

## Review Article

### **Dental implants in geriatric dentistry**

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**Abstract:** An understanding of patient's expectation and can help motivate older individuals to opt Dental Implants as a right treatment modality. Elderly individuals have low expectation of oral health, which needs to be changed by trained professionals. Training in geriatric care should enable the dental professional to understand and empathize with the psychosocial behavior of elderly. All the dental professionals should be encouraged to treat elderly patients under supervision using multi-disciplinary approach. One should deal these elder individuals with utmost care and professionalism to provide them with best clinical and functional outcomes from the treatment. With risk factors in implant dentistry becoming increasingly well understood, an aging population will provide the field of implantology the opportunity to apply this technology and markedly improve oral health of older adults.

**Keywords:** Old age, Gerontology, Geriatrics, Risk Factors, Dental Implants.

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#### **INTRODUCTION**

In the U.S. Surgeon General's first Report on Oral Health in America, the mouth is referred to as a mirror of overall health, reinforcing that oral health is an integral part of general health [1]. Throughout the world, the numbers of older adults are increasing, and these individuals are retaining more teeth. This population has unique problems that necessitate alterations in their treatment plans. They also use more medications, many of which can cause problems such as xerostomia and decreased saliva. Thus, aging can significantly alter the host immune response and inflammatory reaction to pathogens in different ways than in younger population. In these older adults, education, nutrition, counseling, regular dental care, and compensatory home and professional care technique may be required [2].

#### **CLASSIFICATION OF AGE**

By WHO

- Infancy-under 1
- Youth- 1-14
- Young adulthood- 15-24
- Middle adulthood- 25-44
- Older adulthood to average retirement age- 45-64
- Retirement - 65 years

According to Kiyak et al. [3]

- Young ≤ 45
- Middle –aged 45-64

- Young- old 65-74
- Old-old -75-84
- Oldest – old ≥ 85

#### **CHANGES WITH AGING**

##### **Alveolar bone**

The alveolar bone serves to support the teeth in association with the periodontal ligament. Bone formation steadily declines with age, resulting in significant loss of bone mass [4]. The alveolar bone has high plasticity, which under physiological conditions is kept by the equilibrium between osteoblastic and osteoclastic activities. These cells are directly or indirectly influenced by the action of parathyroid hormone (PTH), vitamin D metabolites, calcitonin, estrogen, plasmatic concentration of calcium and phosphates, neurotransmitters, growth factors, and local cytokines [5]. The reduction in bone formation may be due to a decrease in osteoblast proliferating precursors or to decreased synthesis and secretion of essential bone matrix proteins [4,6]. The extracellular matrix surrounding osteoblasts has been shown to play an important role in bone metabolism [6].

Possible dysfunction of this matrix may occur concomitantly with the aging process [3]. One hypothesis of aging postulates that the oxygen-free radical is a major contributor to the aging process; also, oxygen-free radicals have been implicated as a cause of cellular damage [7].

An *in vitro* study showed that oxygen radical treated fibronectin (FN) as substratum diminished bone nodule formation by osteoblasts when compared to intact FN. This finding suggested that FN plays an important role in osteoblast activity and that FN damaged by oxygen radicals during the aging process may be related to less bone formation [6].

Specific to the periodontium are findings of a more irregular periodontal surface of bone and less regular insertion of collagen fibers. Although age is a risk factor for the bone mass reductions in osteoporosis, it is not causative and therefore should be distinguished from physiologic aging processes. Overriding the diverse observations of bony changes with age is the important finding that the healing rate of bone in extraction sockets appears to be unaffected by increasing age [2]. Indeed, the success of osseointegrated dental implants, which relies on intact bone healing responses, does not appear to be age related. However, balancing this view is the recent observation that bone graft preparations (decalcified freeze-dried bone) from donors more than 50 years old possessed significantly less osteogenic potential than graft material from younger donors. The possible significance of this phenomenon on normal healing responses needs to be investigated.

Charles et al [8] conducted a study on relationship between oral alveolar bone loss and aging among African-American and Caucasian individuals. The results showed a significant multiple linear regression model relationship between oral bone loss and aging.

## **DENTAL AND MEDICAL ASSESSMENTS**

### **Review of Dental History**

At the very least, the review should include past restorative, periodontal, and other dental treatment; head and neck cancer and its treatment; allergies, oral hygiene care techniques; tobacco and alcohol use; and any difficulties or problems associated with dental treatment [9]. In addition, the dental history should review past injuries, the individual's perception of past and future dental treatment outcomes, the fluoride status of the drinking water (bottled, well, community), and the type of toothpaste used (fluoride versus non-fluoride).

### **Review of Medical History**

The medical history should be detailed and include a careful review of past and current medical and mental conditions including allergies and invasive procedures. The review should focus on a careful evaluation of systemic diseases and disorders, particularly those that influence dental treatment such as bleeding disorders and use of anticoagulants, diabetes, heart valve problems, certain cardiovascular conditions, stroke, artificial joints, and use of corticosteroids. A consultation with the individual's physician is advisable,

especially for individuals with medical problems or if complicated or invasive procedures are planned. Although obtaining a complete medical history may take longer with older adults, the dialogue between the dentist and the patient often yields valuable medical, psychological, and dental treatment information.

### **Review of Medication Use**

An absolute knowledge of a patient's medical problems, especially in geriatrics, is crucial for providing safe and appropriate dental treatment in the context of any systemic disorders, intake of medications, or other oral pathologies.

Older adults are high users of prescription and over-the-counter medications. Many medications used by older adults can have a negative impact on oral health. To obtain a complete list of prescription and over-the-counter medications, ask patients to bring each medication bottle or package to the dental office. This helps not only obtain a complete medication list but also provides additional information such as medication dose and number of physicians prescribing medications. Ashish et al. [10] determined the prevalence of self-reported medical conditions and drugs used in periodontally compromised geriatric population. 72.8% of patients reported a positive finding in medical histories with most frequent problems being bone/joint dysfunction, hypertension, allergy, diabetes mellitus, eye/ear dysfunction, and cardiovascular diseases. 58% of patients were taking at least one medication. Non-significant differences were recorded with male and female patients. Considering the high prevalence of medically-compromised geriatric dental patients, dentists should consider the conditions that are contraindicated for certain dental procedures or medications.

### **Assessment of Risk**

The American Society of Anesthesiologists established a classification to predict risk of surgical mortality. This stratifies patients into five categories, adjusts for age by not allowing an older adult to be assigned into Class I, and has been validated for patients aged 80+ years. This classification system was originally designed to assess surgical risk under general anesthesia; however, it is also currently used to assess risk before diagnostic testing and outpatient surgery. Dentists can use this classification for patient assessment before invasive periodontal procedures. In addition to assessing medical risk, the dentist should evaluate the risk factors that influence the progression of periodontal disease. The prognostic risk factors that influence periodontal therapy are smoking, genetic susceptibility, compliance, and diabetes.

### **Intraoral and Extraoral Examination**

In addition to assessing past dental treatment, tooth loss, restorations, past dental interventions, dental caries, and periodontal status, the comprehensive dental examination should include a complete head and neck examination of soft tissues. Oral and pharyngeal cancer

is an age related oral disease with serious consequences. Skin of the face and neck should be inspected and palpated for lesions, enlarged lymph nodes, or both. Intraorally, the lips, cheeks, tongue, gingiva, floor of mouth, palate, retromolar trigon, and oropharynx should be inspected and palpated to detect soft tissue abnormalities, particularly red or white patches, ulcerations, or swellings. The risk for oral and pharyngeal cancer increases with age, tobacco use, frequent use of alcohol, and exposure to sunlight (lip). Oral cancer is treatable if discovered and treated early. Oral and pharyngeal cancer detected at later stages can cause disfigurement, loss of function, decreased quality of life, and death. Surveillance, Epidemiology, and End Results (SEER) data indicate that more than 50% of tongue and floor of mouth cancers had metastasized to a distant site at time of diagnosis. In addition, over the last 25 years, the 5-year survival rate of oral cancer has not improved." Oral and pharyngeal cancer lesions may not be painful. Oral cancer may appear as ulceration, a swelling, or a red or white sore that does not heal within 1 to 2 weeks. Other signs of oral cancer may be swollen lymph nodes and difficulty swallowing and speaking.

### Effect of aging on immunocompetent and inflammatory cells

Vaccination as well as a huge number of diagnostic and successful treatment modalities for life threatening conditions such as cancer, vascular disease and especially infectious diseases have and will continue to have a major effect on the longevity of peoples throughout the world [11]. Historically, the increased occurrence of severe infectious diseases as well as cancers has been associated with very young and very old people (that is, older than 65 years of age). These diseases theoretically occur because of suboptimal immune defense mechanisms. Vaccines given at the proper time and boosted appropriately have been extremely effective in preventing the occurrence of disease and mortality in young people with developing immune systems. Ironically, the success in preventing and treating diseases from birth through middle age has and will continue to create the increasing percentage of aged individuals in the population, creating a new set of medical, economic and political challenges.

**Table-1: Changes in the human immune system apparently associated with aging**

Immune component	Change
Adaptive response	Depressed primary response Shortened memory Decrease secondary response
a) T-lymphocytes	A variable decrease in blood Majority express activation markers Switch from naive to memory Clonal expansion of CD8+ cells Decreased proliferation to stimuli Decreased protein kinase activation Decreased calcium signals Decrease in major histocompatibility complex restriction Decreased cytotoxicity
b) B-lymphocytes	Decreased numbers in blood Monoclonal gammopathies Isotype profile changes Decreased secondary response
c) Accessory cells	Decreased numbers in lymphoid tissues Decreased IL-1 production Increased IL-1 production
d) Cytokine	Decreased IL-2 synthesis Decreased IL-2 receptor expression Decreased interferon $\gamma$ 26 Increased synthesis of IL-6 and Tumor necrosis factor A
Innate response	
Natural killer cells	Increased number in blood Variable cytotoxic activity <ul style="list-style-type: none"> <li>• Increased</li> <li>• Same</li> <li>• Decreased</li> </ul>
Polymorphonuclear leukocytes	Normal activity Cell signal transduction changes
Macrophages	No defect in phagocytosis or killing

The time required to age, the environmental factors and the genetic diversity of the human population are factors at least partly responsible for the variability in the data reported on immunosenescence in humans. The human genome consists of about 100,000 genes [12]. We share the same mammalian repertoire of genes with animals as diverse as mice and elephants. The expression of those genes results in very different phenotypes between species and within species. Gene

#### **Relationship between nutrition and malnutrition and the immune system**

Two key public health objectives for the elderly are known as “healthy active aging” and “compression of morbidity”, designed to delay physical deterioration as long as possible. Among the multiple approaches required to pursue this aim, the achievement of optimal nutritional intake is an important element and fundamental for the preservation of general health [13].

In elderly people, the lines of distinction between naturally occurring immunosenescence and the effects of the onset of nutritional distress can become blurred, complicating the assessment of the role each plays in health and disease [14]. Aging has been associated with deficient numbers of T-cell helper and inducer lymphocytes, accompanied by defective functional capacity. However, similar effects have been observed in protein-calorie malnutrition and zinc deficiency. Increased adherence of bacterial cells to epithelium, delayed seroconversion, decrease in serum IgA levels, lowered natural killer cell function, as well as other impairments of immune response have been attributed to dietary deficiencies [15]. Estimates of the extent to which protein-calorie malnutrition exists among elderly people has been undertaken. A Canadian study of long-term-care elderly documented severe malnutrition in 18% of the study population; mild malnutrition in 27%; and over nutrition in 18%. Under nutrition was positively associated with dysphagia, slow eating, low protein intake, poor appetite, presence of a feeding tube and age in a study of 179 men [16].

#### **Immunosenescence**

Immunosenescence refers to the gradual deterioration of the immune system caused by natural aging. It involves the host’s capacity to respond to infections and the development of long-term immune memory. This is not a random deteriorative phenomenon; rather it appears to repeat inversely an evolutionary pattern. The immune system also undergoes age-related modifications leading to structural changes in the lymphoid organs, and functional impairment of some types of immunocompetent cells [17]. The most evident changes in the immune system occur in the thymus, a specialized organ of the immune system. The thymus is a primary lymphoid organ, but also an endocrine gland, responsible for T-cell production and maturation.

expression, environment and behavior combined make us what we are. Healthy centenarians could be considered to have achieved the optimal combination of genetics, environment and lifestyle to allow them to live close to the maximum length of time for human life [12]. Their avoidance of a fatal infectious disease suggests that they have an adequately functioning immune system even at more than 100 years of age and may have avoided many of the effects of aging.

A more rapid and severe development of gingivitis as well as changes in inflammatory response induced by gingivitis in elderly patients have been reported [18]. A greater presence of alpha 2-macroglobulin, IgG3, and B-lymphocytes in the crevicular fluid and a reduction in polymorphonuclear leukocytes (PMN) has also been observed in the elderly [19]. Periodontal ligament cells from the elderly showed an increase in the production of plasminogen activator (PA) prostaglandin E2 (PGE2), interleukin-1 (IL-1) and interleukin-6 (IL-6) when compared to younger cell [17].

Elderly people as a group respond more slowly and less robustly to immunogenic challenges than do young mature adults, resulting in a suboptimal protective immunity. The immune system consists of specialized highly differentiated cells that circulate by the lymphatic and vascular networks through lymphoid tissues facilitating recognition and response to nonself antigens [11]. The complexity of the maintenance and recognition of antigens, cellular interactions and effecting protective immune responses throughout a lifetime by this highly dynamic system is overwhelming. The loss or decrease in function of one or more components of the system due to aging could result in no immunity, compromised immunity or inappropriate immunity. The extent and scope of the biological effects of aging on the human immune response need to be identified.

Adaptive immunity is the antigen-specific form of protection mediated by the cooperation of antigen presenting cells, T cells and B cells that affect an immune response through cytotoxic T cells, effector T cells and antibodies. The adaptive immune responses are characterized by their specificity, memory after an initial exposure to antigen and a greater quantitatively and qualitatively second response to an antigen.

#### **Avoiding medication related problems**

Avoiding medication related mishaps in elderly patients requires effort in several areas. The first steps are identifying and avoiding the use of medications that present at high risk for adverse reactions and identifying the patients who are more likely to experience therapeutic misadventures. The risk of medication mishaps can be minimized by incorporating some simple strategies into the office visit routine for geriatric patients [20].

- Obtain medication history for older patients. This should include prescription and non-prescription drugs, herbal medications and dietary supplements. The list should be updated at every visit or at least annually
- Review the history for medications that may potentially duplicate or antagonize medications prescribed in the dental office. NSAIDs should be avoided in patients taking warfarin or other agents that affect coagulation.
- Review the medication list for medications that have a negative effect on oral health. Many different medications have anticholinergic activity that may cause dry mouth or affect swallowing. A combination of several of these can lead to significant adverse effects.
- Use the primary care physician to coordinate care. Because the primary physician will probably see the patient more frequently, he or she should be notified if any significant addition is made to medication regimen.

The care of many elder adults is medically complex. Collaboration and communication between dentist, patient and other health care providers are essential for maximizing drug therapy outcomes and avoiding medication misadventures.

#### **DENTAL IMPLANTS**

With the increase in life expectancy and overall improved quality of life in the current aging population. While there are fewer missing teeth in this population than in the past, replacement of missing teeth continues to be a concern. While fixed bridgework replaces a few missing teeth, removable, partial or complete dentures have been the treatment of choice for multiple missing teeth. Traditional removable partials and complete dentures contribute to long-term ridge resorption and less bony support of the jaws. Thus dental implants have been used in elderly patients, however the success rate of dental implants is associated with various risk factors [22].

- Oral Hygiene
- Xerostomia
- Cardiovascular disease
- Diabetes
- Osteoporosis
- Cancer

Implant therapy should be considered as a medical model in the geriatric population.

Most patients who can tolerate any dental surgery are acceptable candidates for the implant placement surgery, but the use of implants in the treatment plan may carry substantial risk factors. Because it is important to know and recognize these risk factors, detailed medical history and evaluation are important prior to treatment. The success of implant therapy is

greatly influenced by systemic conditions, and many older patients who are in need of this type treatment have one or more of these conditions. The overall health and well-being of the patient is of primary concern when treating this population.

Lessened manual dexterity and visual acuity may affect oral self-care oral hygiene success rate may be comparable to younger age groups when appropriate modifications of oral health aides are made. When adequate instruction and recall intervals are maintained. Less complicated designs of implant abutments are utilized. It is necessary to consider the patient's present and future ability to accomplish oral hygiene procedures. Elderly patients may have decreased manual dexterity and must be evaluated regarding their ability to maintain good oral health. In patients with decreased ability to perform adequate oral hygiene, design of an implant-assisted or -supported case may need to be simplified. Very complex cases have the potential to present hygiene problems in the future.

#### **Xerostomia**

Salivary flow declines with age, many medications prescribed to the elderly will reduce salivary flow. Condition enhances the accumulation of periopathogenic bacteria that could cause peri-implantitis.

#### **Cardiovascular Disease**

Dental implants are not contraindicated if the disease is controlled. Examples of cardiovascular disease include:

- Hypertension
- Angina pectoris
- Myocardial infarction (MI)
- Congestive heart failure
- Bacterial endocarditis

Moderate to severe hypertension should be corrected prior to implant surgery. Mild hypertension may be controlled with anti-anxiety measures. Patients with angina should be treated in a hospital setting. Elective implant procedures should be delayed for a minimum of 12 months following the MI or until the patient's physician gives consent for implant surgery. Patients with congestive heart failure may be treated depending upon the severity of the disease. Patients with prosthetic heart valves, valvular damage or joint replacement may require systemic antibiotic prophylaxis prior to the placement of any dental implants.

#### **Diabetes**

- Patients with well-controlled diabetes can have successful implant therapy.
- In long term care settings, it is very important that the patient's oral hygiene must be monitored.
- Patients are at greater risk of infection.

- Dental implants contraindicated in uncontrolled diabetics.

Type I Diabetes has a higher risk factor than Type II Diabetes for implant therapy; however, neither is an absolute contraindication if the blood sugar level is controlled by diet and/or medication. Much of the long-term success of implant treatment in these patients is dependent upon the patient's willingness and ability to manage his/her condition.

Diabetic patients are at high risk for infection and in uncontrolled situations can demonstrate poor healing of infected sites.

### **Osteoporosis**

Potential for patients with osteoporosis have a greater risk of implant failure. Presence of osteoporosis in one site of the body does not mean it will affect another site. Evaluate bone density at the implant site. Osteoporosis is primarily a disease of long bones and tends not to affect the bones of the oral cavity.

### **Oral Cancer**

Fifty percent of oral cancer is diagnosed in age 60 years or older. Post-radiation and post-chemotherapy patients should be evaluated with care. Implants are helpful in replacement of both soft and hard tissues lost as a result of cancer surgery. Post-radiation patients often have Xerostomia.

Kondell *et al.* [22] compared the success-rate of 284 implants in 53 elderly patients, aged 65-85 years, with the success-rate of 183 implants in 36 younger patients, aged 18-54 years. The implants supported mostly fixed partial or complete dentures and a few overdentures. After an observation time between 1 and 6 years the overall success-rate in the elderly patients was at least equal, even slightly better, than in the younger group.

Bryant and Zarb [23] made a comparison between closely matched groups of 39 older adults (60-74yrs) who had 190 implants and 43 younger adults (26-49 yrs) who had 184 implants. In both groups the implants supported 23 fixed complete dentures, 12 complete in overdentures, 8 fixed partial dentures, and 2 single crowns. The matching procedure permitted the groups to be identical in terms of gender, implant location, and prosthetic plan. The group's also demonstrated similarity relating to variables not involved in the matching procedure, such as implant length, bone quality, bone quantity, and smoking behaviour. Not surprisingly, the average health of the groups differed somewhat, suggesting better health among the younger patients. Patients were observed for a period of 4 to 16 years after prosthetic loading. At the most recent follow-up, the cumulative implant success rate was 92.09% for the older group compared to 86.5% for the younger group.

Smith *et al.* [24] treated 104 patients, aged 5 to 88 years, with 313 implants. Prosthodontic design included fixed dentures, overdentures, and single crowns. Their objective was to determine the medical risks associated with dental implants. The mean age was  $52.8 \pm 15.7$  years. Fifty-four percent of the sample reported having one or more medical problems and 58% of the patients had a score 2 or 3 on the medical risk scoring-system developed by the American Society of Anaesthesiologists (ASA-score). Twenty-two per cent reported complications, for instance implant failure, wound breakdown, nerve injury, bone fenestration, or entry into the maxillary sinus. The most common complication was failure of one or more implants to osseointegrate (13.5%). There did not appear to be an increased implant failure-rate or an increase in perioperative morbidity in patients with a compromised medical status. Age, gender, and concurrent use of drugs did not correlate with increased implant failure.

Grant *et al.* [25] carried out a study to determine the overall success of dental implants placed in geriatric patients. Dental implants were placed in 47 geriatric patients who were 79 or more years of age at the time of the procedure. The study group was composed of 27 men and 20 women, with a median age of 89 years and a range of 79 to 99 years of age at the time of implant surgery. A total of 73 dental implants were placed in the maxilla and 87 dental implants placed in the mandible. All implants were restored with fixed implant-supported prostheses or removable implant-supported prostheses. One hundred fifty-nine integrated successfully. In the case of the failed implant, the site was grafted and another implant was placed 5 months subsequent to the initial failure. This replacement implant integrated and has been in function for 6 months. The survival rate for dental implants placed in the maxilla was 99% and in the mandible was 100% in our geriatric population. Study concluded that treatment with dental implants can be predictable and safe for the rapidly growing geriatric population. Geriatric patients who are medically stable are suitable candidates for osseointegrated implant surgery, which facilitates oral function, comfort, and quality of life.

Dental implants and implant-assisted or implant-supported fixed and removable restorations remain a valuable treatment option for the geriatric patient in dental implant treatment, chronological age by itself is suggested as one of the risk factors for success, but it would not be a contraindication. Reduced ability to maintain oral hygiene due to age is also not a contraindication to implant therapy. The patient's overall health should be considered first. There exists a greater likelihood of medical complications in this population.

In general, reserved capacity of bone and soft tissue make it possible to establish osseointegration in the long run. Rather than aging itself, the specific nature

of the disease process, such as osteoporosis or diabetes, and local bone quality and quantity at the implant site, mostly related to aging, are more important for successful dental implant treatment.

## CONCLUSION

When one considers the improvements in oral health made in the past. Caries, once considered a ubiquitous oral disease, has been prevented in some children in developed countries. Research on periodontal disease continues to identify risk factors and the pathobiological mechanisms underlying the disease. Concurrently the population of the world is aging presenting new opportunities for improving oral health. More adults are living longer and healthier than previous cohorts of elderly and with which comes the responsibility of the periodontist to understand the various aspects of geriatric periodontal health and treatment needs. Thorough knowledge of physiology, various diseases affecting older adults and methods of treating such conditions is becoming very important in every field of dentistry.

The ability to smile confidently and/or improved self-esteem are fueling the dentistry movement among older adults.

Within the discipline of dentistry, educational change must occur in didactic and clinical formats in predoctoral and graduate training. Developing teachers of geriatrics, research initiatives for applications in clinical practice, and developing a cadre of practitioners who have the knowledge, skills, and values and are willing to commit their time in service to the underserved elderly would be important.

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