



Senescence of the Dental Organs and Management of the Elderly in Dentistry

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Abstract

Human beings adapt, age, to live longer, but this physiological capacity to adapt diminishes. A human being who does not adapt does not age and dies. Normal ageing, which every living organism undergoes, takes place gradually and in the absence of disease. The anatomical and physiological changes associated with old age begin several years before the outward signs appear. Many of these changes begin to manifest themselves progressively from the age of 40 onwards and continue until death, *i.e.* until the body can no longer adapt. Physiologically, the process of senescence leads to a decline in body functions and then to the ageing of tissues and the general appearance of the body. Ageing is a gradual and irreversible process of changes in the body's structures and functions resulting from the passage of time. This general definition given by the World Health Organization (WHO) allows us to approach a subject that is both vast and complex, concerning dentistry. The tissues and organs of the oral cavity undergo profound changes during the ageing process, which alters their functions and their potential for adaptation and healing. Thus, the oral care of elderly subjects cannot be identical to that of young adults because the pathologies are expressed differently and we cannot expect the same therapeutic results. The expected benefit must be multiple, both in terms of restoration of body integrity and function and in terms of the patient's quality of life and health. It must be confronted with the notion of risk which is, once again, multiple since we must take into account the context of several pathologies and polyvalent medication characteristic of the elderly subject and also the fact that odontologic therapeutics frequently involve numerous sessions in the chair, which are difficult to bear for the elderly. Today, more than ever, the dental surgeon has an important role to play in good ageing. Through this work, we will address the following questions: What is ageing? What are the physiological changes of aging in the dental organs? The consequences of dental organ loss -What is the contribu-

tion of the dental surgeon in improving the oral health of the elderly?

Subject Areas

Dentistry

Keywords

Oral Health, Senescence, Dental Organs, Elderly, Care, Odontology

1. Introduction

The ageing process occurs at all levels of functioning: cellular, tissue, organ and systemic.

The massive increase in the number and age of elderly people, attesting to medical progress and an improved quality of life. However, the precariousness of the physical and psychic state of health, as well as the deterioration of the stomatognathic system are a reality for the majority of the geriatric population.

The mouth is the seat of vital and oral functions. The mouth allows us to express ourselves, to communicate, to feed ourselves and to appreciate the taste of food [1] [2] [3].

The tissues and organs of the oral cavity undergo profound changes during the ageing process, which alters their functions and their potential for adaptation and healing. This leads to a specific management and implies to evaluate the benefit/risk ratio for the patient of odontological treatments with respect to pathologies and prescriptions. The therapeutic approach is influenced by the physiological, psychological and sociological complexity of the elderly patient [4] [5].

2. Ageing of the Teeth and Periodontium

The senescence of the teeth and periodontium leads to an increase in the prevalence of carious lesions and periodontal disease. Bacterial plaque accumulates at root surfaces and prosthetic joints, creating favorable conditions for the development of dental and periodontal lesions [6]-[11].

These phenomena are favored by:

- Age;
- The number of oral bacteria;
- Loss of gingival attachment;
- Poor plaque control (decreased dexterity, motor skills, cognitive abilities and cooperation of some patients, inadequate training of caregivers).
- The preponderance of sugary food (often a source of comfort for the elderly patient);
- The use of drugs that affect saliva;
- Salivary flow;
- Difficulties in accessing oral health care.

2.1. Senescence of Dental Tissue

All tissues making up the dental organ (enamel, dentin, pulp tissue and cementum) undergo a process of senescence [4] [5] [12] [13].

The ageing of teeth is characterized by changes in shape and color. As the tooth ages, it becomes more yellowish in color and more brittle. The shape is affected by attrition, which is the main wear mechanism of ageing, but also by abrasion and erosion. Each part of the tooth undergoes its own changes as it ages [14] [15] [16] (Table 1).

Table 1. Changes in dental tissue during aging [14].

Enamel	-Decreased permeability -Increased fragility -Appearance of cracks
Dentin	-Increased translucency -Increased thickness (secondary dentine) -Obstruction of dentine canaliculi
Pulp	-Narrowing of the pulp chamber -Decreased vascularization -Decreased cell number -Increased mineralization

2.1.1. Alterations to Dental Tissues

-Alterations to the enamel:

After the age of 50, the enamel becomes thinner. Enamel, which is a mineralized and acellular tissue, is reduced in volume in certain coronal areas, sometimes leading to the exposure of dentinal islands. Enamel is an inert tissue, incapable of reforming, which undergoes simple wear due to regular attrition in its occlusal area. Wear varies according to the patient's occlusion and eating habits, sometimes leading to complete erosion of certain coronal portions, the enamel surface often shows cracks and fissures, the enamel prisms are collapsed, these alterations may lead the patient to consult often only for aesthetic reasons. [17]-[22].

-Changes in the dentin-pulp complex:

The changes in the dentin-pulp complex with age are considerable. They result in a histological appearance that is totally different from the tissue architecture of the young tooth, with clinical implications [23] [24] (Table 2).

The pulp-dentinal ageing process includes the ageing of the odontoblasts, the reduction of their dentin-genetic function and the ageing of the pulp tissue [14] [15].

In the course of pulpal senescence, which normally accompanies the aging process, slow dentinal apposition occurs, resulting in an overall reduction in pulp volume, including both the pulp chamber and the root canal. In addition to this physiological process directly linked to age, there is also a pathological process of senescence inherent in the aggressions to which the pulp has been subjected [15] [23] [24] (Figure 1).

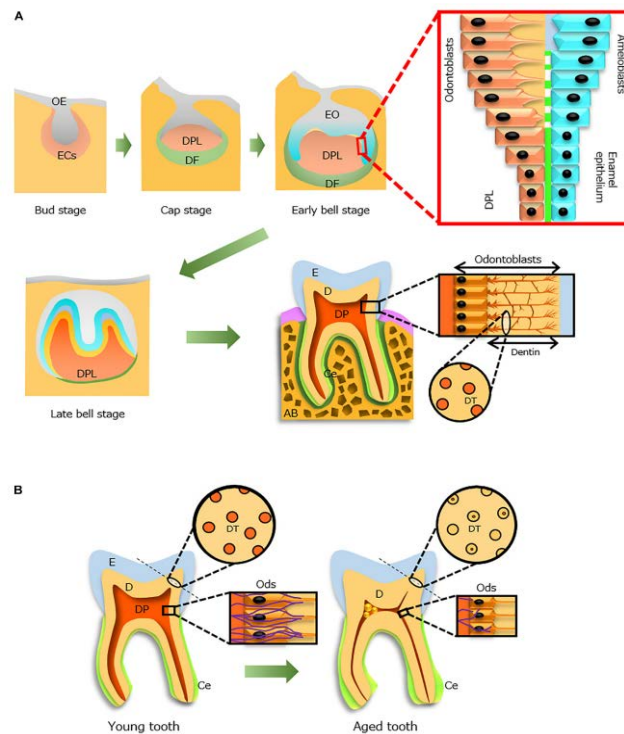


Figure 1. Tooth development during the aging process. (A) Tooth development from the bud stage to eruption. Odontoblasts (Ods, orange) and ameloblasts (blue) form dentin (D) and enamel (E), respectively, through epithelial–mesenchymal interactions. An erupted tooth consists of three hard tissues [E, D, and cementum (Ce)] and a soft tissue [dental pulp (DP)]. The processes of Ods extend into the D where dentinal tubules (DTs, circle) are formed. (B) Aging alterations of the tooth structure. Constriction of the DP cavity (red), occlusion of DTs in increased D, thickening of the Ce (light green), size reduction of Ods (rectangle), and decreased distribution of nerve fibers (violet, rectangle) with advancing age. AB, alveolar bone; DF, dental follicle; DPL, dental papilla; ECs, ectomesenchymal cells; EO, enamel organ; OE, oral epithelium. Light and dark green indicate Ce and periodontal ligament, respectively [24].

Table 2. Histological changes in the pulp during senescence in tandem with its reparative potential [24].

Pulp volume		↘	Apposition of secondary dentine
Odontoblasts	Number	↘	Pulp repair potential
	Activity	↘	
Fibroblasts	Number	↘	Pulp metabolism
	Activity	↘	
Fibers	Thickness	↘	Fibrous degeneration
	Density	↘	
Vascularization		↘	Vitality and defense potential
Pulp calcifications		↗	pulp volume

2.1.2. Consequences of Dental Tissue Senescence

All the tissues making up the dental organ (enamel, dentin, pulp tissue and cementum) undergo a process of senescence. Thus, cracks in the enamel or loss of substance through erosion, abrasion or attrition are characteristic of dental ageing and favor the exposure of sclerotic dentine. In addition, physiological ageing of the pulp tissue results in partial or total fibrosis associated with shrinkage of the pulp cavity, sometimes to the point of complete obliteration.

The increased risk of caries in the elderly, combined with difficulties in accessing oral health care, contribute to the increased prevalence of carious lesions in elderly patients [14] [15] [19] [20].

In addition to anatomical and tissue changes, several factors are involved in the Cario susceptibility observed with advancing age:

- Elderly people are more likely to consume a diet rich in sugars and carbohydrates, with a soft consistency and adherence to the tooth.

- The decrease in salivary flow, in the buffering capacity of saliva and therefore in its protective role, leads to the appearance of an acidic oral pH responsible for demineralization of dental tissues, favoring the presence of numerous bacteria and micro-organisms.

- The decrease in manual dexterity and the loss of autonomy represents major obstacles to the practice of oral hygiene, which results in the accumulation of bacterial plaque, particularly at the dental neck.

2.2. Periodontal Senescence

After their establishment, the periodontal tissues do not constitute a static entity, but, on the contrary, represent a functional, biological entity, in perpetual remodeling. They allow the physiological movements of the tooth in its socket during mastication [25] [26].

The metabolism of each individual evolves towards a slowing down linked to ageing. There is no precise age for the onset of senescence. There are significant individual variations, but common trends are apparent. The different elements of the periodontium are affected by this phenomenon [27] [28] [29].

2.2.1. Changes in Periodontal Tissues

-Changes in the gingiva:



Figure 2. Periodontitis in a 69-year-old male. Deposits of dental plaque and calculus, bright red marginal gingiva, pathological migrations of the teeth, and gingival recessions due to periodontal disease., CCTD clinical case, CHU Casablanca.



Figure 3. Gingival inflammation associated with periodontitis in a smoking patient (75 years old), CCTD clinical case, CHU Casablanca.

Clinically, changes in the gingiva with age are not very visible. The gingiva is less granulated in the elderly, the height of the attached gingiva varies with age, while the muco-gingival line remains unchanged. White lesions or oral keratoses are more frequently encountered in the elderly and could be related to the disruption of the enzymatic systems of keratinization. The gingival epithelium is said to be about one third thinner than in young adults, mainly at the expense of the superficial layers [30] [31] [32] (**Figure 2, Figure 3**).

-Changes in the cementum:

The thickness of cementum increases with age, it can triple. This is a continuous phenomenon during the life of each individual, by apposition of secondary cementum, essentially acellular [33] [34] [35] [36].

Areas of cementum resorption or calcification may be due to age, periodontal disease or occlusal trauma [35] [36].

Areas of cementary resorption or calcification may be due to age, periodontal disease or occlusal trauma [35].

Apical cemental deposition results in an increase in radiological tooth length, which must be taken into account during endodontic treatment [35] [36] (**Figure 4**).

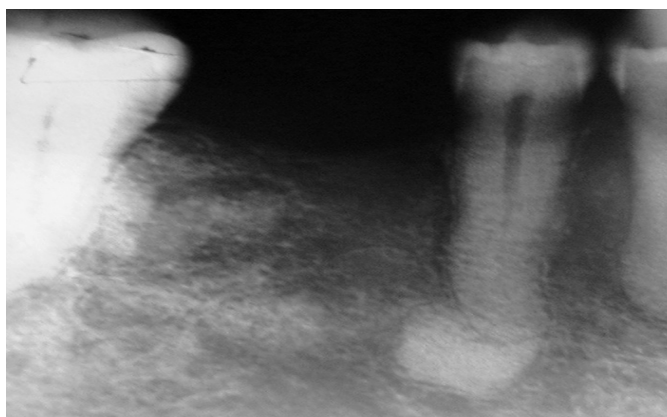


Figure 4. A retro alveolar radiograph of a 53-year-old patient with chronic periodontal disease and apical hypercementosis at 45, CCTD clinical case, CHU Casablanca.

-Changes in the desmodont:

With age, cell metabolism and fiber diameter decrease. Collagenous bundles thicken and tend to mineralize. The proportions of progenitors decrease over time, which compromises the periodontal healing potential in the elderly. The average width of the ligament space decreases with age [25] [26].

-Changes in the alveolar bone:

Several studies have shown that over time, the alveolar bone experiences a reduction in metabolism and, consequently, reduced healing and adaptive capacities [14] [15] [16] [33] [34].

Bone mass progressively decreases, the number of osteoblasts and their activity is reduced, the volumetric proportions of adipose tissue, hematopoietic tissue, osteoid tissue and trabecular bone are altered [37] [38] (**Figure 5, Figure 6**).

Tooth loss associated with periodontal disease is accompanied by greater resorption than if the lost tooth had healthy supporting tissue [21] [22].



Figure 5. A panoramic radiograph of a 65-year-old patient with chronic periodontitis, CCTD clinical case, CHU Casablanca.

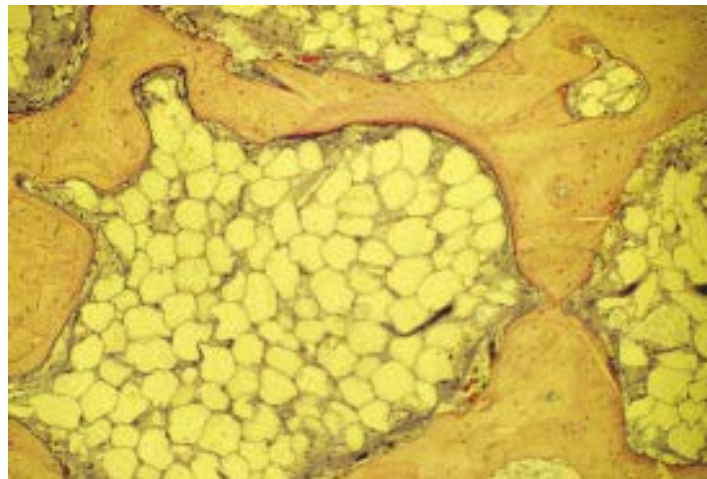


Figure 6. Histological section of human mandibular alveolar bone (80-year-old man). Bone tissue (pink) and interstitial tissue with numerous adipocytes [38].

Other factors that aggravate bone resorption in an edentulous area can be identified:

- Excessive or continuous forces on the alveolar bone without sufficient rest periods;
- The absence of forces (Jores' law);
- Surgical trauma during avulsions [21] [22].

2.2.2. Consequences of Periodontal Senescence

-Gingival recession and loss of attachment:

Gingival recession, the incidence of which increases with age, is related to loss of attachment and reduction of alveolar bone in the affected area and is very common in elderly subjects. They do not appear to be a direct consequence of senescent atrophy but are usually multifactorial in origin. They are the result of specific anatomical factors such as thin periodontium and dental malposition, combined with gingival inflammation and traumatic brushing [35] [36] [37] [38].

The most common gingival recessions are vestibular, then palatal and lingual. Interproximal recessions occur in elderly subjects [35] [36].

Age-related changes in the periodontium do not inevitably result in loss of attachment and alveolar bone loss [35] [36].

-Functional consequences:

Changes in periodontal structures attributed solely to age are not sufficient to result in tooth loss, especially in healthy individuals [35] [36] [37] [38].

Edentulism is the major stomatological problem of the elderly. Partial or total loss is the general rule. It causes great difficulties and is always very badly experienced by almost all patients [39] [40] (**Figure 7, Figure 8**).

Edentation resulting from senescence, caries or periodontal processes can and should be delayed. Although dental hygiene is important, diabetes and hypo Sialia are aggravating factors, the essential thing is regular monitoring of the teeth associated with the necessary conservative care. The difficulty of this management is measured when motor or intellectual difficulties arise [39] [40].



Figure 7. Major dental extractions in a diabetic patient (75 years old) following periodontal disease, CCTD clinical case, CHU Casablanca.



Figure 8. Defected prosthesis promoting plaque retention in a patient with poor oral hygiene, CCTD clinical case, CHU Casablanca.

3. The Consequences of Tooth Loss in the Elderly

The oral condition of the elderly is generally poor, although oral health and comfort are prerequisites for proper masticatory function and nutrition. The ageing of the oral cavity and the associated pathologies lead to a decrease in masticatory potential which is influenced by many co-factors such as the number, condition and mobility of the teeth, the decrease in salivary flow, the possible wearing of prostheses, the presence of gingival inflammation or mucosal pathologies associated with pain. The masticatory potential influences the type of diet of the elderly, with an impact on their qualitative and quantitative nutritional intake, their comfort and their well-being.

Thus, the reduction in the number of teeth, unsatisfactory dental condition and simply the physiological ageing of the oral tissues favor diets low in fruit, fiber and protein and high in carbohydrates. In people with poor dental health, there are deficiencies of iron, vitamin A, vitamin C, folic acid, thiamine and protein, and an increased risk of morbidity and mortality [41] [42].

There is a statistical link between edentulism, low nutrient intakes and multiple dietary inadequacies leading to an atherogenic diet. Totally edentulous people usually have dietary intakes that are quantitatively below recommended levels. Similarly, indicators of undernutrition, such as Body Mass Index (BMI) or weight loss, are correlated with masticatory disorders. It has been shown that edentulism and poorly fitting dentures play a significant role in weight loss above 4% [43] [44] [45]. Furthermore, the decrease in albumin levels is statistically linked to the presence of root caries and many oral disorders are involved in weight loss of more than 10% (halitosis, insufficient oral hygiene, dry mouth, lack of occlusion, temporomandibular pathology, infection-inflammation, mucosal lesions, oral pain, etc.) [46] [47]. Among these disorders, disturbances in the constitution of the food bolus linked to hypo Sialia seem particularly important and lead to feeding difficulties that compromise nutritional status. A statistical link has been demonstrated between a strong reduction in salivary flow, stimulated or not, severe undernutrition [48] [49] and albumin levels [50] [51].

Similarly, a lower BMI is observed in subjects suffering from severe periodontitis; this can be explained by the fact that this pathology associates dental mobility and pain likely to modify the masticatory potential as well as a gingival inflammation evolving in a chronic mode and which can alter the energy reserves of already fragile subjects.

3.1. Dental Consequences

Teeth support each other. When one of them is missing, the adjacent teeth are no longer wedged in place, and they shift into the available space. These malposition teeth become loose and decay. In addition, the antagonistic teeth start to grow (erupt), loosen and decay in their turn [1] [2] [3] [4] [5].

Premature wear of the other teeth: having missing teeth on one side (especially molars) will lead to unilateral chewing on the other side, where the teeth are present. As a result, there will be a mechanical overload on that same side which may lead to fatigue fractures in these more stressed teeth [10] [11].

3.2. Temporo-Mandibular Joint Consequences

If a tooth is missing and the adjacent teeth are bent over, or, more often, if several of them are missing backwards, then the lower jaw is no longer correctly seated and the joint on the side concerned is compressed. The consequences can be manifold: pain, buzzing, cracking or popping of the joint meniscus, muscle contractures.

Prevention of joint compression can be achieved by replacing missing teeth with a denture or implant-supported crowns [14] [15] [19] [20].

3.3. Bone Consequences

The loss of teeth leads to the loss of the supporting bone. Indeed, at the precise moment when a tooth is extracted, phenomena are set in motion that lead to the total, rapid and definitive destruction of this supporting bone. In general, after 6 months after extraction, 30% of the alveolar bone tissue has been resorbed. One year after extraction, 50% of this bone has melted away.

The dental implant, once inserted into the bone tissue, stimulates the bone and prevents its resorption, like the root of a natural tooth.

In the upper jaw, the teeth are anchored under the maxillary sinus.

The maxillary sinus is an air cavity located in the bone volume. Its purpose, while increasing resistance to fracture, is to reduce the weight of the skull. At birth, the volume of the maxillary sinus is approximately that of a pea. It quickly becomes pneumatized, growing by hollowing out the surrounding bone [37] [38].

Its extension is blocked by the roots of the premolars and molars located below.

When these teeth are extracted, the sinus resumes its progression and gradually destroys the surrounding bone. When the available bone height is too low,

the placement of implants is no longer possible. The sinus must first be pushed upwards [43] [44] [45].

The reconstruction of missing teeth is an aesthetic necessity but above all a functional one.

3.4. Dietary Consequences

The loss of teeth is an inseparable part of ageing. It is accompanied by a decrease in saliva production. Both are a source of difficulties in everyday life for those affected. In some cases, they force them to review their diet. This has consequences for their health.

Tooth loss promotes dietary changes and may be a risk factor for being underweight due to disruption of chewing potential and chewing time, associated with dietary changes leading to exclusion of some foods and excessive consumption of others [43] [44] [45] [52] [53]. Age-related loss of striated muscle mass (greater in the edentulous) and compensatory factors such as unilateral chewing also contribute to reduced masticatory efficiency. In addition, physiological atrophy of the mucosa, which is responsible for vulnerability to trauma and pressure during mastication, leads to the avoidance of certain hard and high-fiber foods [54] [55] [56].

Tooth loss is inevitable with age. A study in Germany confirms this. It involved just over 900 young adults aged between 35 and 44 and a thousand senior citizens aged between 65 and 74. The former group had an average of 25 teeth, while the latter had 14.

According to the above-mentioned study, 23% of the senior citizens in the observed group no longer have any teeth. This naturally leads to difficulties in chewing. In many cases, they are offered chopped and mixed food. Sometimes they are pureed [46] [47] [50] [51].

But this type of feeding is not always pleasing. The food becomes unappetizing, both to the eye and to the taste. To remedy this, texturizing agents and molds have been developed. Texturizing agents provide a better texture. The latter give shape to food that has been pureed.

However, feeding on chopped or blended products alone can create a vicious circle. When the chewing muscles are not used very much, chewing becomes increasingly difficult.

The reason why so much attention is being paid to this situation is that, in the long run, tooth loss and reduced saliva can lead to more serious problems. Both play an important role in digestion and nutrition.

Teeth and chewing muscles are involved in breaking down food into small particles. Saliva then helps to bind them together. It is also responsible for the perception of taste and the different sensations found in the mouth when food is introduced. These include juiciness, viscosity and astringency. Saliva is also useful for cleaning the mouth and removing remaining particles. It also helps to protect the teeth and gums from bacteria [37] [38] [43] [44] [51].

All of this can reduce their appetite and cause them to avoid certain foods.

This can lead to undernutrition and food deficiency.

4. Conservative Dental Care in the Elderly

Restorative dental treatment and endodontic treatment in the elderly must take into account the age of the patients, their psychological cooperation, and the age-related changes in enamel, dentin and pulp [21] [22] [54] [56].

In patients whose general condition requires short sessions, caries processes can be stopped by atraumatic restorative treatment, which consists of manual curettage of the carious tissue and obliteration of the cavity with glass ionomer [21] [22].

When teeth are extracted or missing, a dental implant is often the best option to restore the tooth.

But sometimes the patient may think “more teeth mean more problems” and this is not without consequences. Not replacing missing teeth carries health risks.

The effects of not replacing a missing tooth are numerous on the health of an individual. Here are some of the consequences:

- Raising, sinking or pulling away of the teeth in front of or next to the missing tooth;
- Shrinkage of the gums;
- Loss of bone material;
- loosening of the teeth;
- Sagging of the face;
- Chewing and joint problems;
- Headaches or migraines...

In order to prevent the situation from deteriorating, it is important to act quickly after the loss of one or more teeth in order to replace them.

Today, the best solution for replacing a lost tooth or a group of teeth is a dental implant.

-Treatment of tooth loss with dental implants:

Until a few years ago, the only option for replacing complete tooth loss was a removable denture. Uncomfortable and not always stable, this solution did not meet patients’ expectations, and was not at its best from an aesthetic point of view.

Today, excellent implant-based solutions exist to replace missing teeth.

The best option available depends on the patient’s situation and needs:

-Implant-supported dentures. In this case, 2 to 4 dental implants ensure the stability of the prosthesis and its fixation. This is a semi-fixed solution and the removable prosthesis must be removed for cleaning.

-Creation of a fixed bridge on several dental implants. In this case, 6 to 8 implants ensure stability and fixation. The final prosthesis is fixed and cannot be removed. If you have tooth loss and do not want a removable prosthesis, your dentist will suggest the best treatment to replace your missing teeth [14] [15] [19] [20] [46] [55] [56].

5. Conclusions

The ageing population is the most important social phenomenon of our time. This demographic change requires us to take preventive and curative care of oral health in geriatrics.

Practically all doctors are called upon to treat the elderly, whether they are general practitioners or specialists, in the office or in hospital. Care must be provided through increased multidisciplinary coordination of care by integrating dentists and by facilitating prevention through awareness-raising and training of medical and paramedical care staff.

The importance of the family is considerable. It is the natural setting for inter-generational relations, social solidarity, exchange of services and affection. As people grow older, inter-generational relations become more important. Any change in the family structure automatically influences the living conditions of the elderly.

Gerontology is a rapidly developing discipline in view of the ageing population. The health and aesthetic requirements of independent elderly people are higher today than they were twenty or thirty years ago. Practitioners must take into account the general state of health of the elderly, manage their specific health and aesthetic needs and adapt their approach to these often fragile patients.

Multidisciplinary care is then coordinated around a care project adapted to the physical and psychological capacities of the patient. The aim of the rehabilitation is to enable the patient to live as independently and autonomously as possible in a freely chosen and secure living environment.

The loss of this organ, which is essential for mastication, is not without consequences for health. It is therefore essential to have good oral hygiene. A regular visit to the dentist also seems necessary. It can be covered by health insurance and a dental mutual insurance.

Conflicts of Interest

The authors declare no conflicts of interest.

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