

### Gait and balance disorder due to OA

Elderly patients with knee and hip OA adopt different compensatory biomechanical strategies while walking. Typically patients with unilateral hip OA develop a Trendelenburg’s gait. During the stance phase of gait on the affected side, the pelvis is tilted downwards on the opposite site to reduce the load on the affected side. The shift of centre of gravity to the stance leg therefore no longer occurs, leading to instability. Reduction in joint flexion/extension due to pain, deformity or muscle weakness may occur as a result of worsening knee OA, leading to increasing deficits in balance control. For instance, during walking, individuals with knee OA have increased trailing toe clearance, leading to greater dependency on the hip abductor and extensor muscle groups [11]. Alterations in gait patterns and postural stability then result in reduced obstacle clearance rate, difficulties with transfer of centre of gravity and poor balance recovery. While balance control and the biomechanics of walking have been shown to be altered by the presence of OA, there is no published evidence linking these alterations in gait and balance with falls outcomes.

### Other associated symptoms or co-morbidities

OA also leads to neurological and psychological consequences, but the associations between these extra-articular sequelae and falls have to be elucidated. Neurological entrapment may occur as a result of OA. This may manifest as peripheral nerve entrapment manifesting as foot drop or sciatica, or central myelopathy such as cauda-equina syndrome, lumbar stenosis or cervical myelopathy. Associated neurological damage may lead to motor weakness as well as sensory problems including loss in proprioceptive, nociceptive and tactile sensation. Joint pain is also associated with reduced quality of life and depression. Depression is an
established risk factor for falls. Reduced quality of life and depression are also likely to have negative psychological consequences following an index fall, which may then lead to further falls [12].

This risk of fractures in individuals with OA

Four decades ago, Foss and Byers reported the observation of an inverse relationship between OA and osteoporosis [13]. Since then, it has been suggested that the presence of OA is a protective factor for fragility fractures. However, subsequent epidemiological studies demonstrated that OA patients did not have fewer fractures despite a normal/high BMD [10]. The Rotterdam study which involved 2,773 subjects did not have fewer fractures despite a normal/high BMD [10]. The Rotterdam study which involved 2,773 subjects did not have fewer fractures despite a normal/high BMD [10]. Since then, it has been suggested that the presence of OA is a protective factor for fragility fractures. However, subsequent epidemiological studies demonstrated that OA patients did not have fewer fractures despite a normal/high BMD [10]. The Rotterdam study which involved 2,773 subjects did not have fewer fractures despite a normal/high BMD [10]. The Rotterdam study which involved 2,773 subjects did not have fewer fractures despite a normal/high BMD [10].

<table>
<thead>
<tr>
<th>Reference</th>
<th>Participants</th>
<th>Study design</th>
<th>OA criteria</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foss and Byers [13]</td>
<td>140 patients with upper femoral fractures</td>
<td>Prospective</td>
<td>Radiological features of OA on pre-operative X-rays</td>
<td>3/140 had OA changes on X-ray of fractured joint</td>
</tr>
<tr>
<td>Nahit et al. [8]</td>
<td>111 cases, 229 controls</td>
<td>Retrospective study</td>
<td>Hip pain</td>
<td>Falls in women, OR = 3.6 (1.9–6.7) mt men, OR = 0.8 (0.3–2.3)</td>
</tr>
<tr>
<td>Arden et al. [10]</td>
<td>5,552 women &gt;65 year with physician diagnosed (n = 3,366) and radiographic OA (n = 644)</td>
<td>Prospective, cohort study</td>
<td>Self-reported, physician diagnosed arthritis</td>
<td>Recurrent falls, RR = 1.4 (1.2–1.5)</td>
</tr>
<tr>
<td>Leveille et al. [24]</td>
<td>1,002 women &gt;60 years</td>
<td>3-year longitudinal cohort study</td>
<td>Pain-rating scale</td>
<td>Falls with widespread musculoskeletal pain, OR = 1.66 (1.25–2.21)</td>
</tr>
<tr>
<td>Bergink et al. [14]</td>
<td>2,773 men and women &gt;55 years</td>
<td>Prospective cohort study (mean follow-up 5.7 years)</td>
<td>Radiographic grading of knee OA</td>
<td>BMD, ↑ fractures: vertebral, OR = 2.0 (1.1–3.4) non-vertebral, OR = 1.5 (1.1–2.0)</td>
</tr>
<tr>
<td>Arden et al. [15]</td>
<td>6,641 men and women ≥75 years participating in an RCT in Vit D (2,186 cases)</td>
<td>Prospective cohort study</td>
<td>Self-reported knee pain and clinical diagnosed OA</td>
<td>Falls</td>
</tr>
<tr>
<td>Muraki et al. [9]</td>
<td>1,675 men and women, mean age = 64.3 years</td>
<td>Retrospective study</td>
<td>Knee and lumbar back pain</td>
<td>Multiple falls in women only: knee pain, OR = 1.87 (1.06–3.28) lumbar back pain, 1.72 (1.01–2.88)</td>
</tr>
</tbody>
</table>

OA, osteoarthritis. Risks are presented as odds ratio (OR), risk ratio (RR) or hazard ratio (HR) with 95% confidence interval in parentheses.

Do current strategies to treat OA reduce falls?

International guidelines for the treatment of OA have focused on non-pharmacological management because in general there is lack of strong efficacy data on medications currently available to treat OA apart from symptomatic control [17]. Most recently, the American College of Rheumatology 2012 guidelines for OA management does not provide any specific recommendation on balance exercise, but has recommended T’ai Chi as part of non-pharmacology intervention [17].

Exercise

Multi-component exercises reduce falls occurrence as well as falls rate in older individuals according to the most recent Cochrane review on falls intervention in the community [18]. Whether exercise therapy is an effective falls prevention strategy for individuals with OA, and which types of exercises are
likely to be beneficial remains unclear. Studies conducted so far have involved only small numbers of subjects and have yet to measure the hard outcomes of falls occurrence or falls rate. These studies have also only targeted OA sufferers as primary falls prevention rather than secondary prevention in fallers with OA. The diagnostic criteria are also too variable to make meaningful comparisons between studies.

Water-based exercise has been demonstrated to improve balance and strength measures in healthy older individuals as well as older women with OA. A pilot study involving twice weekly water-based exercises which included mainly balance components, however, failed to demonstrate significant improvements in the primary outcome measure of falls risk ratio or the secondary outcome measures of muscle strength, balance, fear of falling or arthritis symptom severity scores (Table 3) [19].

A recent study by Hiyama et al. [20] involving 40 older women, with arthritis evaluated a 4-week walking exercise programme, reported improvements in dual-task walking speed, executive function measured by the trail-making test and the Japanese Knee OA Measures in the intervention group. Both the intervention and control group received ice therapy, range of motion exercises and strengthening exercises, with the single intervention being increasing daily walking by 3,000 steps per day. T’ai chi exercises in older individuals with OA increased knee extensor muscle endurance, improve balance and decrease the fear of falling at 6-month follow-up [21].

A more targeted approach with individualized physiotherapist-prescribed balance training home exercise program in 39 women with lower-limb OA or rheumatoid arthritis had demonstrated an improvement in stability during walking, with a significant reduction in fall risks score and fear of falling [22]. As this was a pilot study with only 4-month follow-up, no information on falls recurrence was available, though 66% of the 27 subjects with OA had reported at least one fall in the past 12 months, of whom two-thirds had experience recurrent falls.

**Weight loss**

Increased body weight is a major risk factor for OA. The contact load experienced by the weight bearing joints is far greater than the actual body weight. The presence of obesity therefore greatly enhances the risk of walking limitation in older patients. Weight loss of at least 10% significantly reduces knee loading, reduces knee pain and promotes improvement in markers of inflammation, metabolism and OA. Among elderly patients, intensity weight loss significantly reduces inflammatory markers with associated improvements in stair climbing and walking speeds in a randomized-controlled study [23]. Although weight loss induced by low-energy diet was beneficial to knee OA, significant weight loss in patients should be followed by exercise to restore or increase the muscle mass. The evidence supporting weight loss in the treatment for OA have mainly reported improvement in the symptom of pain, with fewer studies evaluating pathological and mechanical benefits. No study so far has evaluated the effect of weight loss in reducing falls in older individuals with OA.

**Analgesics and symptomatic slow acting drugs for OA**

Non-steroidal anti-inflammatory drugs (NSAIDs), selective or non-selective, are frequently prescribed in elderly with

### Table 3. Summary of studies evaluating effects of treatment options on balance measures and falls

<table>
<thead>
<tr>
<th>Reference</th>
<th>Participants</th>
<th>Study design</th>
<th>Observation/intervention</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pandya et al. [26]</td>
<td>9 cases with knee OA, 14 aged-matched controls</td>
<td>Prospective, case-control study</td>
<td>Intra-articular steroids</td>
<td>↓ Pain</td>
</tr>
<tr>
<td>Miller et al. [23]</td>
<td>67 adults aged ≥60 years, BMI ≥30</td>
<td>Randomized-controlled study</td>
<td>Intensive weight loss intervention (8.7% weight loss)</td>
<td>↑ Obstacle clearance rate (remains worse than healthy controls)</td>
</tr>
<tr>
<td>Swinkels et al. [29]</td>
<td>118 patients aged ≥65 years undergoing TKR</td>
<td>Prospective observational study</td>
<td>Falls rate before and after total knee replacement</td>
<td>↓ Falls rate (24% versus 12% per quarter), ↑ balance confidence in non-fallers</td>
</tr>
<tr>
<td>Song et al. [21]</td>
<td>82 women with OA</td>
<td>Randomized-controlled study</td>
<td>6 months/ Tai Chi exercises</td>
<td>↑ Muscle strength, ↑ bone mineral density, ↓ fear of falling</td>
</tr>
<tr>
<td>Williams et al. [22]</td>
<td>39 women with OA or RA</td>
<td>Uncontrolled pilot study</td>
<td>Home-based exercise programme</td>
<td>↑ Balance, ↓ fear of falling</td>
</tr>
<tr>
<td>DeCarpita et al. [27]</td>
<td>30 adults with knee OA</td>
<td>Randomized, placebo-controlled study</td>
<td>Intra-articular hyaluronic acid</td>
<td>Improved gait variability, ↓ double support time, ↓ stride time variability</td>
</tr>
<tr>
<td>Levinger et al. [28]</td>
<td>35 (16 men, 19 women) mean age 67.4 ± 7.5 years</td>
<td>Prospective observational study, 12 month follow-up</td>
<td>Falls, falls efficacy and falls risk assessment following TKR</td>
<td>48.5% pre- and 40% post-operative falls (no significant difference), No difference in balance and proprioception</td>
</tr>
<tr>
<td>Matsumoto et al. [30]</td>
<td>74 (6 men, 66 women) aged over 60 years</td>
<td>Prospective observational study, 6-month follow-up</td>
<td>Falls occurrence post total knee arthroplasty</td>
<td>33% reported falls in 6 months</td>
</tr>
</tbody>
</table>

OA, osteoarthritis; TKR, total knee replacement.
knee OA. The recent ACR 2012 guideline on management of OA recommended topical rather than oral NSAIDs in patients over 75 years of age [17]. An observational study which demonstrated increased falls in individuals with OA, with balance impairment associated with increasing severity of the arthritis, has also demonstrated in a subgroup analysis that individuals who used daily analgesia are less likely to experience falls [24]. Symptomatic Slow Acting Drugs for OA (SYSADOA) include glucosamine, chondroitin sulphate and other related substances. Glucosamine and chondroitin sulphate, either as single agent or in combination, a popular medication prescribed despite conflicting efficacy data [25]. There is currently no published data on falls prevention for glucosamine, chondroitin sulphate and other SYSADOA like avocado/soybean unsaponifiables and diacerein.

**Intra-articular injections**

Intra-articular injection of local anaesthetic for symptomatic knee OA provides significant pain relief and improves the success rate in obstacle avoidance [26]. The potential benefits of intra-articular injections of hyaluronic acid on gait measures for knee OA are limited to only one study which showed no significant benefit from intra-articular hyaluronic acid injection on gait velocity in older knee OA patients [27]. The effectiveness of intra-articular treatments of OA for gait, balance and falls, therefore, still needs to be adequately evaluated.

**Joint arthroplasty**

A recent history of fall is common in individuals who had total knee replacements (TKR) and 45% of patients fall again in the year following surgery [28]. The patients may have impaired proximal muscle strength of the lower limbs prior to surgery, and compounded by loss of muscle after knee replacement immediately after operation. Swinkles et al. demonstrated that patients who underwent surgery exhibited a greater fear of falling and reduced lower-limb proprioception and knee extension strength both pre- and post-surgery. Following TKR, there was a reduction in fear of falling and pain, and improvements in function for the surgical group. The number of falls experienced following knee replacement surgery remained high, which may be due to the persistence of impaired lower-limb proprioception [29]. Thirty-three per cent of individuals who underwent TKR reported a fall over the observational period of 6 months, with fallers having reduced range of knee flexion and ankle plantarflexion compared with non-fallers [30]. Joint arthroplasty appears to paradoxically increase the risk of falls in individuals with OA. The follow-up periods of the above studies are not longer than one year. It is possible that longer term follow-up beyond 1 year may demonstrate reduced falls.

**Conclusion**

The relationship between OA and falls remains unclear, but recent larger studies have reported increased risk of falls in older women with lower-limb joint pain and back pain. The interpretation of such studies evaluating falls prevalence in sufferers of OA is complicated by the large discrepancy between the symptoms of joint pain and radiographic evidence of OA, and the varying disease indicators used by the studies. OA of the hip and knee results in reduced toe clearance, impaired obstacle avoidance, and gait and balance disorders, which may increase falls risk. Small studies evaluating water-based exercise, a walking programme, tailored exercises and T'ai Chi involving OA sufferers have reported improvements strength, balance and falls efficacy. Intra-articular steroid have been beneficial in small studies and require further evaluation. Joint replacements may paradoxically increase the risk of falls individuals with OA. Interventional studies with the incidence and rate of falls as primary outcome are urgently required for this common, disabling condition.

**Key points**

- Self-reported joint pain is associated with falls in older women, but not older men.
- The presence of OA is protective against falls related fractures.
- Exercise, weight loss and analgesia are associated with improved balance measures in individuals with osteoarthritis.
- Joint arthroplasty is not associated with falls reduction or improvement with balance measures.

**Conflicts of interest**

None declared.

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