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GERIATRIC ORTHOPEDICS

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Research on orthopedic management of elderly patients is of critical importance, given the high risk for musculoskeletal disorders among older adults. For a summary of the incidence and prevalence of musculoskeletal disorders among adults aged 65 and older, see the opening section of the chapter on geriatric orthopedics in *New Frontiers in Geriatrics Research* (p. 303). [1] This chapter updates that review of research in geriatric orthopedics, noting for each topic the new research that has been described in the literature. Research in geriatric orthopedics conducted since the publication of *New Frontiers* suggests no new research topics for the research agenda in this area and no new Key Questions for this specialty.

With regard to the Key Questions posed in *New Frontiers* (see below), there is still much to be learned regarding the influence of aging on fracture healing. Augmentation of fracture healing in aged bone requires further investigation. Techniques of internal fixation have received some study. Locking plates, plates that have screw holes that are threaded which allow screws to lock into the plate, have been shown to be useful in treating fractures when bone quality is poor. They have been shown to be helpful in achieving fracture union with minimal complications in proximal humeral, [2] humeral diaphyseal, [3] and distal radius factures. [4] Randomized clinical trials are needed to compare this method of treatment in other osteoporotic fractures.

Ortho KQ1: **How can implant fixation in osteoporotic bone be improved?**

Ortho KQ2: **How can fracture healing in the aged person be enhanced?**

Ortho KQ3: **How can the outcomes after fracture be optimized in elderly patients?**

METHODS

A search was conducted on the National Library of Medicine's PubMed database for the years 2000 to 2005; limits applied to the search were age greater than 65 and articles in English. The key words used were *osteoporosis, total hip arthroplasty, total knee arthroplasty, total shoulder arthroplasty, vertebroplasty, spinal stenosis, distal radius fractures, osteoarthritis, foot and ankle, fracture healing.*

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PROGRESS IN GERIATRIC ORTHOPEDICS

NORMAL MUSCULOSKELETAL AGING AND THE AGING ATHLETE

See *New Frontiers,* p. 304.

Ortho 1 (Level B): **Observational studies are needed to define the normal range of motion of the extremities in older people without musculoskeletal disease. Such studies should also examine the range of motion necessary for activities of daily living and instrumental activities of daily living.**

Ortho 2 (Level D): **Observational studies of older athletes are needed to define the incidence and nature of sports-related injuries in older athletes and to examine the utility of arthroscopy in the treatment of knee and shoulder injuries.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

FACTORS THAT INFLUENCE POSTOPERATIVE OUTCOME

See *New Frontiers,* p. 305.

Ortho 3 (Level B): **Observational and case-control studies are needed to determine the elements of preoperative evaluation and treatment that are associated with reduction in mortality in older orthopedic surgery patients.**

Ortho 4 (Level B): **Case-control studies are needed to compare the incidence of malnutrition among older hip fracture patients to that in the general population of older adults. Databases examining risk factors for hip fracture should be expanded (when possible) to include detailed nutritional measures.**

Ortho 5 (Levels B, A): **Observational studies using multivariate regression analysis are needed to identify which nutritional deficiencies (eg, calcium, protein) appear to be predictive of bad outcomes following hip surgery in older patients. Randomized controlled trials based on these findings are then needed to determine the type and duration of nutritional supplementation that would most effectively improve surgical outcome and fracture healing.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

DEGENERATIVE JOINT DISEASE

See *New Frontiers*, pp. 306–307.

Ortho 6 (Level B): **Basic studies are needed to determine the mechanism of action of hylan and hyaluronate injections in providing long-term pain relief from knee arthritis. Additional clinical studies are needed to examine the long-term effect on cartilage in older persons during repeated courses of treatment.**

Ortho 7 (Level A): **A randomized clinical trial is needed to examine if hylan and hyaluronate injections delay or reduce the likelihood of total knee arthroplasty in elderly patients.**

Ortho 8 (Level B): **Existing databases should be examined (or expanded) in an effort to determine the independent contribution that hip or knee osteoarthritis holds as a risk factor for falls by older people.**

Ortho 9 (Level B): **Databases examining the effects of joint replacement surgery should assess baseline and postoperative rates of falling to determine the effects of replacement on falls risk in older persons.**

Ortho 10 (Level B): **Further laboratory and clinical studies of COX-2 inhibitors should examine the effects of these agents in older persons on fracture healing, tissue healing (eg, after rotator cuff injury), and on bony ingrowth (into joint replacements).**

Ortho 11 (Level B): **Case-control studies should examine the surgical and functional outcome in older patients for various methods of fixation and various surgical approaches in total hip replacement. Such studies should examine the outcomes for cementless components in osteoporotic bone.**

Ortho 12 (Levels B, A): **Observational studies are needed to define the outcome of revision hip surgery in elderly patients. Careful reporting of factors associated with outcome would help define future level A studies to further define the optimal approach to this problem.**

Ortho 13 (Level D): **Basic laboratory studies are needed to define the influence of age on the cellular response to wear debris.**

Ortho 14 (Level B): **Observational studies are needed to define the type of hip procedure (cemented or uncemented) that is associated with the lower incidence of periprosthetic fractures in elderly patients. Additional observational studies are needed to generate information on the outcomes of various treatments for periprosthetic fractures in preparation for hypothesis-testing studies.**

Ortho 15 (Level B): **Observational studies are needed to define the**

subpopulation of older patients who might respond to arthroscopy or meniscectomy.

Ortho 16 (Level B): **Observational studies are needed to identify older patients at risk for less than optimal outcome after total knee arthroplasty, for example, those with peripheral vascular disease or neuropathy.**

Ortho 17 (Level B): **Additional observational studies focused on patients aged 85 years and over who undergo total knee arthroplasty are needed to identify risk factors for postoperative morbidity and to begin to define interventional strategies to reduce that risk.**

Ortho 18 (Level D): **Case-control studies are needed to determine whether metal-backed or all-polyethylene tibial components should be used in arthroplasty for elderly patients and whether there are indications for each.**

Ortho 19 (Level B): **Observational studies of older patients undergoing treatment for comminuted distal femur fractures are needed to examine the possible utility of total knee arthroplasty as a reconstructive procedure in this setting.**

Ortho 20 (Level B): **Observational studies are needed to further define those benefits of total knee arthroplasty (eg, increased range of motion, increased strength, decreased pain) which serve to improve gait and balance. Ultimately, such studies may begin to determine whether or not total knee arthroplasty helps to reduce the risk of hip fracture.**

Ortho 21 (Level B): **Case-control or focused cohort studies are needed to compare functional outcomes in older people with shoulder disease who do not undergo surgery with those who undergo rotator cuff surgery, hemiarthroplasty, or total shoulder replacement. Key outcomes for comparison include improved function and decreased pain. Such studies should address how the desired outcomes may change with age, from those aged 65 to 75 years to those aged 90 years and over.**

Ortho 22 (Level A): **Randomized controlled clinical trials are needed of the various preventive regimens (alone or in combination) to identify the safest and most effective treatment strategy for preventing thromboembolism after joint replacement surgery in older patients. Such studies should also address how long deep-vein thrombosis prophylaxis should continue in elderly patients who have had recent total joint replacements or hip fracture.**

Ortho 23 (Level B): **Further retrospective studies are needed to examine risk factors beyond age and poor bone quality for periprosthetic fractures. Case-control studies could possibly suggest protective factors, such as the nature of the implant (cemented or uncemented) and the use of antiresorptive therapies.**

***Ortho 24 (Level A)*: Randomized controlled trials are needed to determine with certainty whether specific prostheses or antiresorptive therapies would be effective at minimizing the risk of periprosthetic fracture.**

***Ortho 25 (Level B)*: Observational studies and subgroup analyses are needed to determine if features of periprosthetic infections are different in elderly patients and to examine differences in outcome for elderly patients when specific established or emerging approaches are used.**

New Research in Surgical Treatment of Degenerative Joint Disease: See *New Frontiers*, p. 307.

Arthroplasty of either the hip or knee performed in elderly patients 89 years of age and older was found to have a perioperative complication rate of 14% in a review of 101 arthroplasties performed in this age group.[5] Significantly improved function and decreased pain has been demonstrated following total hip arthroplasty[5,6] and total knee arthroplasty[5] in the very elderly patient.

New Research in Degenerative Disease of the Hip: See *New Frontiers*, pp. 307–308.

In patients aged 75 years and older, cementless fixation has been found to be successful. Tapered, cementless femoral components have been found, in one study, to have 100% survivability at 5 years in patients aged 75 years and older.[7] These tapered, cementless stems have also been found to be successful in treating periprosthetic fractures.[8] In a study evaluating the use of a modular, proximally porous-coated femoral stem and a cementless acetabular component in 135 patients, no revisions for loosening were needed at 5 years.[9] Still another study found 100% survivability of the acetabular and femoral component 78 months postoperatively in patients older than 80 years.[10] Hemiarthroplasty performed for femoral neck fracture can also be successfully treated with a cementless stem. A retrospective review of over 250 patients with cementless bipolar hemiarthroplasties found that all but two had stable stems with bony ingrowth and a low revision rate at 3.5 years.[11]

A retrospective review of 60 patients treated with a total hip arthroplasty for a femoral neck fracture found that they did not have greater perioperative morbidity than 30 patients who had total hip arthroplasty for osteoarthritis.[12] Likewise, a separate study of 51 patients with subcapital hip fractures treated by total hip replacement found function on follow-up that was comparable to that of osteoarthritic patients treated by total hip replacement.[13]

Patients evaluated following total hip arthroplasty have been found to have improved balance during gait and sit-to-stand activities. Control of trunk velocity, however, was not improved by total hip replacement.[14]

New Research in Degenerative Disease of the Knee: See *New Frontiers*, pp. 308–309.

A review of 110 total knee arthroplasties in 90 patients aged 80 years and older found that after 10 years, even though 96% had complete pain relief and 91% had an excellent knee score, only 14% had an excellent function score.[15]

Cementless fixation has also been evaluated with respect to total knee arthroplasty. One prospective study evaluating a hydroxyapatite-coated, cementless total knee replacement

found that at 5 years, patients aged 75 years and older had results equivalent to those of younger patients. [16]

In a review of 6 patients, constrained total knee arthroplasty was reported to be a successful method for treating periarticular distal femur and proximal tibia fractures. [17]

New Research in Degenerative Disease of the Shoulder: See *New Frontiers*, pp. 309–310.

A meta-analysis found that after 2 years of follow-up, total shoulder arthroplasty performed better than hemiarthroplasty for osteoarthritis of the shoulder. [18] Arthroscopic acromioplasty for chronic rotator cuff tears has been shown to be helpful when conservative measures have failed. [19]

New Research in Complications of Joint Replacement Surgery: See *New Frontiers*, pp. 310–312. No reports of new research on this topic were found.

Modification of Questions on Degenerative Joint Disease in Light of New Research: The recent research on various aspects of the surgical treatment of degenerative joint disease in the elderly patient summarized herein indicates no need for changes or deletions in the research agenda for this important topic.

DEGENERATIVE SPINE DISEASE

See *New Frontiers*, pp. 315–316.

> ***Ortho 26 (Level B)***: **Observational studies are needed to examine the impact of aging on bone fusion or fracture healing and to begin examining strategies to augment the bone healing response after fusion or fracture. Candidate strategies include growth factors.**
>
> ***Ortho 27 (Level B)***: **Case-control or focused cohort studies are needed to refine understanding of which patients benefit (in terms of symptom control and function) most from spinal decompression versus conservative management. Important covariates include duration of symptoms and degree of neurologic deficits and perhaps the degree of osteoporosis. Such studies should attempt to clarify when elderly patients should be referred for spinal decompression in order to experience maximum benefit.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

DEGENERATIVE DISEASE OF THE FOOT AND ANKLE

See *New Frontiers*, pp. 316–317.

> ***Ortho 28 (Level B)***: **Observational studies examining how foot and ankle deformity influence gait and balance in the older person are**

needed. Those deformities that are associated with significant gait problems should be the focus of research on surgical and nonsurgical approaches to these conditions. Appropriate outcome measures (eg, healing, gait improvement) from specific techniques of foot and ankle reconstruction need to be defined. In addition, more study is needed to identify characteristics of footwear that maximize balance.

***Ortho 29 (Level C)*: Controlled trials are needed to identify safe and effective treatment for fungal disease of the foot.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

BONE INSUFFICIENCY AND FALLS

See *New Frontiers,* pp. 317–318.

***Ortho 30 (Level A)*: Adequately powered randomized clinical trials are needed to determine if falls-prevention strategies for older persons will translate into fracture reduction for treated patients.**

***Ortho 31 (Level A)*: Cohort studies or randomized controlled trials are needed to compare the functional recovery of patients whose fractures occur close to a joint and who are treated with either total joint replacement or standard care.**

***Ortho 32 (Level B)*: Methodologic studies are needed to describe outcomes with various approaches to fixation in osteopenic bone.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

FRACTURES OF THE HIP

See *New Frontiers,* pp. 318–321.

***Ortho 33 (Level B)*: Observational studies are needed to examine the effect of shortening of the fractured limb on gait and balance.**

***Ortho 34 (Level B)*: Observational studies are needed to learn whether modalities such as electrical stimulation or ultrasound can speed the fracture healing response in the older patient and therefore decrease fracture collapse or hardware failure.**

***Ortho 35 (Level B)*: Methodologic studies are needed to identify elderly patients with hip fracture who are at high risk for operative intervention and postoperative complications and to devise clinical pathways for their care. Database analyses of the pre-hospital,**

in-hospital, and rehabilitation periods of elderly orthopedic patients should be performed to identify clinical management strategies that result in decreased morbidity and improved functional recovery.

***Ortho 36 (Level A)*: Controlled trials are needed to compare outcomes using cement and noncemented hardware for hemiarthroplasty. Additional controlled trials are needed to compare techniques for repair of intertrochanteric hip fractures.**

***Ortho 37 (Level B)*: Current clinical databases should be expanded to include long-term and functional outcomes of older orthopedic surgical patients recovering from hip fracture.**

New Research Addressing These Questions: Treatment of femoral neck fractures remains varied. A survey of 442 orthopedic surgeons found that, in general, surgeons preferred internal fixation for younger patients and arthroplasty for older patients. However, there was disagreement about the treatment of patients 60 to 80 years old with a displaced fracture, and there was disagreement on the optimal implants for internal fixation or arthroplasty. [20]

Total hip arthroplasty was shown to have better outcomes with less need for revision surgery than open reduction internal fixation in a randomized controlled trial performed at 4 years postoperatively. [21] A prospective cohort study found that those who had total hip arthroplasty had a better functional outcome than those who had internal fixation or hemiarthroplasty. [22]

Modification of These Questions in Light of New Research: The recent research summarized here on the treatment of hip fracture in older patients indicates no need for changes or deletions in the research agenda for this topic.

FRACTURES OF THE WRIST

See *New Frontiers*, pp. 322–323.

***Ortho 38 (Level B)*: Observational studies are needed to compare operative with nonoperative management to suggest which method is better with regard to outcome (time to union and function) following wrist fracture in the older patient.**

***Ortho 39 (Level D)*: Descriptive studies are needed to determine the range of motion and strength of the wrist necessary for good activities of daily living function in older persons.**

***Ortho 40 (Level D)*: Case series describing outcomes with various fixation methods are needed to suggest the best fixation method for wrist fractures in older patients.**

***Ortho 41 (Level C)*: Controlled trials of various graft materials are needed to determine the best graft material to supplement wrist fracture internal fixation in older patients.**

New Research Addressing These Questions: Volar plating of displaced distal radius fractures was shown, in one follow-up study, to have a higher incidence of fracture collapse but lower rate of hardware complications than dorsal plating. [23]

Modification of These Questions in Light of New Research: The research agenda regarding the treatment of wrist fractures in older patients should remain unchanged, and further research is still needed.

FRACTURES OF THE SPINE

See *New Frontiers*, pp. 323–324.

Ortho 42 (Level A): **Randomized controlled trials are needed to compare vertebroplasty with current usual care (no treatment) in older patients. The studies should compare indications (acute and or chronic pain) for vertebroplasty, complications, benefits, and long-term effects of each approach, and they should also examine the effects on adjacent vertebrae (eg, fracture, deformity) following vertebroplasty.**

New Research Addressing These Questions: Vertebroplasty for vertebral compression fractures has been shown to be helpful in reducing pain. A prospective study of 167 patients who received 207 vertebroplasty treatments to stabilize vertebral compression fractures found a significant improvement in pain, reduction in the need for analgesics, and increased mobility. [24] A nonrandomized trial comparing percutaneous vertebroplasty with conservative therapy found a 53% reduction in pain and a 29% improvement in physical function 24 hours after the procedure. Within 24 hours, 24% of treated individuals were able to cease pain medication. [25] A study looking at long-term outcome following vertebroplasty found a slightly increased risk of vertebral fracture adjacent to the cemented vertebra. [26]

Modification of These Questions in Light of New Research: The recent research described here regarding the treatment of spinal fractures in older patients indicates no need for changes or deletions in the research agenda for this topic.

FRACTURES OF THE PROXIMAL HUMERUS

See *New Frontiers*, pp. 324–325.

Ortho 43 (Level B): **Observational studies are needed to more clearly define what constitutes a good outcome following a proximal humerus fracture in the older patient.**

Ortho 44 (Level A): **Controlled studies are needed to compare operative with nonoperative repair of proximal humerus fractures in older patients.**

***Ortho 45 (Level A)*: Controlled studies are needed to compare various operative repairs for proximal humerus fractures in older patients.**

New Research Addressing These Questions: No reports of new research on these questions were identified.

Modification of These Questions in Light of New Research: These items should remain unchanged on the research agenda for geriatric orthopedics.

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