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Overview

Orthogeriatrics – considerations in caring for older orthopaedic patient

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Abstract

Patients over the age of 65 are the fastest growing segment of the population, and it is estimated that it comprises 12.5% of the entire population in the developed countries. Advances in medicine, science and healthy lifestyles have promoted substantially increased lifespans, as well as better quality of life with more physical activity. On the other hand, aging is associated with a variety of physiologic changes that affect orthopedic care. Due to natural involution processes older adults may not have the physiologic reserves necessary to promote healing or to prevent or recover from complications. Degenerative diseases and injuries sustained from trauma in combination with physiologic changes and comorbidity in the aged pose a significant health problem in older adults and a major treatment challenge for an orthopaedic surgeon. This review summarizes some of these unique challenges in care for older orthopaedic patient.

INTRODUCTION

Patients over the age of 65 are the fastest growing segment of the population, and it is estimated that they comprise 12.5% of the entire population in the developed countries *(1)*.This issue has been internationally recognized, and the initiatives termed *Bone and Joint Decade 2000–2010* followed by *Joint Motion 2010–2020* were started in order to raise awareness of the burden of musculoskeletal conditions. The relevant data show that about 50% of all chronic conditions in patients over the age of 65 are due to musculoskeletal diseases, and 80% of these patients have severely limited activities of daily living. Additionally, after age 50 years, the lifetime risks for fractures in women are hip 17.5%, vertebrate 16%, and distal radius 16% *(2)*. For comparison, in men aged 50 years and older, the lifetime risks of fracture are hip 6%, vertebrate 5%, and radius 2.5%.

Advances in medicine, science and healthy lifestyles have promoted substantially increased lifespans, as well as better quality of life with more physical activity. Although more physical activity in elderly patients exerts beneficial influences on many levels (both physical and mental), it also contributes to the development of degenerative bone and joint diseases and higher incidence of traumatic events. On the other hand, aging is associated with a variety of physiologic changes that affect orthopedic care. Due to natural involution processes older adults may not have the physiologic reserves necessary to promote healing or to prevent or recover from complications. Latest advances in conservative treatment and surgical techniques, in combination with

Figure 1. *Roentgeongram of the patient with bilateral hip osteoarthritis (more advanced on the right side). Note the presence of classical radiological signs of osteoarthritis: loss of joint space, subchondral sclerosis, bone spurs (osteophytes) and subchondral cysts.*

better understanding of geriatric physiology allowed orthopedic surgeons to treat their patients with excellent functional results.

The following is a review of considerations that is aimed in helping orthopaedic surgeons to treat their geriatric patients more efficiently and safely.

GERIATRIC PHYSIOLOGY

Physiologic changes associated with aging affect every organ system, generally resulting in a decline in functional reserve capacity *(3)*. The delicate balance between functioning musculoskeletal system and physical demands is usually accomplished by hypetrophy and atrophy. Due to natural involutive changes, in geriatric patient, this balance is substantially compromised. "Primary aging" occurs on cellular and molecular levels within cells and extracellular matrix, and results in regeneration and reparation processes being much slower or completely absent.

The aging process is characterized by gradual decline in a variety of physiological parameters that affect both individual reserve and ability to maintain homeostasis. As a percentage of total body weight, lean body mass decreases, whereas total body fat increases. Between ages 50 and 70, a 12–15% decrease per decade in muscle mass has been observed *(4)*. This results in impaired posture, static and dynamic foot problems and increased risk of fall. Other factors related to aging such as impaired coordination, proprioception, vision and cognitive abilities further contribute to the incidence of acute traumatic events or chronic degenerative musculoskeletal diseases. It has been shown that exercise, particularly resistance training significantly improves muscle strength in older people *(5)*. Resistance training routines are designed to overload muscle by utilizing weights in the 6–10 repetition maximum range. This results in increase in muscle mass, strength and speed of contraction *(6)*. In addition these exercises have been shown to increase postural stability, increase walking velocity, and reduce potential for falls *(7)*. For instance,Fiatarone and co-workers reported a 48% increase in mean tandem gait speed in very old institutionalized patients in response to an 8-week program of high-intensity exercise *(8)*.

Decrease in bone mass and density is another important physiological factor that contributes to overall increase of orthopaedic injury. Throughout early childhood, bone mass increases proportionally to skeletal growth. Fast increase of bone mass occurs during adolescent growth spurt, and continues increasing in following years until it reaches its maximum. This is known as peak bone mass and it varies among individuals due to influence of genetic and environmental factors (it is believed that genetics account for 75% and environmental factors for 25%) *(9)*.

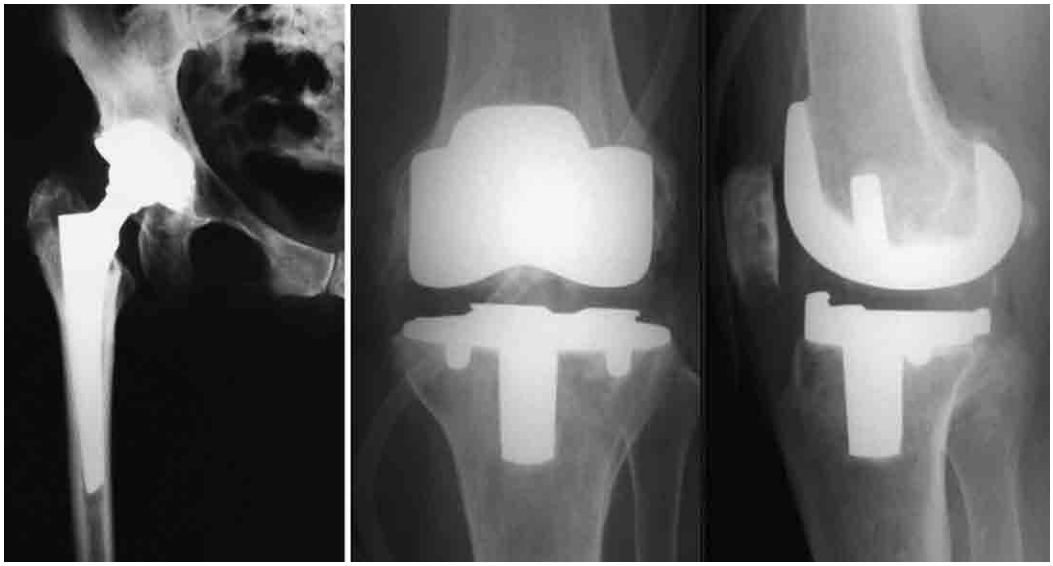

Figure 2. *Roentgenograms of patients with severe osteoarthritis of the hip and knee treated with total endoprosthesis.*

Figure 3. *Roentgenograms of the patient with bunions (hallux valgus), depicting progression of the deformity of the course of years.*

Figure 4. *Patient with severe forefoot deformity and subjective metatarsalgia. The right foot was treated with first metatarsophalangeal joint arthrodesis and II–V metatarsal head resection arthroplasty. Postoperative roentgenogram of the same patient.*

Following attainment of peak bone mass, a gradual loss of bone occurs throughout the ageing process, which eventually results in an increased risk of osteoporotic fractures.

DEGENERATIVE JOINT DISEASE (OSTEOARTHRITIS)

Osteoarthritis (OA) is the most common form of arthritis with over 151 million sufferers worldwide. In Europe, joint replacement surgeries to treat OA are predicted to take place every 1.5 minutes *(10)*. OA is less common before age 40, but rises in frequency with age such that it represents a major source of pain and disability of the large joints in the aging population *(11)*. The knee is the major site of OA followed by hip and hand *(12)*. OA is mainly characterized by the progressive degradation of cartilage, accompanied by intermittent synovitisand local inflammation which leads to functional deficits, limited movement and pain. All these changes in turn contribute to reduced social interactions, distress, and depression *(13)*. The most common risk factors for OA include age, sex, prior joint injury, obesity, genetic predisposition, and mechanical factors, including malalignment and abnormal joint shape *(14)*.

The diagnosis of OA is mostly based on detailed medical history and appropriate physical examination. The patients are usually older than 40 years of age, and the usual presenting symptom is pain in one or few large joints. It is characteristically accompanied by morning

stiffness which usually resolves after half an hour. In more advanced stages of the disease, prolonged stiffness and joint enlargement are evident. Initial workup of the patient with OA should always include weight-bearing radiographs to evaluate the stage of the disease. Classical radiological signs of OA include presence of joint space narrowing, osteophyte formation, pseudocyst in subchondral bone, and increased density of subchondal bone (Figure 1) *(15)*. If clinically indicated this initial workup may be accompanied by tests for sedimentation rate, C-reactive protein and rheumatoid factor to exclude rheumatic inflammatory disease. If the patient presents with swollen joint(s), synovial fluid examination may be conducted to exclude other diagnosis. In osteoarthritis, the white blood cell count is usually less than 500 cells per mm^2 (0.5×10^9 per L) and is composed predominantly of mononuclear cells. In inflammatory aspirates, the white blood cell count is usually greater than 2,000 cells per mm^2 (2.0×10^9 per L), and the predominant cell type is usually the neutrophil *(16)*.

Currently there is no definitive cure for OA, and it is not possible to reverse degenerative joint changes once they take place. Therefore, the primary goals of the OA treatment are to improve quality of life, and the prime targets are pain reduction and optimization of joint function. The treatment should be highly individualized according to the needs of every patient, and the stepwise approach is preferred, begging with simpler options and successively introducing more radical ones. In addition, patient education is of utmost importance and their role in management of the disease cannot be overemphasized. Weight reduction, regular aerobic exercising and adopting healthy life styles are the most important measures for preventing disease progression. Since pain is the primary symptom of osteoarthritis, it is necessary to introduce pain-control medication to improve function of the affected joint. Due to its powerful analgesic effect and relatively safe pharmacological profile (no serious side effects in recommended doses), paracetamol (acetaminophen) 1g four times a day is currently drug of choice for initial OA treatment. Non-selective non-steroidalanti-inflammatory drugs (NSAIDs) should be used with caution in older people after other safer treatments have not provided sufficient pain relief *(17)*. Age-related decrease in gastric bicarbonate secretion, blood flow, and mucosal functioncontribute to a loss of stomach protection and an increased risk of gastritis, ulcer formation, and gastrointestinal bleeding.The lowest dose should be provided, for the shortest duration. It is also recommended to co-prescribe proton pump inhibitor with non-selective NSAIDs. All older people taking NSAIDs should be routinely monitored for gastrointestinal, renal and cardiovascular side effects, and drug–drug and drug–disease interactions. Opioids may be prescribed in patients with severe OA with substantial functional deficits or in patients who are not eligible for elective surgical procedure. However, this also must be individualized and carefully monitored *(18)*. Intra-articular injections of steroids or/and hyaluronic acid (viscosupplementation) are viable alternatives to oral medication in terms of pain relief and functional improvement. Recent meta-analysis showed that intra-articular corticosteroid injection results in clinically and statistically significant reduction in osteoarthritic knee pain 1 week after injection, and the beneficial effect may last up to 4 weeks *(19)*. Another study compared the efficacy of intraarticular hyaluronic acid with corticosteroids for knee osteoarthritis. The authors concluded that from baseline to week 4, intra-articular corticosteroids appear to be relatively more effective for pain than intra-articular hyaluronic acid, but beyond week 8, hyaluronic acid has greater efficacy *(20)*. In advanced stages of the disease, partial or total joint arthroplasty should be discussed with a patient (Figure 2). Contrary to the common opinion that elderly patients are not good candidates for elective joint surgery (45% of patients in one study reported that surgery was not offered as a potential treatment option), most of the available literature data show that elderly patients who had hip or knee replacements for severe OA took several weeks to recover but experienced excellent long-term outcomes *(21)*. It seems that preoperative comorbidity and functional limitations are much stronger predictors of unsatisfactory outcome after total joint replacement. In other words age alone is not a factor that affects the outcome of joint arthroplasty and should not be a limiting factor when considering who should receive this surgery *(22)*.

FOOT AND ANKLE PROBLEMS

Foot and ankle problems such as deformities and arthritis have become more common as more individuals attain longer lifespans. However, aged population nowadays has better health, more mobility, and more active lifestyles which necessitate more active approach in diagnosis and treatment of these disorders. Although conservative options are the mainstay of the treatment in this age group, surgical options should not be overlooked secondary to a misunderstanding of their ability to overcome perioperative management. Careful preoperative examination is necessary to identify eligible candidates for elective lower extremity correctional procedures. Adequate nutritional status (protein levels good are indicators) as well as appropriate dietary supplementation may assist the overall healing process. Preexisting medical conditions should be checked, and thorough discussion about the surgical options and prognosis should be carried out with patient and his immediate family.

Forefoot deformities. The most common forefoot deformities include hallux valgus („medial bunion"), digitus-flexus (hammertoe), hallux rigidus („dorsal bunion"), metatarsalgia and fifth metatarsal bunion („tailor's bunion") (Figure 3). These deformities are particularly prevalent in women after menopause, and when accompanied by osteoarthritis may severely compromise the quality of everyday living *(23)*.The treatment usually starts with shoe wear modification and prescription of physical therapy and analgesics. Many of these patients are overweight and the significant weight reduction usually brings substantial subjective improvements of symptoms. If conservative approach fails, surgical correction should be offered to a

patient *(24)*. Most of these procedures can be performed under intravenous sedation with regional blocks in an outpatient setting or as a short-term stay in a hospital (next day discharge) *(25)*. Forefoot deformities are usually addresses with less complicated osteotomies (e.g. scarf of chevron osteotomy for bunion correction) and resection arthoplasties or arthrodesis for correction of proximal and distal interpahalangeal joint deformitites (Figure 4).

Midfoot deformities.The most common midfoot disorders are usually consequence of advanced osteoarthritis (either idiopathic or secondary due to trauma or rheumatic disease) or of neuroarthropatic changes known as Charcot foot. Surgical procedures used to treat these deformities are divided into cheilectomy (spur removal), osteotomy (bone realignment), arthroplasty (joint replacement) or arthrodesis (joint fusion). All of these procedures have its pros and cons, but generally speaking milder deformities should be treated with corrective osteotomies and cheilectomies, while end-stage arthritic changes have better outcomes with joint-replacing or joint-fusioning procedures.

Hindfoot deformities.The most common deformities and the hindfoot and ankle level in geriatric population are due to osteoarthritis, muscular imbalance or stroke. Osteoarthritic changes (primary or secondary) may affect ankle, subtalar and midtarsal (talonavicular and calcaneocuboid) joints in isolation or combination (Figure 5). Although total ankle joint replacement is being performed more commonly, arthrodesis of the ankle (and subtalar) joints is still the gold standard in the treatment of advanced osteoarthritis in geriatric population *(26)*. It provides stable, plantigrade, painless footwith improved quality of life. If indicated, isolated midtarsal joints arthrodesis may be performed as a safe and reliable procedure. Adult acquired flat foot deformity (AFFD) is a degenerative disease resulting in malalignment of the mid- and hindfoot secondary to posterior tibial tendon dysfunction *(27)*. Clear evidence exists that suggest that the quality of life for elderly patients with posterior tibial tendon dysfunction is significantly affected. Since isolated repair of the tendon does not provide adequate correction and stability, AFFD should be primarily addressed with bone realignment osteotomies such as medial displacement calcaneal osteotomy or lateral opening wedge calcaneal osteotomy (Evans' osteotomy) *(28, 29)*.

OSTEOPOROSIS

Osteoporosis is defined as pathologic condition that affects entire skeleton, and is characterized by a low bone mass in combination with microarchtectural changes, particularly of the cancellous bone *(30)*. In the adult skeleton, physiological structure and mineral content are maintained throughout the life by the constant process of bone remodeling that is regulated by the balanced activities of bone-resorbing osteoclasts and bone-forming osteoblasts *(31)*. The sequence of events in the remodeling cycle starts with osteoclastic bone resorption, i.e. removal of the old bone. Osteoclasts are giant multinucleatedderived from

Figure 5. *Roentgenogram of the patient with isolated talonavicular osteoarthritis (white arrow).*

multipotenthemopoietic precursor of the monocluear/phagocytic lineage and are responsible for bone resorption *(32)*. The resorptive phase is followed by reversal phase, in which pre-osteoblasts (which are derived from mesenchymal precursors) enter the site of resorption. After few days pre-osteoblasts differentiate into fully functional mature osteoblasts which deposit bone matrix into theresorption cavity (lacunae). The matrix is eventually mineralized and the bone structure unit is rebuilt. The duration of on remodeling cycle is estimated at 3 months for cortical bone and 6 months for cancellous bone *(33)*.

Bone remodeling is a balanced process precisely orchestrated by systemic hormones (PTH, calcitonin, thyroid hormones, glucocorticoids etc.) and by number of local factors such as growth factors (TGF-α, IGF-1), cytokines (TNF-α, IL-1, IL-6) and prostaglandins *(34)*. Another important factor that influences bone remodeling is mechanical force exerted on bone itself. It is currently believed that mechanical adaptation is governed by the osteocytes – nonproliferative cells at the terminal stage of differentiation of osteoblasts, which respond to a loading-induced flow of interstitial fluid through the lacuno-canalicular network by producing signaling molecules *(35)*. They produce the soluble factors (sclerostin, DMP1) that regulate the onset of both bone formation and resorption, but also function as endocrine cells producing factors (FGF-23) that target distant organs such as the kidney to regulate phosphate transport *(36, 37)*.

World Health Organization defines osteoporosis as a value for bone mineral density (BMD) 2.5 standard deviations or more below the young female adult mean– referred to as a T-score of –2.5, where a T-score of zero is equal to the young female adult mean *(38)*. It is estimated that one in two women and one in five men over the age of 50 years are at risk of osteoporotic fractures, and it is safe to

say that osteoporosis is an exploding 21st century epidemics of the aging population. Peak bone mass and rate of bone loss are two major determinants of bone mass and mineral density in later life. Both determinants are regulated by complex interrelations of genetic, environmental, nutritional, hormonal and age-related factors *(39)*. Even in absence of any significant pathology, during the third decade of life bone mass begins to diminish at rate of 0.5% per year in both sexes. This rate remains constant in male patients throughout the senescence, but significantly accelerates in females to 3% per year due to cessation of ovarian function during menopause (40). This phase of accelerated bone loss in females lasts for approximately 5 to 10 years, and then returns to those rates observed in men *(41)*.

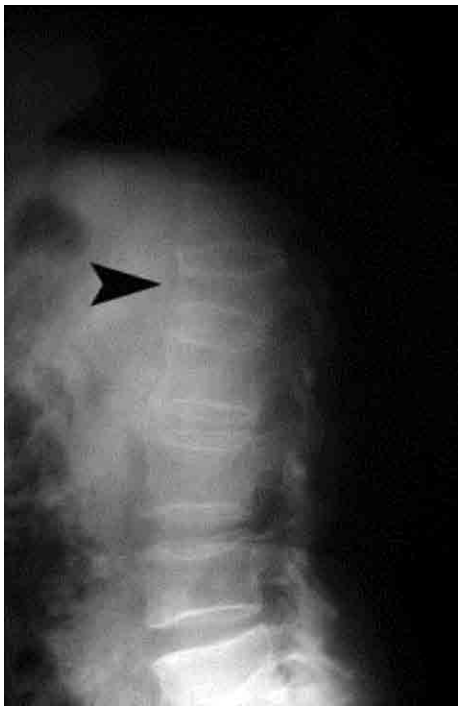

Figure 6. *Roentgenogram of the patient with vertebral compressive fracture as a consequence of osteoporosis (black arrowhead).*

The most serious consequence of osteoporosis are fractures, which have a serious negative impact on quality of life and are often the trigger for accelerated deterioration, ultimately ending in death. Osteoporotic fractures usually occur in sites where cancellous bone predominates over cortical one, are more common in women and exponentially increase with aging. The most common anatomical sites for osteoporotic fractures are spine, distal radius, hip and proximal humerus (Figure 6). Osteoporotic bone fractures are frequent among the elderly, and only in Croatia 5 489 hip fracture cases were registered during 2005. 382 of them died from fracture complications, and 97.38 % of them were over 65 years of age *(42)*. Regardless of conservative or surgical treatment for osteoporotic fracture, it is essential to stress out that after the care of fractured bone has been provided, appropriate diagnostic examinations and pharmacological treatment of osteoporosis should also be done.

CONCLUSION

The world population is getting older, but with more demands in terms of quality of life. Chronic and degenerative diseases of the musculoskeletal system are becoming more prevalent and developed countries, severely reducing the quality of life of senior population. Orthogeriatric care can enhance prompt diagnosis, optimal pre-and postoperative care, and functional recovery in older adults with musculoskeletal disorders.Recognizing the specifics of aging physiology, treating physicians should be aware of effective efficient alternatives to analgesia, procedural sedation, and definitive imaging to promote early surgical management and postoperative recovery.

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