Before discussing the many ways in which plastic surgeons interface with elderly patients, a preliminary question should be addressed: who are the elderly? Life expectancy continues to increase toward the maximum theoretical age of 120 years in humans. A life expectancy of only 21 years could be expected in the Bronze Age and 47 years in 1900.1 In 1998, the mean life expectancy was 72 years for men and 79 years for women. The number of centenarians in the United States is projected to increase from 60,000 in 1998 to 200,000 in 2020 and then to an incredible 5 million in 2046.2 Most recent studies arbitrarily designate “over 65” years as elderly, although it is clear that biological aging, which for so long eluded any attempt to quantify it, dwarfs chronological age in its overall reflection of an individual’s health. Women aged 65 years can expect to have well over a fifth as many years remaining, and their objection to the designation of elderly is understandable.

When interacting with patients of advanced age and their families, health care professionals should alleviate their concerns about ageism, that is, discrimination against elderly persons. Most elderly persons are in reasonably good health and are able to function independently. Only 5% of the elderly population are institutionalized; demographically, most of these patients are very old, female, and white.1 Because of their greater longevity, women are more likely to lose their spouse and live alone and, thus, directly face the difficulties of aging.

Older persons as a group have a lower socioeconomic status than other adults. About a fifth of the elderly population have incomes approaching the poverty level. Socioeconomic status directly affects health and the types of medical problems that will lead the aging patient to seek a plastic surgeon (Figure 1).

ANATOMICAL CHANGES IN AGING: THE BASIS OF AESTHETIC SURGERY

Two biological phenomena contribute to the changes seen in the aging face: the attenuation of facial ligaments and the loss of dermal elastin. Zygomatic ligaments suspend malar soft tissue over the zygomatic eminence. Attenuation of these ligaments with aging leads to inferior displacement of this soft tissue, which accentuates the nasolabial fold and creates the illusion of its deepening. Jowls accumulate behind tethering mandibular ligaments anteriorly and masseteric cutaneous ligaments posteriorly (Figure 2).3

Facial aging occurs not only in skin but also in underlying fat and connective tissue. Dermal elastosis of the skin, lipoatrophy of the neck, and laxity of the facial ligaments all contribute to the stigmata of the aging face.

In the neck, the anterior fibers of the platysma descend and appear as platysmal bands. The muscle hypertrophies but also bowstrings and becomes tethered in this position. Retaining ligaments that formerly held the platysma down against the deep cervical fascia weaken, causing the muscle to descend (Figure 3 and Figure 4).3,4

Body fat distribution varies with both sex and age. Age-related accumulation of body fat can be difficult to counter. A study of fit male long-distance runners showed...
that the average 6-ft (1.82-m) tall man gained 3 lb 3 oz (about 1.37 kg) and added three fourths of an inch (about 2 cm) to his waistline for every decade of life after the age of 20 years. To compensate for these metabolic changes and to maintain his proportions over a 30-year period, the man at age 50 years would have to run an additional 32 miles per week. Age-related changes in testosterone and growth hormone production are suspected to account for these differences.5

After menopause, women begin to acquire the male pattern of weight gain in the abdomen, possibly owing to decreasing levels of estrogen. They complain about the loss of waistline definition.

Both sexes experience changing fat patterns as they progress from the third to the seventh and eighth decades of life. There is less subcutaneous fat, but more intra-abdominal fat and infiltration of fat into and between muscles. Lean body mass declines. Objective indexes of these changes include triceps skinfold thickness, waist-hip measurement ratios, and body fat plethysmography. Subcutaneous fat is more metabolically active than visceral fat but both correlate independently with medical morbidity.3

Weight loss that is surgically induced with gastrointestinal bypass procedures decreases the medical morbidity of obesity. Although liposuction can permanently remove regional fat, the fat removed is small in comparison to total body fat. Liposuction can provide cosmetic improvements to patients who retain areas of regional fat despite diet and exercise and can provide encouragement to the lifestyle modification efforts of those trying to reduce their weight.

The objective of aesthetic surgery is to improve the patient’s psychological well-being by modifying their body image. This is accomplished by reshaping normal structures. Aesthetic surgery has been shown to improve standardized quality-of-life indexes and reduce depression (Figure 4).6 Because depression is common in the elderly population, patients presenting for aesthetic surgery should be screened for its symptoms. Those with clear symptoms of depression should be referred for treatment before further discussion of surgery.

Aesthetic surgery is one component of the evolving field of antiaging medicine. This has been defined as

Figure 1. Plastic surgery operations in elderly persons vary according to socioeconomic status.

Figure 2. Attenuation of support from the masseter cutaneous ligaments allows the soft tissues of the medial cheek to descend inferiorly in the aging face, leading to the formation of the facial jowl. Reprinted with permission from Baker et al.3(p185)
Figure 3. A, The platysma in the neck is supported in its normal anatomical position against the deep cervical fascia by a series of retaining ligaments. Reprinted with permission from Baker et al.3 B, Descent of the platysma muscle due to lax retaining ligaments.

Figure 4. A, Correction of jowls, platysmal bands, and other stigmata of the aging face by rhytidectomy. Reprinted with permission from Grotting.4
“the application of knowledge that delays the physical and mental deterioration associated with senescence to the absolute end of life.”

The intent is more to maximize the quality of life than to lengthen life. Antiaging philosophy also incorporates diet and exercise, other lifestyle changes, and medical or hormonal manipulations.

AGE-RELATED PATHOLOGIC CONDITION THAT MAY NECESSITATE RECONSTRUCTIVE SURGERY

Older individuals with sun-damaged skin are prone to develop actinic keratoses and basal cell carcinomas. These patients should be examined every 6 months by a physician with a special interest in the early detection of cutaneous pathologic abnormalities. Serial photography may be helpful.

Dermabrasion and deep chemical peels have been shown to clear the skin of actinic keratoses and small skin cancers and to reduce the number of degenerative lesions seen during a 5-year follow-up period. Current evidence suggests that the carbon dioxide laser does not impart this protective effect, probably because of its more superficial depth of resurfacing. The distinction between basal cell carcinoma and actinic keratosis is important. Overtreatment of actinic keratosis can cause unnecessary morbidity. Typical actinic keratoses present with scaling, redness, microulcerations, and a poorly defined border. They occur in areas of high sun exposure and have an estimated rate of malignant transformation of 5% to 10% over 10 years. They may be treated with destructive techniques such as cryotherapy or electrodessication and curettage, or, in cosmetically sensitive areas, it may be reasonable to obtain a biopsy specimen and to follow-up the patient’s condition clinically.

In the past 10 years, a histologic subtype of actinic keratosis has been recognized that has a higher incidence of malignant transformation and fails to respond to standard destructive techniques. Termed “proliferative actinic keratoses,” these lesions are distinguished by their larger size (>1 cm) and faster growth rate. More aggressive treatment, which may include complete surgical excision, is justified.

A small percentage of patients aged 65 years or older seek aesthetic or reconstructive breast surgery. Statistics from the American Society of Plastic Surgeons indicate that breast reconstruction in this age group is the most common breast procedure done by plastic surgeons, amounting to 7% of all such procedures in the general population in 2000. This represents about 5000 breast reconstruction operations done that year, and while an additional (but certainly much smaller) number were done by American Society of Plastic Surgeons nonmembers, it is small when compared with the number of mastectomies performed in this age group.

Breast reduction and breast lift procedures make up the remainder of plastic surgery operations ordinarily done in this population. The 65-years-and-older age group constituted 3% of both breast reduction and breast lift procedures. This equates to about 2500 breast reductions and 1400 mastopexies done annually by American Society of Plastic Surgeons members in the United States.

These data indicate that plastic surgery breast operations in the elderly population, although less frequent, are not rare. Adherence to the guidelines in the “Optimizing Perioperative Safety in Patients of Advanced Age” section will reduce unnecessary morbidity and mortality in this population.

Chronic medical conditions are common in elderly persons. The 3 leading causes of death in this population are coronary artery disease, cancer, and cerebrovascular accident. In addition to causing 75% of the mortality in elderly persons, they also account for 50% of their bedridden days. Hip fractures and other orthopedic injuries are another major cause of immobilization and disability. Primarily for these reasons, the elderly population are most affected by pressure sores.

Unless promptly and effectively managed, pressure sores profoundly affect quality of life, predispose to osteomyelitis and septicemia, and are strongly associated with mortality. When an elderly patient is admitted to the hospital, their ability to reposition themselves should be assessed and reassessed whenever their condition changes or operations are performed. Only antipressure surfaces should be used both while in bed and when sitting. Nutritional status should always be assessed and malnutrition aggressively treated. Patients with a history of involuntary loss of 10% or more of their body weight must be considered malnourished. Serum albumin or preferably prealbumin levels should be determined. Nutritional status is an independent predictor of pressure sore development.

Pressure sores (excepting those on the heel) should be debrided of any necrotic tissue or eschar and freshly debrided or clean pressure sores should be expected to show evidence of healing within 4 weeks. Nonhealing wounds should be assessed for the presence of occult infection or another impediment to healing. Reconstructive flaps should be undertaken only when there is a reasonably good prognosis for long-term success (“Optimizing Outcomes in Reconstructive Surgery in Elderly Persons” section).

Osteomyelitis associated with pressure sores is a long-term condition (Table 1). It has been locally seeded and is best treated locally as well by surgical debridement. Few systemic symptoms are present. When bone is visible at the base of a long-standing pressure sore, osteomyelitis is usually present. Antibiotic agents should be used adjunctively, and long-term antibiotics up to or exceeding 6 weeks in duration is warranted in circumstances when all involved bone cannot be debrided. Whenever possible, any exposed bone on the torso should be covered with a fasciocutaneous or myocutaneous flap.

Table 1. Differences Between Acute and Chronic Osteomyelitis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Acute Osteomyelitis</th>
<th>Chronic Osteomyelitis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seeding</td>
<td>Hematogenous</td>
<td>Local</td>
</tr>
<tr>
<td>Causative organism</td>
<td>Staphylococcus aureus</td>
<td>S aureus or gram-negative</td>
</tr>
<tr>
<td>Treatment</td>
<td>Antibiotic agents alone</td>
<td>Surgical debridement</td>
</tr>
<tr>
<td></td>
<td>generally successful</td>
<td>generally necessary</td>
</tr>
</tbody>
</table>

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Other frequent causes of chronic osteomyelitis in the elderly population are lower extremity ulcerations secondary to diabetes mellitus, peripheral vascular disease, or both. The presence of peripheral vascular disease must be rapidly determined, and patients lacking peripheral pulses, whether having diabetes mellitus or not, warrant further vascular assessment. There is a misconception in the medical literature that there is microvascular occlusive disease in the diabetes-affected foot that renders vascular bypass ineffective. It is known that occlusive disease is rare at the microvascular level in persons with diabetes mellitus, instead, the primary problem is rheological and can be medically manipulated.13 There is, however, an accelerated rate of atherosclerotic disease in the tibioperoneal trunk distribution in persons with diabetes mellitus. The presence of a multidisciplinary team ensuring adequate wound debridement, immediate vascular reconstruction when indicated, and careful off-loading and pressure redistribution have been shown to markedly decrease institutional amputation rates.14 Prolonged antibiotic therapy is indicated only when complete debridement of infected bones is impossible.

Sternal osteomyelitis following median sternotomy is best treated with definitive surgery and adjunctive antibiotic agents. Pectoralis muscle flaps are most commonly chosen for reconstruction although rectus abdominus and omental flaps may also be effective.

Mandibular osteomyelitis occurs in elderly patients with poor dentition or periodontal disease. This may originate from a periapical abscess and may spread hematogenously to the brain where it can be difficult to distinguish from tumor even on computed tomography or magnetic resonance imaging. A panoramic tomogram of the mouth or other plain x-ray films are usually diagnostic, and definitive surgery involves removal of the diseased tooth, root, and mandible.

Subacute osteomyelitis may be seen in elderly patients undergoing prosthetic hip or knee replacement. The incidence is higher when the indication for the operation is rheumatoid arthritis. Elevation of the erythrocyte sedimentation rate helps to distinguish this from mechanical loosening of the prosthesis.

Vertebral osteomyelitis usually results from hematogenous dissemination but can originate from the urinary tract in men. Tuberculous spinal osteomyelitis is more common in the elderly population than in the general population.

Acute osteomyelitis occurs most often in elderly persons as a result of a fall with an associated fracture. When the skin remains intact, Staphylococcus aureus is the most likely organism. Microabscess formation leads to pressure necrosis of additional bone and to sequestra. Pain and tenderness are a common presentation, and blood culture results can be helpful. Within a few days of the onset of symptoms, bone scans will usually be positive for disease. Acute osteomyelitis by definition is the first episode and resolves by medical means within 6 weeks.12

Contracture formation is a common sequela of debilitation in the elderly population. Once disabled by strokes, or degenerative neurologic disease, or immobilized by fractures or other medical conditions, aggressive preventative measures must be taken or contractures result. Of all patients having strokes, more than 50% will eventually develop contractures. Muscle weakness and spasticity also contribute to their origin.15

Contractures occur in muscles, tendons, ligaments, and joint capsules. The pathophysiology of their development is explained by the rapid accommodation of muscle to both use and disuse. The half-life of contractile proteins is 7 to 15 days.15 Without any demand placed on muscle tissue, sarcomeres are lost from the end of myofibrils and connective tissue shortens and loses elasticity.

Many strategies have been developed to prevent contracture formation. Although passive stretching is commonly provided by therapists, there is no scientific basis for the frequency and duration of this treatment. Available data indicate that each contracted structure must be stretched for 30 to 50 minutes for this to be effective, which is impractical.

Immobiliation in a fixed position can be effective temporarily, but long-term use will cause muscle atrophy, decreased muscle-tendon ratio, and loss of elasticity. Because of connective tissue creep, static splints fail to provide prolonged stretch. This deficiency can be obviated by using dynamic splints, which can be adjusted to maintain the range of motion limit.

Electrical stimulation is best used in the prevention of muscle atrophy. It can also treat contractures effectively, but the effect is not maintained after the discontinuation of therapy. Botulinum toxin type A can be used to temporarily paralyze spastic muscles, but repeated injections are necessary to sustain improvements.

Surgery provides a therapeutic opportunity for redefining the length and range of the musculotendinous structures. The hips, knees, and ankles can be released simultaneously. When necessary, Achilles tendon or hamstring lengthening should be part of the operative plan. Recurrence will occur without proper adjunctive treatment such as dynamic splinting.

OPTIMIZING PERIOPERATIVE SAFETY IN PATIENTS OF ADVANCED AGE

Elderly persons are prone to dehydration, a condition that must be corrected prior to surgery. Volume expansion should not be done rapidly, however, because of decreased cardiovascular responsiveness to changes in intravascular volume.1

Cardiopulmonary reserve must be evaluated in each patient. Long-term conditions must be understood and optimized to the greatest extent possible before undertaking elective operations. The patient’s risk of perioperative mortality or morbidity should be stratified as low, moderate, or high, and this information should be part of the risk-benefit discussion for informed consent (Table 2).

Urine output should be monitored closely with a low threshold for more invasive methods of measuring intravascular volume and cardiopulmonary performance. A hemoglobin level over 9.5 g/dL reduces the risk of perioperative myocardial infarction. Because of the high in-
cidence of cardiovascular disease in elderly persons, preoperative transfusion to this level should be considered.10

AGE-RELATED CHANGES IN WOUND HEALING

Poor healing in long-term wounds is more often caused by comorbid conditions than by age alone.17 In the case of the acute surgical wound, studies have shown a statistically significant increase in the rate of wound dehiscence with advancing age, but no adjustment for comorbidity was incorporated.

A trial of experimental forearm wounds in humans showed no statistically significant difference in tensile strength between person older than 80 years and those younger than 70 years.17 Malnutrition, which has been experimentally linked to low levels of hydroxyproline deposition in humans, is an example of a comorbidity more common in the elderly population that may have contributed to the unproven conclusion that advanced age alone is associated with poor wound healing.

The one aspect of wound healing that has been shown to occur more slowly in elderly persons is epithelialization. This was demonstrated in experimentally produced partial-thickness wounds in humans. Collagen synthesis and fibroblast-mediated wound contraction do not decrease in elderly persons, but the number of elastin fibers in skin decreases.

Although impaired wound healing has not been proven to occur clinically in humans on the basis of age alone, some basic science evidence suggests that this may be the case. Fibroblast replication decreases with advancing age, and senescent fibroblasts are less sensitive to many growth factors at both the receptor and postreceptor levels. Inhibition of DNA synthesis and replication has been associated with the appearance of a specific protein both in vitro and in vivo. Loss of dopaminergic neurons may lead to autonomic dysfunction that may impair peripheral perfusion, potentially compromising both wound healing and resistance to infection.

OPTIMIZING OUTCOMES IN RECONSTRUCTIVE SURGERY IN ELDERLY PERSONS

Studies have shown that the reconstruction of torso defects with musculocutaneous or fasciocutaneous flaps has an unacceptably high level of complications when serum albumin levels are less than 2.0 g/dL. Although levels of prealbumin, transferrin, or other markers may be a more accurate reflection of the patient’s actual nutritional status, evidence of marked malnutrition or catabolic metabolism is a contraindication to all but emergency flap coverage procedures. While exposure of a major blood vessel, brain, or other viscera may constitute such an emergency, the presence of exposed bone does not. Any osteomyelitis can be debrided and the wound packed open until a reasonable chance of healing can be expected, that is, an anaerobic state and a fair nutritional status have been regained.

As in all age groups, there is no point undertaking reconstructive procedures unless the integrity of the result can be expected to be maintained. Patients should have access to adequate equipment and assistance for a prolonged period to be selected as operative candidates.

PREVENTIVE AND PUBLIC HEALTH STRATEGIES TO MINIMIZE THE NEED FOR RECONSTRUCTIVE SURGERY IN ELDERLY PERSONS

Economic studies have shown that the costs of preventing and treating pressure ulcers approach those of treating cancer and cardiovascular disease. Most of these costs are incurred in lengthy hospital stays and in the use of antipressure beds.

The development of stage III or IV pressure sores is indicative of poor nursing care. Government agencies are becoming more aggressive in citing institutions for the development of these ulcers in their patients. In particular grievous cases, criminal prosecution has been felt to be warranted, and a manslaughter conviction was obtained in one such case.

In addition to improper mattresses, poor seating, often in collapsible wheelchairs or in gerichairs contributes to pressure sore formation. Pressure sores may also develop when the head of the bed is continuously elevated at least 30° (for nasogastric tube feeding or as a precaution against aspiration). A dichotomy exists in our society in that reimbursement for antipressure devices is not always available even though the need is clear. This conservation of economic resources frequently backfires for third-party payers when a long hospital stay and multiple operations are required.

More than two thirds of all pressure sores occur in elderly persons. The US Healthcare Financing Administration was sufficiently concerned about the $1.3 billion annual cost of treating pressure ulcers that it conducted its own retrospective cohort study to document the level of compliance with hospital processes that may prevent pressure sores. The results of this study are summarized in Table 3.18 They concluded that hospitals and physicians have numerous opportunities to improve care related to pressure ulcer prediction and prevention.

The prevalence of pressure sores in nursing homes has been reported to be as high as 24%. The US Department of Health and Human Services has targeted this figure to be reduced by 50% by 2010.

CONCLUSIONS

Patients of advanced age may seek aesthetic plastic surgery procedures to rejuvenate their appearance or require
reconstructive plastic surgery to restore form and function after illness or debilitation. Understanding the unique biological circumstances of the aging patient enables the surgeon to provide the best medical care, commensurate with the dignity and respect that the patient deserves.

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REFERENCES


Table 3. National Estimate of Compliance With Pressure Prevention Processes

<table>
<thead>
<tr>
<th>Process</th>
<th>Compliance, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of pressure-reducing device</td>
<td>7.5</td>
</tr>
<tr>
<td>Stage I pressure ulcer staged</td>
<td>20.2</td>
</tr>
<tr>
<td>Documentation of being at risk</td>
<td>22.6</td>
</tr>
<tr>
<td>Stage II or greater ulcer staged</td>
<td>30.9</td>
</tr>
<tr>
<td>Nutritional consultation</td>
<td>34.3</td>
</tr>
<tr>
<td>Repositioning a minimum of every 2 hours</td>
<td>66.0</td>
</tr>
<tr>
<td>Use of daily skin assessment</td>
<td>94.0</td>
</tr>
</tbody>
</table>

*Surgical Anatomy*

Cremasteric muscle: Its nerve is the genitofemoral (L1, 2). Its artery is the cremasteric branch (exterior spermatic artery) of the inferior epigastric artery. Its action is to retract or draw up the testis, and stroking the skin of the thigh supplied by the ilio-inguinal nerve (L1) reflexly brings about this retraction.

Source: Boileau Grant JC. A Method of Anatomy: Descriptive and Deductive. 5th ed. Williams & Wilkins Co; 1952:214.