

Geriatric medicine gives **new impetus** to implantology

From anatomical and biological basics to dental practice

authors_ Werner Götz, Rolf Vollmer and Friedhelm Heinemann, Germany



Fig. 6

Fig. 6_ Leonardo da Vinci: Head study of an old and a young man from the beginning of the 16th century. A typical toothless face of an aged man (left).

_The increase in life expectancy and the drop in the birth rate are the main causes for demographic aging, especially in the industrial nations. In about 20 years nearly 40% of the German population will be older than 60 years. This signifies that gerostomatology will become increasingly important for practical dental medicine. Therefore, the knowledge of changes inside the oral cavity due to aging, and age correlated oral diseases are becoming more important. Whereas age-related facial phenomena have always been a reason for medical indication in plastic and esthetic facial surgery, the increasing number of senior citizens, who ask for an overall therapeutical concept for "dentofacial rejuvenation" requires an interdisciplinary view regarding the aging processes in face and oral cavity.

Dental implantologists are particularly in demand when it comes to interdisciplinary cooperation. It does not make any sense to perform a facelifting procedure, and postpone the restoration of teeth and the reconstruction of the stomatognathic system. On the contrary, first the oral cavity should be restored, and the function and esthetic of teeth should be recovered with fixed or removable dental prostheses. The

restoration should be carried out from the inside, working outwards.

_The biology of aging

Aging stands for the irreversible change of an organism, which is characterized by an accumulation of tissue and cell damage that leads to a progressing decrease in organ functions. There is a higher risk of disease and death, and the adaptability of the body regarding external and internal stress is reduced. So far, none of the 300 existing age-related theories can explain the phenomenon of aging adequately. Especially theories treating changes due to aging, which are based on cellular and molecular biological, and genetic levels are favored. Until now, clearly defined "age genes" that might cause aging have not been found in the human genome.

In human history aging has nearly always been equated with disease. Modern gerontology clearly distinguishes between the so called physiological (primary) age-related changes and geriatric diseases. Physiological aging, which is characterized by physiological regressive processes, and which stands for normal aging, differs from so called unimpaired aging, where even normal physiological losses are low. Among those people over 60, there is an increasing number of "healthy" aging persons, who state that they are subjectively feeling healthy. The causes for unimpaired aging are not only due to genetic disposition, but they also strongly depend on exogenic factors such as (healthy) lifestyle, mental vigour, and the socioeconomic status. In the future, these "young elderly" will increasingly be eager for qualitatively high standard restoration and "anti-aging" methods.

Secondary aging means that in addition to physiological changes due to aging, geriatric diseases appear. These diseases are correlated with aging and/or there is a higher risk of illness at a greater age. Among them are e.g. cardiovascular diseases, metabolic diseases such as diabetes melitus, degenerative diseases of the locomotor system or psychic diseases. Age-related oral diseases are e.g. xerostomia (dryness of the



Fig. 1 69-year-old patient: Anterior teeth of the upper jaw with age-related changes, e.g. recessions, yellow stains, enamel cracks in one tooth.

Fig. 2 65-year-old patient: Complete and almost caries-free dentition with age-related changes e.g. minor recessions, enamel cracks.

mouth), root caries and malignant oral tumors, and their premalignant lesions. It is disputed if parodontopathies, especially recessions and inflammatory changes, are correlated with age.

Typical age-related physiological organ changes do not only effect oral health in a wider sense, but also one has to consider holistic aspects when treating and advising senior citizens. Decreasing neuromuscular abilities due to increasing loss of bone and muscle volume, and the reduced nerve conduction speed may have an effect for example on handling dental prostheses. Also a reduced immunological competence regarding oral microflora, deafness and defective vision on compliance due to age, functional losses concerning the gastrointestinal tract, especially its motility, and eating behaviour affect oral health. Reduced functions of organs and metabolism lead to changed pharmacodynamics and kinetics in age, which have to be considered in dentistry when medicating antibiotics or in case of local anesthesia.

Dental and oral age-related changes

The differential diagnostical distinction of pathological oral changes in older patients implies the natural knowledge about physiological changes. It must be critically remarked that due to the lack of clinical and scientific studies, our knowledge about age-related oral changes is still quite incomplete. Individual variabilities in the aging of each person should also be considered. When looking at the whole natural dentition, shortenings of the dental arches are a typical age-related dental evidence as a result of lifelong mesial movement. It is important for restorative and

esthetic dentistry that a yellow staining appears on the teeth of older people (Figs. 1, 2), in case that the teeth are not already covered with exogenically caused pigmentation (e.g. in smokers). Especially in the region of the anterior teeth other phenomena are of great importance, e.g. loss of incisal edge contours, loss of marginal ridges or contouring of dental crown surfaces (Figs. 1, 2). Losses of hard substance in terms of abrasion, attrition etc. are no longer considered to be typical age-related phenomena in industrial countries, because in comparison with former times, the composition of food has changed significantly.

With increasing age dental enamel suffers from progressive embrittlement and hardening due to dehydration and compression of crystal structures, which clinically often appear in the form of enamel cracks (Figs. 1, 2).

The loss of organic components and the progressing hypermineralization imply dentin sclerosis. The age-related alterations of both hard substances lead to changes of the material characteristics which have to be considered for filling therapies, etching or in case of application of adhesive systems. The pulp cavity decreases due to the accumulation of secondary dentin (Fig. 3). The pulp tissue itself is subject to different age-related changes: The connective tissue becomes fibrotic, calcifications appear, odontoblasts degenerate and die off, nerves and blood vessels also degenerate (Fig. 4). Thus, the hemodynamics of the old pulp, the sensitivity, and the sense of pain are reduced. This might signify that the reaction time for cold pulp testing has to be longer than in younger patients. However, vitality and function of the pulpa can be retained to a very great age.

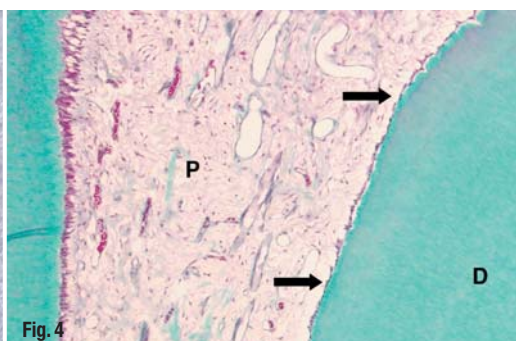
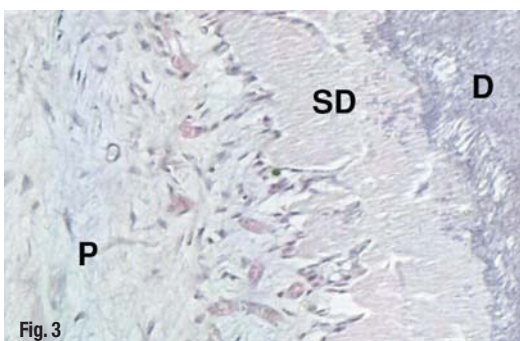


Fig. 3 Premolar of a 66-year-old patient (histological specimen): Apposition of secondary dentin (SD), P = pulpa, D = dentin.

Fig. 4 Molar of a 70-year-old patient: Histological specimen of the pulpa (P) with fibrosis, loss of odontoblasts (arrows), D = dentin.

Fig. 5 Molar of a 68-year-old patient: Histological specimen with hypercementosis: Annual ring-like apposition of cementum, PDL = periodontal ligament

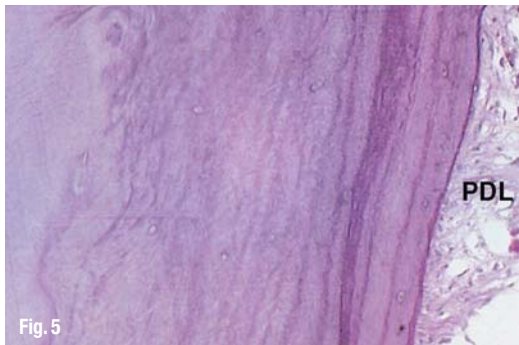


Fig. 7 77-year-old female patient: Residual dentition in the lower jaw, distal development of alveolar ridge atrophy and formation of the alveolar crest mucosa.



An age-related narrowing of the periodontal cleft can be explained with a longlife apposition of root cementum (Fig. 5), which in extreme cases can even lead to hypercementoses. Although in older patients the gingival stippling dwindles macroscopically, the gingiva only suffers minor changes. It is probable that the continuous humidification with saliva and its multiple anabolic factors have a positive effect. There is a controversial discussion whether it comes to apical migration of the junctional epithelium (passive eruption, Fig. 1, 2) in dentally fit older people with normal gingiva. These regressive changes are probably due to continuous, lifelong, and mostly subclinical phases of inflammatory changes with loss of attachment.

The question if there is a higher risk for gingivitis and periodontitis with growing age, cannot be answered precisely. It is known that within general gerontological immune changes also the lymphocytic defense may be affected. Even host reactions e.g. on lipopolysaccharides (LPS) are retarded in old age. The plaque of older people contains more immune factors e.g. IgA.

The only comprehensive clinical study regarding the state of the oral mucosa of older patients came to the conclusion that there were no structural and functional differences compared with the oral mucosa of young patients, provided that there were no local or systemic diseases present. In contrast to the facial skin (see below) the oral mucosa is not influenced by photoaging. Oral perceptions e.g. touch, temperature or pain are not or only slightly affected in old age. On a case-by-case basis the state of the oral mucosa strongly depends on individual and regional differences. Histological studies of epithelia of older people showed atrophies and hyperkeratoses as well. The dentist bears high responsibility in view of early detection of age correlated pathological changes of the oral mucosa, and especially with regard to malignant tumors, and premalignant lesions e.g. leukoplakia.

Saliva, mastication and deglutition in old age

It was long believed that saliva secretion, taste, mastication, and deglutition were reduced in older people with full dentition. There has been a change of

thinking thanks to numerous clinical and physiological studies that have been carried out during the last few years.

Though on the occasion of autopsies, considerable pathological changes of the oral salivary glands could be found even in generally healthy older people, studies showed that there was only a minor reduction of salivation rates. There were hardly any differences in quantity and composition of saliva compared with younger people. A change of salivary secretion e.g. a reduction (hyposialy) has to be considered to be pathological even in old age. The main reason for xerostomia (dryness of the mouth), which is caused by a reduced amount of saliva, is due to the intake of medication. More than 30% of the people older than 65 years suffer from this. Xerostomia is a frequent side effect of many pharmacological substances.

A good blood supply protects the tongue from heavy regressive changes in old age. Although taste buds diminish with increasing age, the taste hardly diminishes, contrary to the olfactory sense. There are no current studies that prove a significant difference in the perception of taste qualities in older people. Disorders in the perception of taste almost always have pathological causes.

Within the framework of muscular degeneration processes during physiological aging, the muscles of mastication, tongue and fauces also suffer from atrophies coupled with a loss of strength and tone. These changes are even more pronounced in toothless elderly people. However, current studies show a good functional preservation of mastication properties. Even toothless people or long-term denture wearers often still have functional reserve capacities. Minor losses can be found in older test persons especially with regard to oral motor abilities, so that the oral phase of the swallowing process may take longer. Considerable dysphagia (impaired deglutition) in older people is often symptomatic for a general disease e.g. diabetes, neurological diseases or tumors of the upper intestinal tract.

Edentulism and the aged face

In former times there was no clear distinction between age and disease, aging was put on the same

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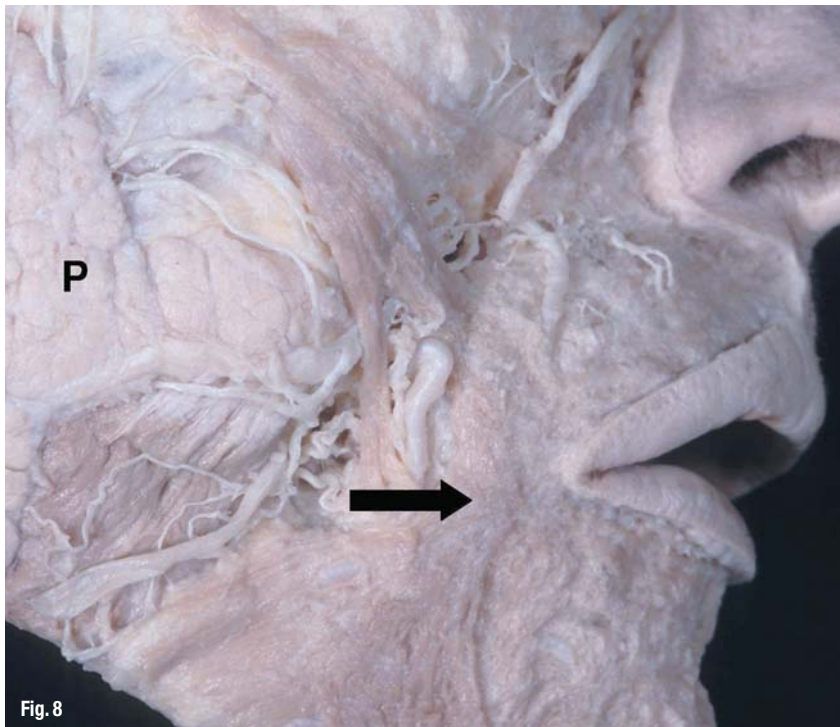


Fig. 8

Fig. 8 Anatomical specimen of the superficial lateral face region, arrow: Modiolus, P = Parotis.

level with loss of teeth. Historical illustrations mostly show old people, with a typical aged face, which is a consequence of edentulism (Fig. 6). In industrial countries at least, improved dental restoration and successful prophylaxis have made it possible that an increasing number of senior citizens retain a complete and caries-free natural dentition until a very great age (Fig. 2). Therefore, an increasing loss of teeth is not necessarily attributed to age.

However, the effects of demographic aging will be so eminent that one cannot expect a decline in edentulism in the German population until 2020.

According to DMS IV (Deutsche Mundgesundheitsstudie IV, German Oral Health Study) of 2006, 23% of the people between 65 and 74 years of age were affected. Field studies showed that independent of the age, the main causes for loss of teeth are still caries and periodontopathies. Current studies even suggest that edentulism may be a risk factor for cardiovascular diseases, chronic infections, malignoma of the upper intestinal tract and perhaps also for senile dementia.

The typical age-related changes of the edentulous jaw, which lead to alveolar ridge atrophy in form of disease disuse atrophy by developing a jaw ridge, are of special interest for prosthetics and implantology (Fig. 7). Long-term sequelae can be seen in the architecture of the jaw and facial bones: Shortening of dental arches, divergences of dental arches, anterior rotation, and the formation of prognathic relation ("witch chin"), reduction of anterior face height and vertical dimension of occlusion etc. (Figs. 6, 8). The insertions of the masticatory muscles shift, and a flattening of the vestibule, and

a probable mouth floor elevation may be the consequence. The so called alveolar ridge skin mucosa derives from the dentate parts of the gingiva, and appears as a firm, fixed or mobile, unfixed mucosa (Fig. 7).

The face in old age

The ever visible face often plays a more important esthetical and thus psychological role for elderly people than teeth and oral cavity, which cannot be seen with the closed oral rim. Apart from the bony (osseous) basis, the soft tissue parts (jaw and mimic muscles, subcutaneous adipose tissue, skin) are very important for the aging process. There are many factors e.g. gender, nutritional status, individual disposition for general diseases that influence these processes. Some exogenic factors e.g. smoking, alcohol, and solar radiation have negative effects. The loss of teeth and the resulting changes of the osseous relations and the atrophy of facial bones intensify the aging appearance of the facial soft parts and present the image of the aged face (Fig. 6, 8).

The loss of osseous and dental support due to edentulism and the age-related loss of the muscular tone lead to a so called perioral collapse. The modiolus, a nodular ligament bundling the mimic muscles of the lower and middle face (Fig. 9) shifts to caudal. The consequences are lip inversion and the decrease of the vertical dimensions of the upper lip. Additional age-correlated lip changes such as a general reduction of the lip volume together with the loss of the lip vermilion, or the fading of the lip vermilion due to decreased vascularization, the flattening of philtrum and cupid's bow, or hanging labial angles have quite a negative influence on the appearance of the lower face (Fig. 10). The decreasing elasticity of the upper lip of elderly people with full or partial dentition implicates that the lower anterior teeth become more visible when opening the mouth. Numerous fine wrinkles spreading radially from the lips are common in elderly smokers. Angular cheilitis is quite often found in senior citizens with lip changes.

Implantological restoration for aging patients

The demographic development, and the loss of teeth at a greater age increase the need for implantological restorations in elderly patients. On the one hand patients do not want to accept removable prostheses, and on the other hand due to a late loss of teeth, adaption to a full prosthesis is often impossible. Even patients who had worn a full prosthesis for a long time, often require implant supported, fixed or removable prostheses, especially af-



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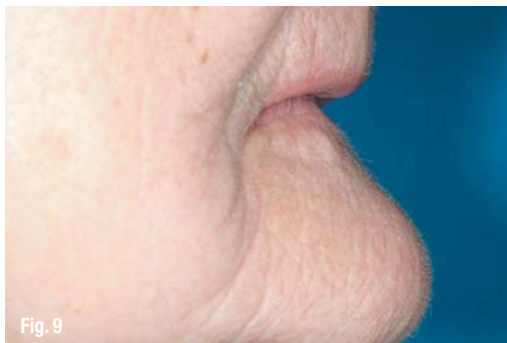
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Fig. 9 75-year-old female patient: Profile of the lower face: "Witch chin".

Fig. 10 81-year-old female patient: Appearance of the lips in edentulism.



ter their full prosthesis has become insufficient due to anatomical changes or physiological aging. The psychological effect is also important. The full prosthesis, which many people know from their parents and grandparents, is negatively associated with age. Therefore, many "young elderly" favor implant restorations.

There are no medical and scientific reasons for an age limit with regard to dental implants. Clinical studies of recent years have shown that neither age, nor most of the age-related diseases, bear any risk factors for implant prognosis. This is also the case for parameters such as the stability of the implant or periimplant resorptions. In addition to the medical history (anamnesis), a corresponding frequency of certain diseases and multimorbidity, some facts have to be taken into account: With regard to older patients one has to look at the generally reduced blood flow (circulation) and the changes in the gingival region. Peculiarities within the operative site must also be considered.

The lower jaw bone of young patients is internally and externally supplied with blood. In elderly patients the blood vessels of the bone atrophy, so that the blood circulation can mostly be guaranteed by the periosteum. Thus, the jaw bone should only minimally be deperiosteated during surgery. Given the ideal case and manageable conditions, even a stamping technique may be possible. Of course prosthetics also have to be adapted to the conditions of elderly people. In general one has to count on limited fine motor skills, which are often due to health impairments e.g. stroke aftermaths. In those cases it is convenient to refrain from complicated bolt constructions and favor e.g. telescope or conical telescope crowns, which can easily be removed and cleaned. Concerning the increasing number of elderly people with implants, one has to keep in mind, if or to what extent the risk of periimplantitis for this group of patients will play an important role in the

future. The age-related changed immunology may have a negative influence on this.

Meanwhile expert associations have realized that gerostomatology or geriatric implantology will become more important in the near future. Accordingly the German Association for Dental Implantology (DGZI) has developed a special study group modul for geriatric implantology.

_Conclusions for everyday practice

Dentistry is becoming more important, especially for senior citizens and as a consequence there is an increasing demand for dental implants. With respect to general anamnesis and determined age-specific changes, the aging patient can be treated well and adequately, also allowing for his or her fine motor skills. We even talk about the "young elderly", who want to retain their lifestyle without being bothered by removable and loose dental prostheses. Gerostomatology and especially geriatric implantology will become more important in the future, since edentulism will considerably decrease in younger people in the coming years.

References

This publication is a reviewed, updated and especially dedicated to implantologists version of the following article by the first-mentioned author:

Götz, W.: Gesicht und Mundhöhle im Alter. *Face* (1/2007), pp. 8–14

A reference list is available on request from the first mentioned author.

_Figure sources

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<p>Prof Dr med Werner Götz Rheinische Friedrich-Wilhelms-University Bonn Dental Clinic Department of Orthodontics Oralbiological Research Laboratory Welschnonnenstr. 17 53111 Bonn, Germany Phone: +49-2 28/28 72 21 16 Fax: +49-2 28/28 72 25 88 E-mail: wgoetz@uni-bonn.de</p>	

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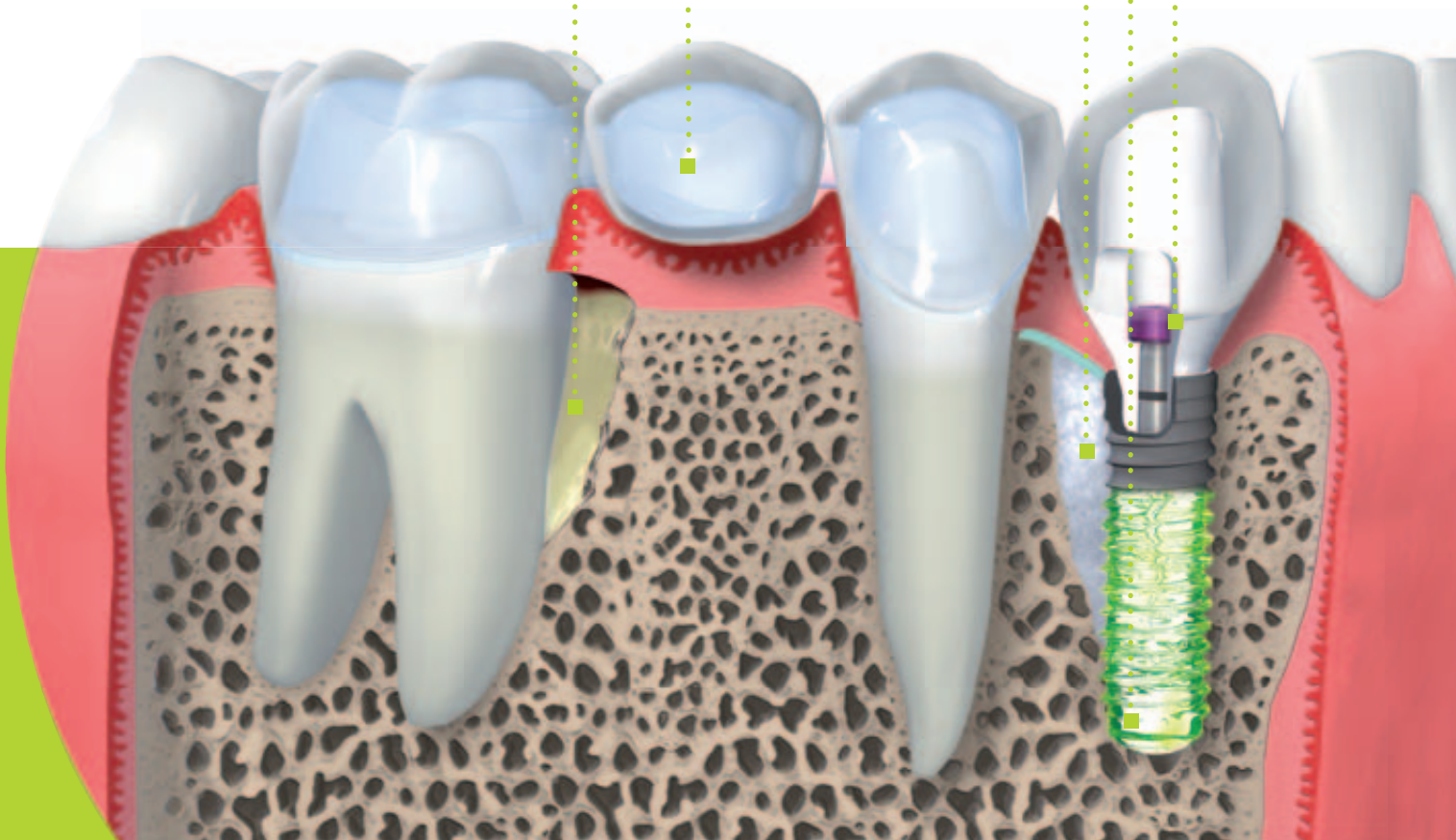
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