



Influence of Musculoskeletal Conditions on Oral Health Among Older Adults

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Both musculoskeletal disorders and diseases of the oral cavity are common and potentially serious problems among older persons, yet little attention has been given to the links between them. Several musculoskeletal diseases, including osteoporosis, Paget's disease, and arthritic disorders, may directly involve the oral cavity and contiguous structures.

Drugs used to treat musculoskeletal diseases, including corticosteroids and bisphosphonates, increase the risk of suppression of the immune system and osteonecrosis of the jaw, respectively.

Many people with disabling osteoarthritis, rheumatoid arthritis, and other conditions have difficulty practicing good oral hygiene and traveling to dental offices for professional help. Various inexpensive measures can help such individuals, including education of their caregivers and provision of antimicrobial mouthwashes and special toothbrushes. (*Am J Public Health*. 2008;98:1177–1183. doi:10.2105/AJPH.2007.129429)

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musculoskeletal system and of the oral cavity are among the most common and potentially disabling conditions of older adults. Little attention has been given to the relation between the 2 disease groups, but important

linkages exist. An increased understanding and awareness of these associations can lead to interventions to improve the health status and quality of life of older people. We review the relations between some common musculoskeletal disorders and diseases of the oral cavity and contiguous structures in older adults and then suggest preventive measures. Some of the material for this essay is adapted from a chapter in *Improving Oral Health Care for the Elderly: An Interdisciplinary Approach*.¹

EFFECTS OF MUSCULOSKELETAL CONDITIONS

Musculoskeletal conditions are the most frequent impairment reported in the US National Health Interview Survey and are the leading cause of disability among persons 65 years and older.^{2,3} In the US National Health Interview Survey, older persons reported an average of 20 days of restricted activity and 7 days in bed per year for each of their musculoskeletal impairments. Approximately one third of nursing home residents have musculoskeletal impairments, with arthritis and osteoporosis being most frequent. Injuries are also a major problem for older individuals. Each year,

about 2% of noninstitutionalized persons 65 years and older experience a fracture.³ A survey in the United Kingdom found that among adults reporting a long-standing musculoskeletal disorder, the most important areas of daily life affected were ability to get around, stand, walk, go shopping, and participate in social and leisure-time activities.⁴ In general, obtaining medical or dental care is known to be a problem for many older people with impaired functional status, especially those who are homebound or who reside in long-term care facilities.^{5,6} People with disabling musculoskeletal conditions are likely among those thus affected.⁷

EFFECTS OF ORAL CAVITY CONDITIONS

Diseases of the oral cavity are also very common in older people. In the United States, almost half of individuals 75 years and older have caries of the root surface (in which the tooth root is exposed as a consequence of periodontal disease) on 1 or more teeth, and 65% have at least 4 mm loss of attachment (an indicator of significant loss of supporting structures of the teeth) on at least 1 tooth.⁸

Oral diseases can have a large impact on quality of life. In a

random sample of people 65 years and older in England, 72% said their oral health was important to their quality of life, particularly regarding their eating habits, level of comfort, ability to maintain a carefree manner, appearance, and general well-being.⁹ In a study of older individuals in North Carolina, 30% said that their teeth had an adverse effect on chewing, 19% on enjoyment of eating, 15% on appearance to others, 11% on smiling and laughing, and 10% on having confidence.¹⁰ It is known that persons with oral infections are at increased risk of major systemic diseases such as cardiovascular diseases, cerebrovascular diseases, and diabetes.⁴

Although oral health among older adults has improved in recent decades, widespread problems remain, especially among those of low socioeconomic status and among institutionalized individuals of poor health or poor functional status. Homebound and institutionalized elderly have many dental needs that are not currently being met.⁶

OSTEOARTHRITIS

Osteoarthritis, sometimes called degenerative joint disease, is a gradual deterioration of the joint cartilage with proliferation



and remodeling of the bone beneath the cartilage. The usual symptoms are pain and stiffness accompanied by loss of function. The course of osteoarthritis is variable and may differ from one joint to another. The joints most commonly involved are the knees, hands, feet, hips, and spine. The strongest risk factor for osteoarthritis is age, and on autopsy, some cartilage damage is almost universal among older people. Several factors contribute to the increased incidence and prevalence with age, including accumulated wear and tear, stress from superincumbent weight, increased joint instability from ligamentous laxity, increased vulnerability of the joints to mechanical insults, and decreased resilience and reparative capacity of cartilage.¹²

In Western countries, osteoarthritis is a leading cause of pain and physical disability in older people. The World Health Organization predicts that osteoarthritis will become the fourth leading cause of disability worldwide by 2020.¹³ Osteoarthritis adversely affects many components of quality of life, including general health, physical health, mental health, extent of activity limitation, pain, sleep, and feeling healthy and full of energy.¹⁴

Severity of osteoarthritis in the hands is correlated with impaired functional ability.¹⁵ Hence, many people with osteoarthritis in their hands are unable to maintain proper oral hygiene, resulting in accumulation of plaque and calculus, which increases the likelihood of dental caries and periodontal disease.⁷ Certain

medications used to treat osteoarthritis, including corticosteroids and nonsteroidal anti-inflammatory drugs, may suppress the immune system, thus potentially affecting the tissues of the oral cavity by increasing the risk of delayed wound healing, prolonged bleeding time, and fungal infections.

Mobility limitation resulting from osteoarthritis, particularly in the lower extremities, makes it difficult for those affected to visit dental offices for both routine hygiene and treatment. A large national survey in Australia⁷ found that persons who reported that they had osteoarthritis were less likely to have visited a dental professional within the past 2 years than were persons from the general population without arthritis (57% vs 72%; Table 1).

Although the data in Table 1 were not adjusted for socioeconomic characteristics or insurance status, education and income level were not strongly or consistently related to frequency of dental visits, although urban versus rural residence was. The results of the Australian study are consistent with other studies that found impaired functional status and poor health in general to be associated with less use of dental services.^{5,16} When those participating in the Australian study did visit a dentist, those who reported osteoarthritis were more likely to require extractions and fillings than were those without arthritis. They were also more likely to visit the dentist for restorative and prosthodontic treatment involving construction and insertion of dentures as well

TABLE 1—Percentage of Persons Reporting Having Visited a Dental Professional Within the Past 2 Years, by Self-Reported Arthritis Status: Australia, 1995

Arthritis Status	Visited a Dental Professional, %
Osteoarthritis (n = 3091)	57
Rheumatoid arthritis (n = 1193)	55
No arthritis (n = 49 544)	72

Source. Adapted from Pokrajac-Zirojevic et al.⁷

as for denture repairs and for denture and teeth cleaning. They were less likely to see dentists for routine checkups and preventive treatment.

In addition, osteoarthritis of the temporomandibular joint, the joint between the temporal bone of the skull and the mandible, is one cause of temporomandibular joint dysfunction. A disk of cartilage separates the skull from the mandibular condyle. When this cartilage disk degenerates, the result can be discomfort of the joint or an altered occlusion and associated pain in the mandible. Most patients with temporomandibular disorders who seek treatment do so because of pain, although for a subset the main symptoms are popping, clicking, and other noises when the joint is in motion.¹⁷ With severe osteoarthritis of this joint, the person cannot open the mouth wide.

RHEUMATOID ARTHRITIS

Rheumatoid arthritis is an inflammatory disease that damages the synovial tissue connecting the bones and joints. About 1.6% to 1.9% of people aged 60 to 69 years and 2.5% to 2.8% of those 70 years and older have rheumatoid arthritis.¹⁸ Although it is less common than osteoarthritis, the manifestations of rheumatoid arthritis are generally more severe. The synovitis results in destruction of joint cartilage and erosion of bone. The typical symptoms are stiffness, pain, and swelling of multiple joints, most commonly of the hands and wrists. Systemic manifestations of rheumatoid arthritis, including vascular, renal, and eye complications, may also be present. The clinical course is variable, but as the disease progresses, most people with rheumatoid arthritis experience functional limitations, physical disabilities, and sometimes early mortality. Rheumatoid arthritis is considered to be of autoimmune etiology, and genetic factors are important.¹⁹

As with osteoarthritis, rheumatoid arthritis can affect oral health in several ways.^{7,15} Because of the usual involvement of the hands, personal oral hygiene may be difficult. This poor oral hygiene, along with the inflammatory reactions in the disease process, results in an increased risk of periodontal infections and dental caries. Mercado et al.²⁰ found a high prevalence (62.5%) of advanced periodontal disease in patients with rheumatoid arthritis. Immunosuppressive agents used



in the treatment of rheumatoid arthritis also increase the risk of opportunistic infections, delayed wound healing, and prolonged bleeding time. In addition, dry mouth frequently occurs in persons with rheumatoid arthritis,²¹ which leads to difficulty chewing, an increased risk of root caries, and other problems of the teeth and their supporting structures. Rheumatoid arthritis can also contribute to the occurrence of temporomandibular joint dysfunction.

People with rheumatoid arthritis are less likely to visit a dental professional than are persons without arthritis. In the Australian study by Pokrajac-Zirojevic et al.,⁷ only 55% of those with rheumatoid arthritis had visited a dental professional within the past 2 years, compared with 72% of persons without arthritis (Table 1). Similar to the persons with osteoarthritis, persons with rheumatoid arthritis were more likely than were persons without arthritis to require extensive dental care when they did visit a dental professional.

OSTEOPOROSIS

Osteoporosis is a skeletal disorder characterized by compromised bone strength that predisposes a person to an increased risk of fracture.²² Hip fractures are particularly common and disabling in older people. When the definition of the World Health Organization is applied,²³ about 20% of postmenopausal White women in the United States have osteoporosis in their femoral neck.²⁴ About 40% of

White women and 13% of White men in the United States experience an osteoporosis-associated fracture of the hip, vertebrae, or distal forearm after 50 years of age.²⁵ Factors that affect the risk of osteoporotic fractures include low bone mineral density and other components of poor bone quality, a propensity to fall, lack of protective responses during a fall, and various other characteristics of the fall.

Studies have quite consistently found that bone mineral density in the mandible (lower jawbone) and maxilla (upper jawbone), as well as bone mineral density specifically in the alveoli (tooth sockets), are modestly correlated with bone mineral density of other skeletal sites.^{26–28} Dense mandibular alveolar trabecular patterns (a component of bone strength) are strongly correlated with higher skeletal bone mineral density.²⁹ In addition, menopausal hormone replacement therapy is associated with higher bone mineral density in mandibular alveolar bone, as it is with bone mineral density in other skeletal sites.²⁷ Evidence is inconsistent as to whether low bone mineral density contributes to the development of such dental problems as tooth loss and loss of attachment.^{30–33} More work in this area is needed.

Of the drugs currently used in the treatment and prevention of osteoporosis and associated fractures, bisphosphonates are used most frequently. Their use has rapidly increased since their introduction in the 1990s.^{34,35} In 2005 in the United Kingdom,

approximately 10% of all women 70 years and older were prescribed bisphosphonates.³⁵ Bisphosphonates are of particular concern to oral health because a potential side effect is osteonecrosis of the jaw, which consists of areas of bone necrosis that do not heal. Osteonecrosis generally appears as an area of exposed alveolar bone in the mandible or maxilla. Usually, the area of exposed bone develops after a tooth extraction or oral injury, but this is not always the case.

Osteonecrosis of the jaw was first reported in association with bisphosphonate therapy in 2003,³⁶ mainly among patients with multiple myeloma or breast cancer who were receiving high doses of the intravenous bisphosphonates pamidronate or zoledronic acid, especially after recent dental pathology, trauma, or oral surgery. Another series of 63 patients with osteonecrosis of the jaw was reported soon thereafter.³⁷ Again, most of the cases were cancer patients who had received intravenous bisphosphonates, but a few had taken oral alendronate or risedronate for osteoporosis.

In a review of 368 cases reported in the literature through January 2006, Woo et al.³⁸ found that 60% of the cases occurred after a tooth extraction or other dentoalveolar surgery, and the other 40% occurred spontaneously. The spontaneous cases tended to occur in patients wearing dentures, which are a potential source of local trauma. Ninety-four percent of the cases had been treated with intravenous

bisphosphonates (primarily pamidronate and zoledronic acid), and 85% of the patients had multiple myeloma or metastatic breast cancer. The other 15% of patients were taking oral bisphosphonates for osteoporosis or Paget's disease.

Most information on risk factors for osteonecrosis of the jaw comes from follow-up of cancer patients. The most important risk factors are type of bisphosphonate (pamidronate or zoledronic acid), total dose, and a history of trauma, dental surgery, or dental infection.^{38,39} Risk increases with longer length of follow-up after initiation of bisphosphonate treatment.^{38–40} The risk of osteonecrosis of the jaw among patients using oral bisphosphonates for osteoporosis or Paget's disease has been estimated to be around 1 per 10 000 to 1 per 100 000 per year of use, compared with 1 to 10 per 100 (depending in part on duration of use) among cancer patients treated with higher doses of intravenous bisphosphonates.⁴¹ Although its occurrence thus appears to be relatively rare among bisphosphonate-treated persons with osteoporosis and Paget's disease, there is concern that more cases of osteonecrosis of the jaw will be seen among users of oral bisphosphonates as their length of use becomes greater.⁴²

No effective treatment is available for patients who have developed osteonecrosis of the jaw. Therefore, prevention of its occurrence in the first place, to the extent possible, is highly desirable. The recommendations



Recommendations of the Task Force of the American Society of Bone and Mineral Research Regarding Risk of Osteonecrosis of the Jaw Among Patients With Osteoporosis and Paget's Disease Who Are Initiating or Already Using Bisphosphonate Therapy

1. Good communication among physicians, dentists, and patients should take place. Patients should inform their dentists that they are initiating bisphosphonate therapy.
2. Patients initiating or already taking bisphosphonates should be informed of the benefits and risks, including the risk of osteonecrosis of the jaw, its signs and symptoms, and the risk factors for developing it.
3. Patients should be informed that the risk of osteonecrosis of the jaw associated with routine oral bisphosphonate therapy for osteoporosis or Paget's disease is low, ranging between 1 per 10 000 and 1 per 100 000.
4. Patients taking bisphosphonates should be encouraged to maintain good oral hygiene and to have regular dental visits. They should report any oral problems to their dentist and physician.
5. Patients concerned about osteonecrosis of the jaw should be encouraged to seek additional information from a dental specialist.
6. Because the risk of osteonecrosis of the jaw is low and associated with longer duration of use, it is not necessary to have a dental examination before beginning therapy or otherwise to alter routine dental management.
7. For patients who have been receiving oral bisphosphonate therapy for more than 3 years, the following precautions are advised:
 - Patients with periodontal disease should be given appropriate nonsurgical therapy. Any necessary surgical treatment should be aimed primarily at reducing or eliminating periodontal disease. Minimal bone recontouring may be considered when necessary.
 - On the basis of current information, dental implant procedures may be undertaken, but informed consent should be obtained and documented.
 - When possible, endodontic treatment (root canal therapy) is preferable to extraction or periapical surgery (surgical endodontic therapy involving removal of the root tips).
 - It is uncertain whether bisphosphonate therapy should be stopped for a period before and after an invasive dental procedure.

Note. Adapted from Khosla et al.⁴¹

made by a task force of the American Society of Bone and Mineral Research to minimize the risk of osteonecrosis of the jaw among bisphosphonate-treated patients with osteoporosis and Paget's disease are shown in the box on this page.⁴¹ Following these guidelines should minimize the risk of osteonecrosis of the jaw in treated patients.

PAGET'S DISEASE

Paget's disease is a thickening and weakening of bone that occurs

when the normal balance of bone formation and bone loss is disrupted. Large, highly active bone-resorbing cells (osteoclasts) produce abnormal bone resorption. The bone-forming cells (osteoblasts) try to repair this damage, but the new bone that is formed is structurally disorganized, weaker, and prone to fracture and deformities. Paget's disease can affect any part of the skeleton, but most frequently involves the spine, skull, pelvis, and legs. Osteoarthritis in adjacent joints is common, and neurologic,

cardiovascular, and metabolic complications may occur. The most common neurologic complication is hearing loss in patients with Paget's disease of the temporal bone. The causes of Paget's disease are unknown, although the disease appears to run in families.⁴³

The incidence increases with age, and Paget's disease occurs in 1.5% to 3.0% of people 60 years and older in the United States.⁴⁴ Only about 10% of affected persons have symptoms, usually consisting of aching pain

caused by small fractures or from nerve compression. Sometimes visible deformities develop, such as an enlarged skull or curvature of the femur of lower leg. A survey of mostly long-term patients with Paget's disease documented the strong adverse effect of the disease on quality of life.⁴⁵

The jaw is affected in about 17% of cases.⁴⁶ When the jaw is involved, the effect on dental health is usually substantial. In early stages of the disease, loss of bone around the base of the teeth can result in loosening of the teeth and eventual tooth loss. More often, overgrowth of bone with spreading of the teeth and malocclusion occurs. Patients without teeth often have trouble with the proper fit of dentures. Other complications include root resorption, an increase in the amount of tooth cementum, excessive bleeding on extraction, and osteomyelitis. Tooth extractions may be difficult because of increased amount of cementum. Infections are a frequent complication following dental procedures.⁴⁷ Because of the many potential oral complications, some dentists avoid patients with Paget's disease.⁴⁸

Among pharmaceutical agents, bisphosphonates are often used to decrease bone resorption and slow bone turnover. The doses used are generally higher than those used in the treatment of osteoporosis.⁴⁴ Patients who use bisphosphonates for Paget's disease have an elevated risk of osteonecrosis of the jaw, as described in the section on osteoporosis.^{38,41} The guidelines given in the "Osteoporosis" section for



minimizing risk of osteonecrosis of the jaw among patients using bisphosphonates should also be followed by patients with Paget's disease who are using these agents (see the box on page 1180).

OTHER MUSCULOSKELETAL DISORDERS

Although not specifically diseases of older individuals, low back and neck pain are common, are frequently associated with mobility limitation, and thus also may result in fewer visits to dental professionals for routine care. In addition, because of the functional integration of the cervical spine and the masticatory (chewing) system, cervical spine disorders can affect jaw function, and persons with temporomandibular disorders may seek care for pain and dysfunction in the neck region.^{49,50}

Less-common musculoskeletal conditions may also affect the oral cavity. Osteomyelitis, in which bacteria or fungi infect bone and bone marrow, can occur in the jaw bones of elderly patients, especially those with poor dentition or periodontal disease.⁵¹ Abscesses involving the dentition and adjacent bone are common, and the abscess may extend deep into the bone. Osteomyelitis may also occur in association with bisphosphonate-induced osteonecrosis of the jaw, as described in the "Osteoporosis" section.

Across all ages, fracture of the jaw bones most commonly occurs as a result of violent acts such as assault and gunshot wounds. In older individuals,

however, falls and motor vehicle accidents are the most common causes of fracture of the jaw.^{52,53}

WHAT SHOULD BE DONE?

Musculoskeletal conditions are linked to diseases of the oral cavity and contiguous structures in 3 main ways. First, several diseases of the musculoskeletal system can involve the oral cavity as part of the disease process. Dental and medical professionals should be aware of this and monitor patients for these problems. Dentists should schedule extra time for patients with musculoskeletal diseases, as needed.

Second, drugs used to treat several musculoskeletal disorders, including bisphosphonates for osteoporosis and Paget's disease and corticosteroids for the arthritic disorders, can increase the risk of oral problems. If these drugs are used, then increased surveillance by dental professionals is needed. Also, treatment for oral diseases, such as dental procedures, can affect the risks associated with use of these agents. Such patients need to be treated with particular care. The guidelines presented in the box on page 1180 should be carefully applied to patients using bisphosphonate therapy.

Third, many musculoskeletal conditions, whether or not they directly affect oral health, make it more difficult for people to get around and can thus make it less likely that those afflicted will receive good dental care. Persons with arthritic disorders and other disabling diseases need to be aware of the importance to their

health of routine dental visits, despite the possible inconvenience of the visit. When office visits are not feasible, home visits for prophylactic oral hygiene could be helpful to persons with disabling musculoskeletal diseases. Although oral hygiene services are available in almost all nursing homes, they are usually provided by nursing staff rather than dental professionals, and many studies of nursing home residents indicate a high prevalence of inadequate oral hygiene, along with associated dental, gingival, and periodontal conditions.⁶

Interventions undertaken among elderly disabled people in general almost certainly have relevance to persons disabled with musculoskeletal conditions. Several studies in countries such as Japan^{54,55} and Switzerland⁵⁶ have shown beneficial effects of programs in which dental hygienists or dentists visit institutionalized and community-dwelling dependent elderly individuals or their caregivers. In addition, the burden to the caregivers of trying to provide oral care is reduced.⁵⁵

A study in England reported that oral hygiene can be enhanced with the education of caregivers (mainly non-nurses) in a nursing home setting (Table 2).⁵⁷ In Finland, a study showed that organized, hands-on instruction of the nursing staff caring for long-term hospitalized patients resulted in substantial improvement in the oral hygiene of the patients.⁵⁸ In the United States, a need exists for the provision of primary dental services to disabled individuals. New approaches to the delivery of these services need to be explored.

Also helpful would be such simple and inexpensive measures as providing antimicrobial mouthwashes and high-fluoride toothpastes and mouth rinses to disabled individuals. Mouthwashes containing chlorhexidine may be especially useful in helping to control plaque accumulation when mechanical oral hygiene practices are not feasible.⁵⁹ Electric or other special toothbrushes can be provided to those afflicted with impairments of their hands and upper extremities. Such

TABLE 2—Dental and Gingival Plaque Scores Among Nursing Home Residents at Baseline and Follow-Up, by Caregivers' Oral Health Education Program Status in a Cluster-Randomized Control Trial: England

Outcome	Oral Health Education Program Received (n = 37)		No Oral Health Education Program Received ^a	
	Baseline, Mean (SD)	18 Months, Mean (SD)	Baseline, Mean (SD)	18 Months, Mean (SD)
Dental plaque score	2.15 (0.49)	1.87 (0.49)	2.10 (0.54)	2.18 (0.53)
Gingival score	1.37 (0.41)	1.08 (0.37)	1.38 (0.51)	1.36 (0.35)

Source. Adapted from Frenkel et al.⁵⁷

^aFor plaque, n = 41; for gingivitis, n = 42.



measures would enable them to maintain better oral hygiene even without professional intervention. Sonic and ultrasonic toothbrushes may be advantageous in decreasing plaque and gingival bleeding in individuals whose hand function is limited.⁶⁰ A pilot crossover trial among institutionalized care-dependent elderly persons in Japan showed the effectiveness of a chewable toothbrush for plaque removal.⁶¹

CONCLUSION

Older persons with a variety of musculoskeletal conditions are at increased risk of deterioration of their oral health. All those associated with the health of older persons need to be aware of this issue and take preventive and therapeutic measures as needed. On the basis of current knowledge alone, much can be done to improve the oral health of disabled older persons. ■

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