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2-я КАФЕДРА ТЕРАПЕВТИЧЕСКОЙ СТОМАТОЛОГИИ

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ГЕРОНТОСТОМАТОЛОГИЯ

GERIATRIC DENTISTRY

Учебно-методическое пособие

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Представлены характеристика стоматологического статуса пожилых людей и научно обоснованные методы лечебно-профилактической помощи населению старших возрастных групп.

Предназначено для студентов 5-го курса медицинского факультета иностранных учащихся, обучающихся на английском языке по специальности «Стоматология».

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MOTIVATIONAL CHARACTERISTIC OF THE THEME

Total time: 70–90 minutes (seminar).

The populations of many countries in the developed world are characterized by large segments of aged persons. Today, while ageism remains ingrained in our daily lives, there is a growing emphasis on productive, successful, or healthy aging. Dental professionals will need to be well schooled in the risk factors associated with oral health conditions of older persons, specific disorders and diseases, and therapeutic and preventive evidence-based interventions to knowledgeably respond to the imperative presented by the aging demographic revolution.

The purpose of the seminar: to integrate knowledge about the features of dental status in the elderly and to determine the scheme of effective methods of therapeutic and preventive dental care.

The tasks of the seminar. The student should know:

1. Age-related changes of the oral organs and tissues.
2. Epidemiology of the main dental diseases in the elderly population.
3. Features of dental caries and pulp diseases in the elderly.
4. Distinctive features of periodontal and oral mucosa diseases in the elderly patients.
5. Methods of examination in the elderly.
6. Psychosocial problems of geriatric dental services.
7. Algorithm of the provision of dental care to the elderly.

Requirements for the initial level of knowledge. For full understanding of the topic the student must revise:

– from human anatomy: anatomical features of the oral cavity;

– from histology, cytology, embryology: morphological structure of enamel, dentin, cementum, periodontium and oral mucosa;

– from therapeutic dentistry: clinical features of dental diseases, dental examination and treatment planning.

Control questions from related disciplines:

1. Anatomical structure of teeth.
2. Blood supply and innervation of teeth and periodontal tissues.
3. Histological structure of enamel, dentin, cementum, periodontium and oral mucosa.
4. Clinical features of dental caries, pulpitis, periodontal and oral mucosa diseases.
5. Principles of prevention and treatment of dental diseases.

Control questions for the seminar:

1. Principles of geriatric medicine and dentistry.
2. Tendencies of oral diseases in the elderly population.
3. Age-related changes of the oral organs and tissues: enamel, dentin, cementum, pulp, periodontium, jaw bones, oral mucosa, tongue, salivary glands.

4. Clinical features of dental caries and non-carious lesions in the elderly. Methods of prevention and treatment.

5. Clinical features of periodontal diseases in the elderly. Methods of prevention and treatment.

6. Xerostomia, its complications, methods of prevention and treatment.

7. Clinical features, treatment and prevention of oral mucosa diseases in the elderly patients.

8. Treatment plan and treatment options for the elderly patient.

9. Prosthetic evaluation and prosthodontic care.

10. Disability in the old age and problems of geriatric dental services.

INTRODUCTION

The provision of excellent oral health care to an increasingly aging population requires effective approaches to patient evaluation. Dentists are working with an ever larger number of frail or functionally dependent older adults, many of whom have got extensive medical problems, take multiple medications and have complicated psychosocial issues that can significantly affect the prognosis of dental intervention. Thus it is critical that dentists take a consistent and systematic approach to patient assessment. Competency demands that clinical assessment should be the keystone in geriatric dental practice.

Principles of geriatric medicine

"Old people are sick because they are sick, not because they are old"

Ferguson Anderson

"Old people have lost all their teeth because they had dental disease, not because they are old"

L. C. Niessen

Certain fundamental principles provide the foundation for the competent practice of geriatric medicine and dentistry:

- Age-related changes
- Disease-related changes
- Interactions of age and disease
- Disease chronicity
- Atypical presentation of disease
- Multiple pathology
- Multiple medications
- Functional loss.

ORAL EXAMINATION AND ASSESSMENT

A comprehensive oral assessment includes a detailed oral health history, evaluation of extraoral, perioral and intraoral structures and conditions. Although methods may vary among individual practitioners, a consistent approach should be used from one patient to the next to assure completeness.

Patients should also be queried on their compliance with preventive oral health behavior (e.g. brushing, flossing, use of fluoridated toothpaste, fluoride mouth rinse), as well as their ability to chew (with removable prostheses, and if they currently use them), taste and swallow. Finally, it is helpful to know satisfied patients are with their smiles and if they would like to improve their oral aesthetics.

Extraoral clinical examination

When the dental history interview is completed, the next general step in the assessment process is a detailed extraoral clinical examination of the head and neck.

Facial form

Examine: symmetry and size of eyes, nose, mouth and ears; facial profile of maxilla and mandible; skin color; swellings (unilateral or bilateral).

Consideration: Light skin color may suggest susceptibility to skin cancer; unilateral swelling may represent a cellulitis or salivary gland tumor; bilateral swelling could implicate Sjongren's syndrome, masseter muscle hypertrophy or cherubism. Asymmetry of the neck may represent a benign or malignant tumor (e.g. lymphoma).

Skin

Examine: pigmentation; color; texture; elasticity; presence of oedema; nodules; ulcerations; scars; or other surface aberrations. *Considerations*: bluish-black pigmentation may represent bruising; yellow or red pigmentation could imply jaundice or vascular lesions, respectively; texture changes can be a result of wear and tear or altered thyroid status; dehydration may cause elasticity loss. Systemic diseases may induce petechiae, cyanosis, flushing, pallor and eruptions.

Hands

Examine: size, shape, flexibility, movement. *Considerations*: disfigurement of joints and digits due to rheumatoid and osteoarthritis ability to provide adequate oral hygiene independently, swelling of joints and tissues. Lack of mobility may be a manifestation of a CVA (cerebrovascular accident or stroke).

Hair

Examine: color; texture; and distribution. *Considerations*: systemic diseases may alter hair color and texture; watch for sudden hair loss.

Eyes

Examine: sclera; lens; size and characteristics of eyes and lids; conjunctiva. *Considerations*: red sclera/allergy and yellow sclera/jaundice; opacities in the suggest poor patient vision; exophthalmos and redness or ulcerations of conjunctival surfaces may represent signs of systemic disease.

Ears

Examine: anatomy and palpation. *Considerations*: anomalies may suggest mastoiditis; referred mandibular molar pain; myofascial pain dysfunction syndrome.

Lymph nodes

Examine: size, tenderness and mobility. Use bimanual technique. *Considerations*: preauricular or postauricular lymphadenopathy may suggest infections of scalp, eyes or temporal or frontal areas. Submental, submandibular or cervical nodes portend oral or pharyngeal infections, autoimmune diseases or tumors (benign or malignant).

Temporomandibular joint (TMJ) and muscles of mastication

Examine: tenderness, joint sounds, maximum opening distance and jaw movements. *Considerations*: pain, crepitus, clicking, trismus or deviations when opening or closing may suggest muscle dysfunction, internal joint inflammation or derangements, neoplasm, trauma, arthritis, dislocation, ankylosis or arthrosis.

Parotid gland

Examine: anatomy and surface characteristics, clarity, consistency and amount of secretion. *Considerations*: enlargement, nodules and pain.

Sinuses

Examine: palpation and percussion testing. *Considerations:* sinusitis and referred maxillary molar and premolar pain.

Neck

Examine: visual inspection and palpation. *Considerations:* thyroid enlargement; jugular vein distention, use of accessory muscles of respiration; lymphadenopathy, forceful pulsation (hypertension or thyrotoxicosis); and expansive pulse (aneurysm).

Breath

Examine: poor hygiene, periodontal disease, caries, chronic sinusitis, acute necrotizing gingivostomatitis (ANUG), hairy or coated tongue, systemic diseases (diabetes, uraemia, upper respiratory tract disease) and external factors (alcohol, drugs, garlic).

Intraoral and perioral soft and hard tissue examination

Soft tissue and dry mouth evaluation

The lips and the corners of the mouth are usually examined first for mucosal changes (ulcers, erythroplakia, leukoplakia, exophytic lesions), areas of swelling or enlargement and evidence of actinic cheilitis (degenerative changes, especially in the vermilion of the lower lip). The corners of the mouth may have inflammation and redness, a crusty appearance or fissures characteristic of angular cheilitis. Herpes simplex, squamous cell carcinomas, trauma and chancres are all atypical findings.

Areas of tenderness and induration should be identified by palpation of the buccal mucosa and mucobuccal folds. Assessment of lesions, color and salivary duct openings opposite the second maxillary molars (Stensen's duct) is necessary.

Long-term use of corticosteroids, antibiotics and cytotoxic agents may be associated with the presence of opportunistic Candida albicans infection. These lesions are typically soft, white and slightly elevated non-fixed plaques but may also be areas of erythroplakia.

The dorsal, ventral and lateral surfaces of the tongue (which is handled with a gauze square) should be closely inspected for atypical size, color, papillae, coatings, lesions and tremors or movements.

Tooth structure loss, caries and restorations

Attrition (occlusal wear), erosion and abrasion (non-occlusal frictional factors) and resultant tooth structure loss are very prevalent in older adults. Approximately 75 % of elderly people had the incisal or occlusal enamel lost to attrition. Abrasion had resulted in notable loss of tooth structure in 30 % of elderly.

Both coronal and root caries are prevalent in older adults (fig. 1). Factors influencing this high rate included misaligned and shifting teeth, faulty restorations, recession of gingival tissues, mouth dryness, medications, poor oral hygiene, change in diet and partial denture design or clasps. Identification of these carious lesions is accomplished by careful clinical and radiographic examination.

Fig. 1. Active coronal and root caries in mandibular teeth

Root caries is usually found on virgin root surfaces exposed by gingival recession, but may also be adjacent to previous restorations. Buccal and proximal are the most common sites for root caries lesion, which generally develop coronally to the current gingival margin. The gingival pocket is the site of only a few lesions. These subgingival root caries lesions may be located proximate to marginal gingival inflammation. They may initially appear as small round lesions that spread laterally and coalesce to form a collar around the tooth. These lesions undermine the enamel by creating a ledge but do not directly affect the outer enamel. Enamel fracture is facilitated by more advanced lesions which gives the impression that the caries developed both in the root and coronal portion of the tooth. Such lesions are often found under moderate to heavy accumulations of plaque and much less frequently under presence of only pigmentation or stain.

When potential root carious lesions are evaluated, modification of the standard approach to coronal caries detection should be considered. Cementum seems to present the tactile sensation of yielding to the explorer tip under firm pressure be-

cause it is less dense than enamel. To distinguish carious from sound cementum, it is necessary to feel for greater comparative softness associated with the lesion as well as easy explorer removal with no withdrawal resistance or sticking.

The periodontium

Several parameters must be considered and recorded in a thorough periodontal examination. These include the location and degree of gingival bleeding and inflammation, and associated plaque and calculus build-up (slight, moderate or heavy). The relative positioning of opposing and proximal teeth, as well as inadequate proximal contact and marginal ridge relationships, should be examined and charted. These areas can be identified by impaction of food. All remaining teeth should be charted using 6–8 periodontal probings per tooth pocketing as well as recession to calculate periodontal attachment loss. The anterior teeth mobility may be tested by placing the handles of the dental mirror on both the lingual and labial surfaces to transmit alternate directional force. Vertical displacement is elicited by pressure on the occlusal or incisal surface. A large sickle scaler can be used to exert directional force to assess posterior teeth.

Bone loss with bifurcation or trifurcation involvement with multirooted teeth should also be recorded. Classifications are: Incipient — slight bone loss; Class 1 — definite bone loss; Class 2 — moderate to severe bone loss extending deeply under the tooth; and Class 3 — through and through, i.e. very severe bone loss extending from one furcation entrance to another.

A specific periodontal diagnosis (such as normal, gingivitis or periodontitis: early, moderate or advanced; localized or generalized) should be recorded for each tooth. In addition, serous, purulent or bloody discharge from periodontal pockets upon palpation should be noted. Buccal or lingual swelling and additional evidence of periodontal abscess formation, should also be recorded.

Alveolar ridge

Extensive alveolar bone changes are common in partially or fully edentulous elderly people. The mandibular alveolar crest height loss can approach 1 cm. The dentist should determine and record alveolar ridge characteristics, including the shape, size, alveolar mucosa integrity, tuberosities, interarch distance and the degree of bony resorption associated with tooth loss.

Occlusion

There should be a clinical and laboratory component to the occlusal examination. During opening and closing of the mouth, deviations and deflections associated with maxillary and mandibular midlines should be checked. The maximum opening can be measured with a Boley gauge or a plastic prosthodontic ruler (40–60 mm is the normal range). The Boley gauge can also measure overbite (maxillary and mandibular incisor vertical overlap), overjet (maxillary and mandibular incisor horizontal overlap) and intraocclusal distance (the difference between the vertical dimension of rest position and the vertical dimension of maximum intercuspation). Dysfunctional occlusion can be identified by tooth mobility and migration; pain in the

TMJ, periodontium or tooth; alterations in the lamina dura; widening of the periodontal membrane space; and atypical occlusal wear.

Diagnostic aids

Radiographic evaluation is one of the more important diagnostic tools in oral assessment. Radiographs are invaluable in identifying caries, periapical lesions, periodontal disease and intraosseous lesions when coupled with clinical examination and case history. Radiographs also aid in evaluating the sinus, preprosthetic assessment identification of trauma and detection of other abnormalities.

There are several recommendations for effective radiographic assessment. Radiographs cannot replace a complete clinical examination, including patient history. Radiographs should be individualized and based on high-yield selection criteria, including previous periodontal or endodontic therapy, the presence of implants, clinical evidence of periodontal disease or deep carious lesions, a history of pain or trauma, swelling, tooth mobility, a deep or large restoration and the presence of other intraoral findings such as salivary hypofunction.

When evaluating restorative, periodontal and endodontic needs, panoramic radiographs are usually less effective than intraoral films. For dentate patients, the initial examination usually requires a comprehensive set of radiographs (bitewing and periapical radiographs). Vertical bitewing radiographs may be helpful in identifying interproximal root surface lesions, but not buccal or lingual surface root surface lesions. It may be difficult to recognize recurrent or secondary caries in older adults because radiopaque restorations may mask new lesions. Proper vertical angulation is necessary to obtain diagnostic radiographs. A cupped-out or notched-out appearance of an ill-defined radiolucency may identify root caries. Cervical burnout may occasionally be misinterpreted as cemental caries, and precise clinical examination is necessary if in doubt. Dentate recall patients at lower risk (no caries within past 2 to 3 years and no periodontitis) should have posterior bitewings at 2-to 3-year intervals, whereas patients with high caries risk need them every 12 to 18 months.

The radiographic display of the pulp is important in identifying calcifications, evidence of resorption, periapical lesions (fig. 2) and diminished chamber size.

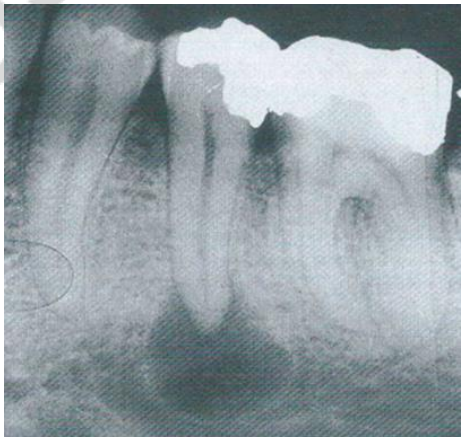

Fig. 2. Radiograph of lower left second premolar demonstrating significant periapical pathology

Periapical and bitewing radiography is used to determine the level of supporting bone. The lamina dura (a thin radiopaque line) that surrounds the roots of the teeth should be closely inspected. Periodontal disease may be implied by a lack of continuity. Traumatic occlusion may be indicated by a widening of the periodontal ligament space at the apex and contralateral side. Wide periodontal spaces suggest mobile teeth. If bone levels are more than 1.5 mm apical to the cementoenamel junction, the diagnosis of horizontal bone loss can be made. Periodontal recall patients should have individual examination using periapical and/or bitewing radiographs.

Panoramic radiographs, however, play a very important role in the examination for pathological conditions that are not visible clinically or with intraoral radiographs. A current panograph (within 6 months) should be considered by the dentist prior to the fabrication of complete dentures.

Pulp assessment is necessary when patients complain of pain, when radiographs display periapical radiolucencies and when there is soft- tissue swelling or fistulas. It is also required when the tooth is discolored and prior to crown preparation or the abutment designation of fixed or removable prostheses. Hot and cold thermal testing can aid in the diagnosis of pulpalgia, both moderate and advanced. Electric pulp testing is probably the most effective method of determining pulp vitality in younger patients. However, for elderly people, the positive and negative predictive value of pulp testing (likelihood that the tooth is vital when it tests positively and likelihood that the tooth is non-vital when it tests negatively) is not as consistent.

Laboratory testing is an additional method of assessing older patients. Some laboratory tests can be performed in the dental office while others require referral to a laboratory or physician. Laboratory tests, stemming from chairside recognition of systemic and local pathological processes, can provide valuable information for the dentist in making the diagnosis. These tests include microbiological testing (direct examination of oral specimens, throat cultures, antibiotic sensitivity tests, caries activity tests, oral candidiasis cultures and root canal and root apex cultures); blood tests, including blood sugar, serology, haematology, blood chemistry and immunohaematology; urinalysis to test for renal diseases, diabetes mellitus and hyperthyroidism; contact allergy testing; oral exfoliative cytology; and oral biopsy, excisional and incisional with aspiration.

Biopsy is the most accurate method of diagnosing soft-tissue lesions. If the dentist is not comfortable performing the biopsy, the patient may be referred to a dentist who is more familiar with soft tissue biopsies (e.g. oral medicine specialist, oral pathologist, oral and maxillofacial surgeon). Excisional biopsy is the best method for relatively small, well-defined lesions, although oral pathologists do not need a large specimen for accurate diagnosis. Multiple incisional biopsies may be indicated for larger or diffuse lesions. Oral exfoliative cytology, fine needle aspiration (FNA), brush biopsy, vital dyes and stains (toluidine blue), chemiluminescence, fiber-optic transillumination and direct optical fluorescence may also be used for diagnostic reasons.

Prosthetic evaluation

A careful evaluation should be made in situations where missing teeth require restoration for optimum function. Decisions on when and how to restore edentulous areas should be made after careful examinations of the maxilla and mandible and their existing skeletal and dental relationships. Impressions and mounted study models are essential to this assessment, as are the appropriate radiographs (including CT scans if implants are considered).

When existing prostheses are present, they should be carefully evaluated. Patient speech patterns should be noted initially. Inadequately articulated *'5'* sounds as well as clicks and whistles may denote several problems: significant soft/hard tissue changes that have occurred since the prosthesis was fabricated impaired oral-muscular function or an improperly fabricated denture. The esthetic appearance of the dentures should also be examined. When the prosthesis is removed, evaluate for: (1) denture defects (cracks, missing teeth, worn teeth or denture base); (2) denture adhesive usage; (3) the presence of denture identification; and (4) the presence of food debris, plaque or calculus. Clinical examination for potential prosthesis-related pathology is also important. This includes angular cheilitis, denture stomatitis, traumatic ulcers, inflammatory and peripheral hyperplasia, severe alveolar ridge resorption and movable fibrotic tissue (epulis fissuratum).

When the prosthesis is reinserted, the functional aspects of the denture should be assessed. They include: (1) stability (resistance to pressure applied in a horizontal direction); (2) retention (resistance to pressure applied in a vertical direction); (3) the vertical dimension of occlusion (the amount of interocclusal distance available); (4) occlusal contacts; (5) peripheral border extensions; and (6) the relative positioning of maxillary and/or mandibular prostheses (fig. 3).

Fig. 3. Severely worn prostheses with subsequent dysfunctional shift in mandibular position

Patient perception is also very important. Queries should be made regarding satisfaction with denture aesthetics, function and comfort as well as any desire for receiving additional prosthodontic treatment to address deficiencies. It is conceivable that important mitigating factors (for example, the patient's perceived needs, severe residual ridge resorption, severe impairments, mouth dryness) may overrule treatment for objective prosthesis deficiencies.

ORAL DISEASES AND RISK FACTORS IN THE AGED PATIENTS

Dental caries

Sugars

Dental caries occurs as a consequence of interactions between bacteria on the surface of teeth and within demineralized enamel and dentine and fermentable carbohydrates in food. The bacterial biofilm begins to form on the surface of a tooth immediately after it has been cleaned, but the biofilm (dental plaque) does not reach acidogenic *maturity* until it is about 4 days old. Mature dental plaque has a characteristic microbial flora and is capable of metabolizing some carbohydrates to produce acids. The microbiology of dental plaque is complex and is discussed elsewhere, but our understanding of this process is expanding continuously as molecular biology techniques permit the identification of bacterial species within plaque which currently cannot be cultured by conventional means.

Sugars are an inescapable component of all diets and yet they are also causatively linked with tooth decay. However, there are fewer data linking decay in older adults to sugars consumption.

Is frequency or quantity of sugars intake important?

Sugars that are taken into the oral environment can be metabolized by plaque bacteria to produce acids. The acid in turn results in a reduction in pH on the surface of the tooth causing demineralization and potentially caries. The oral environment is very effective at remineralizing tooth structure providing that salivary function is maintained. However, it takes time for the oral and plaque pH to rise above the demineralization threshold for tooth tissue, particularly dentine and it takes time for the remineralization to occur. Hence there is a maximum number of de- and re-mineralization cycles that the natural defense mechanisms of the mouth can cope with. If the total number of episodes of demineralization exceed this maximum the outcome will favor overall demineralization of tooth tissue, which can manifest itself as either caries or erosive pattern tooth wear. Within limits, the absolute quantity of sugars that are consumed at any one time are irrelevant to this relationship. There is no evidence on what frequency of sugars intakes might be regarded as safe for preventing caries in older populations. The 'rule of thumb' for young people is four sugars containing intakes per day but the increased risks seen in older people, particularly those with dry mouth, may make even this level unacceptable. It is of note that the mean number of sugars intakes daily for the 'free-living' 65+ population in the UK was 5.1, rising to 7.9 for the 'institution' sample in the 65+ National Diet and Nutrition Survey. It was in this population that frequency of sugars intake was associated with root caries activity. There are no data relating to coronal caries activity and sugars intake for older people.

Alcohol

Alcoholic drinks also contain sugars which can initiate decay and acids which also dissolve tooth tissue. This increased acid burden in the mouth associat-

ed with generalized neglect in individuals who become addicted to alcohol can result in very extensive carious lesions on multiple teeth.

Smoking

Smokers have a higher incidence of caries than past or non-smokers. The mechanism for this phenomenon is unclear; a salivary link is unlikely as they show greater levels of output than non-smokers. However, smokers are more likely to consume sugars-containing drinks and snacks than non-smokers; furthermore, their oral hygiene tends to be poorer. These effects influence both coronal and root surfaces of teeth.

Erosive or acid-mediated dissolution of tooth tissue

This term is usually used to describe loss of tooth structure from acid which is not a metabolic product from sugars by bacteria in dental plaque. The acids involved can be either extrinsic, usually from foods/drinks or intrinsic, as a result of Gastro Esophageal Reflux Disease. There is no epidemiological evidence linking loss of tooth structure in older adults and dietary acid; there is compelling evidence from national surveys of children's and adults' dental health from the UK of high levels of erosive pattern tooth tissue loss. Whilst acids soften tooth substance, physical removal of that softened surface is thought to occur through contact with foods or by tooth to tooth contact. The patterns of tooth wear in older people reflect a life-time's exposure of teeth to acids, oral functional contacts and often dental care, making the identification of specific causality in a cross-sectional study very difficult. The extent and severity of erosive pattern wear that is seen in younger people is of particular concern for the future. Such wear is irreversible and will pose a long-term management problem for the remainder of the lives of the individuals concerned.

Periodontal disease

This is a chronic inflammatory process. As a disease process driven by inflammation, it is susceptible to those variables which influence the chronic inflammatory response. There is an increasing evidence for the role of reactive oxygen species (ROS) in moderating the effects of inflammation and hence interest in the antioxidant activity in peripheral blood. The effect of ROS seems to extend beyond simple interactions with tissues as they are also thought to be implicated in the mechanisms for increased tissue destruction in both smoking and type II diabetes. There have been attempts to affect the severity of this disease with both local and systemic application of antioxidant supplements; however these have shown limited benefit as yet. There is some evidence for vitamin C depletion and replenishment having a moderating effect on gingival bleeding in periodontally healthy individuals.

Smoking

There are strong links between periodontal attachment loss and smoking. Smoking not only influences the development of and flora that comprise dental plaque but it also exerts direct effects on the tissues, modifying the blood flow

through these tissues and influencing fibroblast function. It also affects the immune responses which are key to defense against any inflammatory disease.

These effects occur with both smoked and smokeless tobacco, but are reversible within disease pathogenesis so that treatment outcomes are improved in those who stop smoking compared with those who continue, although the effects of smoking impact on periodontal outcomes for up to 10 years after cessation.

Oral health and foods choice

Chewing efficiency, digestion and foods choice

Teeth serve a primary function in foods consumption: breaking down large pieces of food into smaller particles and mixing them with saliva to allow a bolus of food to be formed for swallowing. This comminution of food along with salivary enzyme activity, is an important component of the initiation of digestion of foods.

The process of breaking up food and converting it into a bolus to be swallowed is associated with the release of tastants from the food enhancing our enjoyment of the things we eat.

Impaired chewing function will affect all of these components. People with poorer masticatory function are less efficient at breaking food down to facilitate bolus formation. They tend to use fewer chewing strokes and 'accept' larger food particle sizes in the food bolus prior to swallowing. Whilst there are no documented problems associated with this, there could be an increased risk of choking in people who chew their food less effectively and who also have impaired swallowing, for example people with dysphagia post stroke.

Saliva is also critical to this process. However, those individuals who have reduced salivary flow, through disease of the salivary glands, radiation damage or as a side effect of drugs, will experience increasing challenges in terms of chewing and swallowing (as the lubricant effect of saliva will be less) and of forming food particles into a bolus for swallowing as saliva is the *glue* which holds the bolus together.

The number and distribution of remaining natural teeth and/or the presence of complete or partial dentures are likely to influence the ease of chewing. There is a particular problem when trying to chew with conventionally retained dentures where the prostheses are controlled by the oral musculature and the forces of adhesion and cohesion between the salivary film between the denture base and the oral mucosa. Food particles will act as a profound destabilizing influence during chewing as forces are applied eccentrically to the dentures so stabilizing pressure is required from the tongue musculature. This is a difficult learned skill which is easily lost if dentures are left out of the mouth for any period of time (for example during periods of illness), furthermore it is a skill that is likely to be more difficult to learn with increasing age. The current trends in tooth loss would suggest that the age at which people are being rendered edentulous is progressively rising.

If edentulism is one of the key determinants of oral function it is worth noting that a proportion of older dentate people are edentate in one arch (predominantly the upper). There are few data on the prevalence of this pattern of oral health but proportions of 2.7 % for the adult population in Switzerland and 23 % over 65s in the UK have been reported. These individuals function in a similar manner to those who are edentulous. People who are edentulous in the lower jaw and function with denture against some natural teeth in the upper jaw report more problems with chewing and swallowing foods than any other combination.

Masticatory efficiency

Variables which influence the ability to break down foods by chewing are usually assessed by measuring the size of test foods that have been chewed for a specific number of chewing cycles or have been chewed until the study participants would feel the particles were small enough to swallow. The test food is then removed from the mouth and the particle size analyzed using a graded sieving method or image analysis techniques.

This methodology has demonstrated reduced chewing efficiency with smaller numbers of teeth, with teeth and removable partial dentures (RPDs) compared with natural teeth, and with complete dentures compared with a natural dentition. The effect of age alone on chewing efficiency is negligible, although there is some reduction in oral motor function in older people, probably relating to altered muscle bulk.

Understandably, chewing efficiency is affected by the number and distribution of teeth; maximum biting force is reduced in people with advanced periodontal disease and increasing tooth mobility. The relationship between masticatory efficiency and biting force is unclear. This is particularly difficult to clarify in subjects who have periodontal disease with mobile teeth as they also tend to have fewer teeth. The relative impact of the effect of mobility of teeth compared with numbers of teeth has not been clarified.

Taste perception with age

Taste is perceived through the taste buds on the dorsum of the tongue, the soft palate, the pharynx, larynx epiglottis and in the upper third of the esophagus. The quantity and distribution of taste cells do not appear to change in normal, healthy adults with increasing age.

Tastants must be dissolved in fluid, derived from saliva, to allow the specific taste to be perceived. Individuals cannot taste their own saliva as a product of habituation, but there are changes in the ionic composition of saliva and in the salivary mucins with age that must result in progressive change in this background flavor. However, this change may go some way to explaining the variations in taste perception with increasing age.

Like all age changes, the manifestation of altered taste varies from individual to individual but the changes generally comprise both alteration in the ability to discriminate tastes (that they are present at all when compared with water) and in recognizing the five different taste qualities in a food compared with the young.

There are five principal tastes: bitter, salty, sour, sweet and umami (umami is the taste of savory which is perceived separately from salt and sour). Bitter, salt, sour and to an extent sweet are reduced by aging in healthy, un-medicated adults. It has also been shown that these effects are amplified in people who take multiple medications and in those who are chronically ill. It is interesting to speculate that this amplification may also be associated with changes in saliva and other oral secretions in individuals who are taking multiple drugs. The effect extends to all the principal tastes, with increase in detection thresholds of 11.6-fold for sodium salts, 7-fold for bitter, 5-fold for umami, 4.3-fold for acid and 2.7-fold for sweet.

People with complete dentures often complain of impaired taste which they attribute to full palatal coverage with the denture base. The rationale for this is less clear as there are few, if any, taste buds on the hard palate. Impaired taste is more likely to be associated with poorer release of tastants from foods which are not chewed well.

An obvious solution to altered taste is to explore the value of flavor enhancers on foods consumption. Flavor enhancement can take the form either of adding artificial flavors to *fortify* the food, or adding something that amplifies natural taste. The most common chemical in this latter group is monosodium glutamate. Some beneficial effects, either as an arrest in decline of food intake or of overt increases in energy intake and even increases in body weight, have been seen with this approach.

Pathology of oral mucosal disease

Clinical and histological changes occurring in aging oral mucosa

Changes with age are found in many tissues of the body and similar age-related changes are perhaps to be expected for the oral mucosa. However, although clinical examination of the mucosae of the elderly often suggests subtle changes in mucosal texture and coloration, such changes may not be directly related to age itself. Several studies have reported that the oral mucosa became increasingly thin, smooth and dry with age and that it acquires a satin-like, edematous appearance with loss of elasticity and stippling. The tongue in particular is reported to show marked clinical changes with a tendency for the development of sublingual varices and a smoother surface with loss of filiform papillae. An increasing susceptibility to pathological conditions such as *Candida* infections could reflect a reduced epithelial turnover and a decreased rate of wound healing has been reported. Although such observations suggest an age-associated tendency to epithelial atrophy, data from kinetic studies have not clearly or consistently indicated loss of regenerative abilities. Possibly mucosae may become more susceptible to minor injury with age and also become more permeable to noxious substances. However, with the exception of permeability, few direct measurements of the mechanical properties of a normal or aging mucosa have been made that can be related to its structural or kinetic functions. Quantitative data are few but clinical experience suggests that advancing age is associated with reduced levels of taste, loss of other

forms of sensory perception and perhaps a reduced or altered control of immune defenses.

Prevalence of mucosal lesions

Oral mucosal lesions are common among the elderly. An epidemiological health investigation in Helsinki, Finland, revealed one or more lesions in as much as 38 % of the examined 338 home-living individuals: 91 men and 247 women, aged 76, 81 or 86 years. Among complete denture wearers the prevalence of mucosal lesions was 51 % while in elderly with some natural teeth the prevalence was 31 %. These findings were consistent with the results of a large study of elderly people in Santiago, Chile. The most common finding of both studies was denture stomatitis, which occurred alone or combined with other lesions in 22–25 % of denture wearers. In the Finnish study the most common changes unrelated to denture wearing were coating of the tongue (7 %), angular cheilitis (6 %) and varicose veins under the tongue (4 %). Leukoplakia and inflammation of the buccal mucosa were both seen in 3 % of the examined individuals. Interestingly, the total number of mucosal lesions correlated positively with the number of daily medications.

Oral cancer

The term oral cancer comprises several types of malignancies; however, squamous cell carcinomas (SCC) are by far the most prevalent type, accounting for more than 90 % of malignant neoplasms of the oral cavity and oropharynx. Non-Hodgkin lymphomas are rare in the oral cavity although the second most prevalent type. Sarcomas, e.g. fibrosarcomas and liposarcomas primarily seen in younger age groups, and malignant melanomas are very rare.

Epidemiology and etiology of oral cancer

Globally some 300 000 cancers of the oral cavity occur and oral cancer causes some 145 000 deaths. The incidence and morbidity rates vary considerably worldwide reflecting cultural and social practices and, possibly of minor importance, genetic predisposition. Men are affected much more often than women possibly reflecting, at least in industrialized countries, the greater use of tobacco and alcohol among men. The global incidence and mortality rates for oral cancer increase sharply with age. It should be mentioned that increases in incidence have been seen in younger subjects in recent decades.

The primary risk factors are tobacco and excessive alcohol use. Furthermore, numerous studies have shown a synergistic effect of these agents. In many European countries a significant rise in incidence of intraoral cancer has been related to rises in alcohol and/or tobacco consumption. The use of smokeless tobacco placed intraorally is a major cause of oral cancer in several countries. Recent studies have indicated that human papillomavirus infection possibly plays a role in a small subgroup of cancers of the oral cavity. Also, inadequate consumption of fresh fruit and vegetables contributes to the risk of developing oral cancer. Extensive sun exposure is a risk factor for lip cancer although tobacco habits also seem to be involved. Furthermore, patients who are immunosuppressed, e.g. renal transplant recipients, have a higher risk of cancer development of the lower lip. Possi-

ble factors that may contribute to malignant transformation in the elderly are decreased cellular immunity and malnutrition. When etiological factors are considered among women with tongue cancer, the average age among those who use tobacco and alcohol is 11 years lower (60 years) than for those who do not use tobacco and alcohol (71 years).

THE TREATMENT PLAN

Thorough assessment has been described as the keystone of geriatric medicine and dentistry. When the elderly patient is involved, the modifying factors are generally significant and must be part of the planning process. The dentist must determine which factors directly influence the physical, psychosocial and dental health outcomes associated with older adults. To help obtain clarity keep in mind the following patient factors:

1. *Patient attitude and motivation.* Does the patient see the need for treatment and does he or she want to undergo what is necessary to accomplish the results? Does the patient see a value in completing the treatment? Will the patient give consent? Is he or she able to give consent? Does the patient have the resources to pursue this care?

2. *Patient health concerns.* Are there health issues that will affect treatment decisions? A healthy person with the potential for longevity will necessarily be approached differently than one who is terminally ill.

3. *How will our treatment affect the quality of the patient's life?* Is the treatment likely to improve the patient's quality of life in a positive way or will the cost of the therapy in stress, discomfort and financial terms outweigh the potential benefit?

4. *Can the patient maintain his or her oral health?* Does the patient have the motor skills, visual acuity and cognitive ability to care for his or her mouth and the dental treatment planned?

5. *What is the chance of an untoward result in the performance of the therapy?* What is the possibility of an iatrogenic result in attempting the therapy, either in terms of the dental outcome or in terms of an adverse event in the patient's health or quality of life?

6. *What is the prognosis of the proposed therapy?* What will happen if no treatment is rendered? What is the worst case scenario?

7. *What skills does the dentist have?* What is his or her experience with this type of problem? Are the equipment and materials necessary to accomplish the proposed therapy available and part of the provider's knowledge base?

Then we must consider orally related factors:

– What is the problem?
– Why did it occur?

8. *How bad is the condition?* What is the degree of dental and/or periodontal disease? If it is a tooth in question, how badly decayed is it? Is it restorable? Is it abscessed?

9. *What is the overall oral health status?* What is the ability to maintain oral hygiene? What is the importance of the tooth to the patient's ability to function? What is the tooth's importance to the patient's occlusion?

10. What is the caries or other disease risk or experience for the patient?

The next step will be to approach the therapeutic plan systematically. Once the patient's problems have been identified, diagnosed and a resolution selected, it is time to organize and implement.

The pressing conditions that need prompt attention will be addressed *first*. They can be considered an emergency when the patient is in pain or presents with an infection. These conditions require attention to the causative agent of the pain or infection, particularly when the infection is so severe as to cause delirium or cognitive changes. The importance of the intervention at this point is to remove or ameliorate the condition that is causing pain or address the infection. This may be something that the dentist can do or may require referral to a site that can address the patient's emergency needs.

The *second* phase of a treatment plan would involve those procedures that will stabilize the patient's oral status. The objectives of this phase are to correct active disease entities so they do not progress, and complete initial therapies that have an influence on the definitive treatment proposed. At this time, it is also critical to evaluate the patient's control of environmental factors, ability and willingness to participate in their maintenance. Oral hygiene is evaluated; efforts are made to show the patient how it needs to improve to optimize oral health. Homecare efforts can be supplemented with dietary counselling and fluoride applications as appropriate.

Consider the need to alter the plan of treatment based on the outcome of the first two phases of treatment. Then prepare the patient for definitive treatment if that is part of the plan of treatment.

The *third* phase of a treatment plan is the terminal or rehabilitative phase.

The objective of this phase is to complete definitive treatment procedures that will restore the oral condition to optimal health and function. Recall that in the geriatric patient that definition includes the patient factors discussed previously.

Finally, there is a phase of the treatment plan that typically occurs at the completion of all treatment but should be in constant consideration throughout the execution of all phases of the plan of treatment. This *fourth* phase would be outcomes assessment or evaluation of the effectiveness of treatment and solutions to problems, recall and maintenance. The objective of this phase is to assess the success of therapy, evaluate the reasons for failure if they occur and reinforce proper patient maintenance. This re-evaluation phase needs to occur constantly to assure that the plan of therapy is on track and that it is effectively meeting the needs of the patient and correcting the identified problems.

TREATMENT

The dentate patient will present with needs that are common to all patients of all ages and they will have conditions that are specifically common to the elderly. When we deal with patients in general, and not just the elderly, we as dentists have certain mechanical approaches to the problems with which patients present.

When the patient is dentate the typical approach is to restore teeth back to form and function. If we are dealing with carious lesions our approach and material selected will be dictated by the surfaces involved, the depth of the caries. When possible, we will be placing an appropriate direct restorative material. If the damage either due to caries or loss of tooth structure is extensive, our choices may be an indirect restorative approach to achieve the goal of returning the tooth to form and function.

When the dentition is missing and replacement is sought, we will consider removable prosthetics in the form of complete dentures or partial dentures. When there is adequate tooth support in the edentulous areas to allow the placement of fixed prosthodontics, tooth borne therapy should be a consideration. Finally, we should also consider implants when conditions permit as there is no evidence other than patient health issues and economic conditions to contraindicate the implementation of implant therapy in the treatment planning of the geriatric patient.

Endodontic therapy and periodontal therapy do not change because of age and the therapy, when indicated, will proceed with outcomes that are similar to other population groups. However, endodontic therapy among elders is more likely to be complicated by pulpal sclerosis.

The geriatric population group does require us to consider the appropriateness of any of these therapies in the context of what is in the patient's best interest and what will be the benefit they will gain from accepting these therapies.

Looking carefully at each of the treatment options

Caries is a chronic infectious disease that is common in the elderly. Many geriatric patients have gingival recession with exposure of additional root and interproximal surfaces. A generalized decline in the ability to maintain plaque free tooth surfaces and other patient-related factors leads to a particular susceptibility to root caries.

The materials available to accomplish the restoration of the form and function of the damaged teeth are: dental amalgam, composite resin, glass ionomer and indirect restorations (crown and inlays/onlays). Because restorations have a finite life expectancy and there is an attendant risk of recurrent caries and new caries, we need to also include the prevention of new caries using other options such as fluoride.

Treatment options can be varied but generally are determined by the size and severity of the lesion and the benefits restoring this tooth will have to the patient's overall condition. Incipient lesions may respond to homecare instruction and

the use of fluoride. When the appearance of the surface suspected of being caries is hard, smooth and polished in appearance, treatment should be conservative. When this lesion is soft, the affected areas should be removed conservatively and restored with amalgam, composite or glass ionomer. The choices of the restorative material may be dictated by aesthetics and ability to obtain retention in or on the remaining tooth structure. Glass ionomer, with its ability to be adherent to the tooth surface by chelation, is a popular material to use. It also has an advantage of containing fluoride which may decrease the recurrence of decay in the adjacent surfaces.

Composite resin allows a rapid and simple approach to treatment of many restorative needs in a single visit. It has an additional benefit in that repairs and additions can be made to these restorations by proper preparation and re-etching of the appropriate surfaces. Teeth of the elderly have had more time to accumulate the effects of attrition, erosion and abrasion and sclerotic dentine making it more difficult to successfully bond to their teeth. The restorative dentist must therefore keep this in mind when treating the teeth of the elderly and maximize the potential bond strengths by careful adherence to the principles of bonding (isolation, maximization of quality collagen, moist demineralized dentine and maximum enamel surface areas). Composite restorative material has the added benefit of being used to splint teeth. Periodontally involved teeth that are mobile can be stabilized and their longevity improved by a simple procedure of bonding teeth together with composite and a fiber material (fig. 4).

Fig. 4. Splinting of teeth

Splinting can also be used as an inexpensive alternative to a fixed solution when a single tooth needs to be replaced. The extracted tooth or a replica can be splinted to the adjacent teeth and provide the patient with an inexpensive alternative to the restoration of the edentulous site with an indirect solution. Care needs to be taken with these direct approaches to ensure that the resultant architecture is cleansable by the patient.

Prosthodontic care

Frequently complete and partial removable dentures are necessary to restore function and facial support to the geriatric patient. When a patient lacks sufficient supportive occlusal units, a partial denture is indicated. This restorative therapy

can provide occlusal support and return function to the patient. Having occlusal support protects the temporomandibular joint. It also improves function, allowing the ability to provide proper nutrition through better mastication of a variety of food substances. The tooth supported removable partial denture will have the added benefit of force distribution and protection of the remaining teeth from excessive occlusal forces on the unsupported dentition. The use of a partial denture will also provide needed stability to complete dentures. The distal extension partial denture is particularly useful in the improvement of the stability of a complete denture, improvement of mastication and support to the temporomandibular joint.

The design of all prosthetics should include a provision for failure. This will permit a provision for repair or correction of the existing prosthesis with minimal expense and disruption of the patient's life.

Complete denture therapy usually falls under the following categories: the patient broke or lost his or her denture; the denture has become excessively worn and no longer functions or fits; the dentition is beyond hope and/or is insufficient to support any other reasonable solution. Esthetics forces some patients to seek a new denture and this may be instigated by the patient or frequently a family member.

The completely edentulous geriatric patient often has atrophic supporting alveolar structures and changes in the vertical dimension of occlusion. Care must be exercised in the construction of the new denture. One must address the need to increase vertical dimensions carefully. Tooth placement must be guided by impression techniques that capture the neutral zone. The neutral zone is defined as the area in the mouth where, during function, the forces of the tongue pressing outwards are neutralized by the forces of the cheeks and lips pressing inwards. The "neutral zone" philosophy is based upon the concept that for each individual patient there exists within the denture space a specific area where the function of the musculature will not unseat the denture and where forces generated by the tongue are neutralized by the forces generated by the lips and cheeks. The influence of tooth position and flange contour on denture stability is equal to or greater than that of any other factor.

Overlay dentures or removable partial dentures are options that should not be overlooked in patients with some remaining teeth. The retained roots provide support and stabilization to the removable prosthesis. The retained periodontal ligament provides proprioception giving the patient a better sense of discrimination than with a conventional denture. The alveolar bone is preserved by the existence of the retained roots and this will minimize future resorption of the alveolar ridge. The retained roots may be a site for retentive devices that will aid in the success of wearing the denture. A deterrent associated with this therapy is the added expense of the endodontic treatment that may be required and continuing preventive treatment required to preserve the retained root structure. One of the most common reasons for failure of overdenture abutments is caries.

Fixed restorations may be required when the damage is extensive and the ability to return the tooth or teeth to form and function requires this level of treat-

ment. Here the dentist must look at the necessity of the treatment and the ability of the patient to benefit from this therapy. Not all teeth are equally important in function and need to be restored or replaced. Third molars and second molars for example are expendable in a mouth that has a stable occlusion involving first molars and premolars. There are a number of studies that point to sufficient adaptive capacity to maintain adequate oral function when at least four posterior occlusal units remain. Contemporary adhesive approaches to prostheses retention add a further dimension to the prosthodontics dynamic.

Periodontal care

The fact that more geriatric patients are retaining their teeth and doing so for longer periods of their lives makes them at risk for periodontal disease. The diagnostic procedures and techniques for treatment do not change because the patient is elderly. It is well accepted that the response to periodontal therapy is similar to younger adult patients.

The concept that should be a guiding principle for treatment is the appropriateness of these therapies in the context of what is in the patient's best interest and what will be remaining intact fixed splint by using composite and resin fiber. This alternative therapy has been a successful solution for over two years and has kept this patient from having to wear a mandibular partial denture.

In conclusion, a pragmatic approach to treatment planning that is based on a comprehensive dental, medical, psychological, social and functional assessment of the patient. The patient's desires and perceived needs must be considered, as well as the ethical issues involved in decision making, including the concepts of autonomy, beneficence, non-maleficence, justice and veracity. Critical attributes of geriatric practitioners are compassion, caring and a thoughtful deliberation on the best solution along with a discussion with the patient (or caregiver) of the risks and benefits of alternative forms of treatment. Finally, and the most critical issue in treatment planning and treatment of the geriatric patient, is the competence of the practitioner.

DISABILITY IN OLD AGE – THE RELATIONSHIP WITH ORAL HEALTH

Like people in other age groups, older adults have very different thoughts about what it takes to have a good life. But on the whole one wish is common for all older adults: to have a good functional ability in everyday life, so that one can manage for as long as possible without help.

The prevalence of chronic diseases rises with age, and in old people it is common to have several diseases and symptoms at the same time. A combination of potential diseases, medical treatment and physiological/biological age-changes may cause problems with activities and opportunities for self-realization in daily life. These problems may be of great importance for the individual's feeling of self-worth

and independence at the same time as disability may be decisive for change of dwelling or allocation of help. Accordingly, the main purpose of most health care intervention in older adults is to improve or sustain functional ability for as long as possible. This is the case with regard to medical treatment and rehabilitation, but also with regard to preventive work among community-dwelling older people.

Three terms are commonly used to identify vulnerable older adults: frailty, comorbidity and disability. *Frailty* is a physiological state of increased vulnerability to stressors that results from decreased physiological reserves, and even dysregulation, of multiple physiological systems. *Comorbidity* is defined as the concurrent presence of two or more medically diagnosed diseases in different organ systems in the same individual, with the diagnosis of each contributing disease based on established, widely recognized criteria. *Disability* is defined as difficulty or dependency in carrying out activities essential to independent living, including essential roles, tasks needed for living independently in a home and desired activities important to one's quality of life. Although early stages of these processes may be clinically silent, the syndrome may become detectable by looking at clinical, functional, behavioral and biological markers. Older adults with early signs of disability and with actual disability are at larger risk of having oral health problems. This has several implications.

First, it should be recognized that prevention of disability in older adults will eventually also cause better oral health in the old people. This may be the case with regard to specific prevention of various diseases and with regard to health promotion, e.g. promotion of physical exercise and to stop smoking. Here, the effect may be indirect via functional ability, i.e. treatment of a disease or increased physical exercise may improve the functional ability of older adults, thus making it easier to take, proper care of the teeth. But the effect may also be direct, i.e. treatment of a specific disease such as diabetes or stopping smoking may have a direct beneficial effect on oral health.

Second, it is important to be aware that older people who feel fatigued when they perform their daily activities are at larger risk of disability and of oral health problems. This should be recognized in the multidimensional interventions, which take place in several communities, e.g. in Denmark, where all 75+ year-olds living at home in the municipalities are offered annual preventive home visits. Here the preventive home visitors should be aware of oral health problems as one possible consequence of feelings of fatigue.

Third, problems with fine motor activities caused by dexterity problems may make it difficult to take care of the teeth and periodontium. This may be relieved by an enlarged hand grip or an electric toothbrush, but if the person is severely disabled he/she may need daily help with tooth brushing and interproximal flossing. For institutionalized older adults one way may be to assist nursing staff through educational initiatives, which should encourage them to offer daily mouth care as an integral component of their personal hygiene care for all disabled older people in residential and home care. This care includes daily tooth brushing, quar-

terly or semiannual preventive assessments and service education for daily caregivers (nurses and aides), so that they learn the essential skills to provide daily mouth care for frail older adults.

Finally older people with personal care disability, for example, may require more frequent dental visits to compensate for their physical disability. Frail and functionally dependent older people living in long-term care facilities or at home, have special difficulties in accessing dental care because the problems of attending a dental clinic often appear insurmountable. The accessibility of the dental office is important too, especially for functionally disabled older patients.

PREVENTIVE ORAL HEALTH CARE FOR ELDERLY PEOPLE

The oral cavity is an ideal habitat for microorganisms. There are different surfaces in the mouth for microbial attachment, usually a frequent supply of energy and optimal temperature and moisture conditions. Today elderly people retain their own teeth in increasing numbers and they often have received restorative treatments not meeting the present day quality standards. This fosters accumulation of plaque. Dental prostheses further enhance the colonization of bacteria and yeasts in the mouth. On the other hand, salivary flow and defensive systems, which play an important role in controlling plaque-borne infections, may become impaired in the elderly, mainly due to drugs used daily for systemic diseases and due to the diseases themselves. Finally, decreased manual dexterity of the elderly poses difficulties in maintaining satisfactory oral hygiene. Dietary habits can change with increasing age with elderly people often favoring soft foodstuffs and carbohydrate rich food instead of vegetables and a fiber rich diet. Oral microorganisms readily ferment such carbohydrates for energy metabolism and subsequent growth. Microflora in the oral cavity is exceptionally dense and voluminous in dental plaque. 1 mg of plaque contains 10^{11} bacteria and over 700 bacterial species have been identified in the mouth.

In addition to dental plaque, oral mucosal surfaces are also colonized by other microorganisms. *Candida* sp., of which *C. albicans* predominates, are particularly important and may cause local and systemic infections. In mucosal infections non-*albicans* strains such as *C. krusei* and *C. glabrata* are identified in increasing numbers among older people. These strains tend to be resistant to the commonly used antifungal drugs. In general, the increased global use of antimicrobial drugs results in selection pressure for resistant strains which may be a cause for concern in the oral environment.

From the oral cavity, microorganisms may gain access to blood circulation and spread all over the body. Odontogenic bacteremia is a well-known entity and its role in the development and progression of systemic diseases has become a topic of great concern. The theories that oral microorganisms may play a role in the development of atherosclerosis are of particular concern. Such bacteremia is not a

threat in healthy individuals because the body's defensive systems clear microorganisms from the circulating blood and prevent systemic harm. However, in patients with poor health or compromised defensive mechanisms bacteremia can be dangerous. Poor oral health has been shown to increase mortality among the elderly. Consequently, preventive oral health care cannot be overemphasized. The following sections describe evidence-based observations of oral health care among the elderly with some practical recommendations and visions for the future.

Prevention of plaque induced diseases

Plaque induced diseases mainly comprise dental caries and periodontal disease. The best strategy to prevent these diseases is the elimination of plaque, which in reality is not possible. However, successful control of plaque, by mechanical cleaning of the teeth, has been shown to reduce the frequency of both caries and periodontal disease. Chemical plaque control is another possibility but it is restricted to short-term strategies due to the potential side effects of the currently available agents. It should be emphasized that controlling dental plaque not only affects the dental diseases but also reduces potential systemic consequences by reducing the number of microorganisms of oral origin and their subsequent spread to other organs.

Mechanical cleaning

Daily mechanical cleaning of the teeth, dental prostheses and oral mucosa is the cornerstone of oral health care in the elderly. Poor oral hygiene has been shown to associate with bronchopneumonia; the mechanism is thought to be direct spread of oral microorganisms by aspiration to the lower parts of the respiratory tract. This association is particularly strong in individuals with periodontal disease. However, there may be other factors involved in this outcome as good oral health care among the elderly has been associated with improvement in the sensitivity of their cough reflex.

Daily oral hygiene of residents in nursing homes is often ignored and they might not want or understand the need to ask for help. A satisfactory level of hygiene may also be difficult to maintain in home-dwelling older adults due to impaired manual dexterity. This in turn may lead to the accumulation of voluminous dental plaque (fig. 5). Powered toothbrushes with an oscillation-rotation action are more effective in reducing plaque and improving gingival health than manual toothbrushes. Elderly individuals accept powered toothbrushes the same way as younger ones.

Hence, regular twice daily mechanical cleaning should always be recommended. If an older person's motor functions are impaired, an electric toothbrush and other specially developed mechanical aids, such as tongue scrapers, can be recommended. Eating is also an important part of maintaining a healthy microflora in the oral cavity.

Fig. 5. Voluminous dental plaque accumulation due to neglected daily oral hygiene

Combining frequent mechanical cleaning (tooth brushing and flossing) with antimicrobial agents such as chlorhexidine mouth rinse further decreases the number of bacteria in the mouth. Use of chlorhexidine has been shown to reduce the incidence of ventilator-associated pneumonia. Chlorhexidine mouth rinse can also be used to control the number of *Candida* in patients with removable dentures. Chlorhexidine is indeed the gold standard in chemical plaque control. However, due to its unpleasant side effects of altered taste and staining of the teeth, continuous use of chlorhexidine is not advisable as a daily means of controlling oral hygiene unless the patient is at high risk of pneumonia or other systemic complications. A variety of other chemical agents have been investigated for controlling dental plaque in older people. These include daily use of a combination of amine fluoride and stannous fluoride mouth rinse, which also appears to have antifungal effect, povidone-iodine, cetyl pyridinium chloride, essential oils, zinc citrate, triclosan, tea tree oil and sanguinarine. Local delivery of antibiotics, such as tetracycline derivates, has also been investigated to facilitate dental plaque control but for obvious reasons this is not a strategy for long-term population base preventive programs.

Fluorides

There is no doubt that fluorides are effective in the prevention of dental caries. However, use of fluorides in toothpaste or mouthwash for dental caries prevention has been mainly investigated in children and adolescents. In old age, root caries is usually the problem, and there is only limited evidence to show that fluorides may prevent or retard its progression. The few studies that have been performed in older adults suggest that fluoride toothpaste and, in the case of high caries risk individuals, the adjunctive use of other fluoride delivery systems may be effective in preventing coronal and root caries. The actual chemical nature of fluoride used in mouth rinse or toothpaste does not seem to play a key role in the efficacy of a product as long as the concentration of fluoride is optimal. However, it needs to be re-emphasized that there is only limited evidence of use of fluorides in caries prevention in the elderly.

Prevention of dental erosion

Dental erosion is the dissolution of dental hard tissues in a chemical process that does not involve bacteria. All foodstuffs, drinks or regurgitated gastric juice with a pH value below the critical pH of dental enamel, pH 5.5, or dentine when

this is exposed at pH 6.0 causes acid-mediated softening of the surface of the tooth. If the frequency of acidic assault exceeds the capacity of the oral environment for repair and remineralization erosive damage ensues. Hence, reduction in frequency of eating or drinking acid-containing products and treating any underlying gastrointestinal diseases is a life-long challenge in the prevention of irreversible lesions on the teeth. In patients with malignant disease an additional threat in this regard is cytotoxic drug treatment which can frequently cause vomiting. So far dental erosion has not been reported to be a specific problem in elderly generations but as the number of old people who have retained their own teeth increases it is expected that more erosion will be seen. It is often difficult to identify specific aspects of tooth wear in older people that may be associated with erosion alone against a background of a life-time's 'physiological' wear and tear to tooth tissue. The only effective prevention for erosion is eliminating the cause and/or treating any underlying systemic pathology.

Prevention of oral mucosal diseases

The prevalence of yeast infections increases with increasing age. Therefore, control of *Candida* is important in the elderly. Removable dental prostheses, in particular, increase oral *Candida* counts and care must be taken to mechanically clean them properly after every meal. If nothing else, rinsing the removable prostheses under running water is recommended. Cleaning the prostheses alone in edentulous patients, however, does not effectively decrease the number of microbes in the mouth. Mechanical cleaning of dentures will remove plaque from the surface of the plastic, but older resins become porous and the surface becomes colonized with *Candida* species. The only way to effectively clean such surfaces is by soaking the denture in an antimicrobial solution. One of the most effective is a 1 % sodium hypochlorite solution with an overnight soak (1 % hypochlorite is the concentration commonly used/recommended for sterilization of baby products). Cleaning oral mucosa with moistened cotton swabs may be needed for better oral hygiene, in particular among bedridden patients. However, care should be taken not to use acid-containing pre-moistened swabs frequently because of the risk of dental erosion of natural teeth. Unfortunately such preparations have been used in many hospital wards.

Ill-fitting dental prostheses may cause mucosal lesions and in the worst cases may be associated with malignant transformation in the epithelium. Consequently, frequent check-ups are called for in patients with dental prostheses. Clinical experience has unfortunately shown that edentulous subjects often stop visiting dentists after they get total prostheses. The best way to prevent stomatitis caused by ill-fitting prostheses is to assure frequent dental examinations and appropriate hygiene advice.

Prevention of oral mucositis has mainly been investigated in connection with the side effects of radio- or chemotherapy used in the management of cancer. Various cytoprotecting agents and antimicrobial agents have been studied. How-

ever, no clear pattern has been identified regarding patient type, cancer treatment or type of antimicrobial agent used, and inconsistent assessment of oral mucositis has made comparison of outcomes difficult.

There are no evidence-based data on the prevention of other mucosal diseases such as lichen planus or vesico-bullous diseases. Similarly, the etiology of oral leukoplakia and erythroplakia is not fully understood but because some of these mucosal conditions are thought to be premalignant, close and frequent follow-up examinations are recommended for patients presenting with these mucosal changes, with biopsy as required for suspicious areas. However, scientific evidence is weak in this area and treatment protocols are based on clinical experience alone.

There is every reason to believe that maintaining good systemic and oral health in general reduces the risk of exacerbation of mucosal diseases. It is evident that if the oral mucosal symptoms and signs are caused by underlying systemic disease (for example, such as rheumatic disease, diabetes or celiac disease) control of the disease in question is also of key importance to reduce the severity of oral mucosal lesions. For local symptomatic treatment, vegetable oil such as olive oil can be recommended. Some patients with mucosal diseases benefit from use of sour milk products and vitamin B-preparations have also been recommended. It should be reinforced that these recommendations do not meet the rigorous criteria of evidence-based care but are based on tradition and clinical experience. For prevention of repeated herpes episodes, however, specific drugs are available and should be prescribed in such patients. Mild herpetic cases can be controlled by topical anti-herpes preparations while severe cases call for administration of systemic drugs.

Prevention of xerostomia and burning mouth

Reduced salivary flow renders the patient susceptible to dental and oral mucosal problems and oral discomfort. There is sound evidence that dry mouth negatively affects quality of life. Medications such as diuretics, anti-hypertensive drugs, anticholinergics, anxiolytics and antipsychotics may significantly reduce salivary flow. This, in turn, reduces the salivary clearance effect in the mouth which may lead to plaque accumulation. Low salivary flow also affects buffering capacity with resultant increased risk of caries and erosion and reduces humoral defensive systems in the oral cavity which may lead to mucosal problems.

Xerostomia (subjective feeling of dry mouth) and hyposalivation (measured low salivary output) are very common problems among elderly subjects. Reduced salivary flow increases the individual's risk of oral infections. This together with frailty may add to the detrimental effects of oral disease. Impaired saliva flow may simply be associated with dehydration; a sufficient daily intake of water is important for everyone. Elderly people often drink much less than the recommended intake of 1–1.5 L of water per day for a variety of reasons; poor sensory desire for thirst, a need for assistance in drinking and a fear of urinary incontinence often discourage people from drinking an adequate amount of fluid.

A variety of commercial preparations for dry mouth is also available. In isolated cases cholinergic drugs such as pilocarpine can be prescribed for older adults with reduced salivary flow.

Burning mouth syndrome is described as burning or itching and/or painful sensation in oral mucosa (including the tongue, when it is called glossodynia) of patients where no medical or dental reason is to be found. In other words, there are no clinical signs explaining the patient's complaint. The symptoms characteristically develop during the morning with full blown sensation later during the course of the day. The sensation can be extremely painful, leading to significant morbidity. The prevalence in populations is not known but being female and over 50 years of age seem to be risk factors for burning mouth. Because the reason for burning mouth is not known, there is no prevention. However, some peri- and postmenopausal women benefit from hormone replacement therapy although the scientific evidence is still weak. Burning mouth often goes hand-in-hand with xerostomia and reduced salivary flow appears to be a risk factor for it. Thus, the same preventive protocol as presented for dry mouth can also be recommended for burning mouth patients. These patients often benefit from the use of vegetable oil to lubricate their mouth mucosa. Oral discomfort of this type can also be associated with iron deficiency, when appropriate replacement therapy will be beneficial.

However, pharmacotherapy for reduced salivary flow has mainly been investigated in patients with cancer or Sjogren's syndrome and its use is of limited value in the elderly populations due to potential drug interactions.

Prevention of oral cancer

Etiology and pathogenic mechanisms of cancer are not fully understood. However, use of tobacco and alcohol are well-known risk factors of cancer in the mouth too, like in any other part of the body. Over 90 % of patients with oral cancer use tobacco in some form. The risk of oral cancer associated with smoking is both dose and duration dependent while smoking cessation leads to a reduction in risk. Respectively, 75–80 % of oral cancer patients frequently consume alcohol and alcohol is the principal risk factor in non-smokers. Risk increases linearly with amount of alcohol consumed over 4 units of alcohol per day (1 unit is 8 g of alcohol: about 250 mL of beer at 4 % alcohol or 25 ml of spirits at 40 %). The alcohol concentration also seems to increase the risk with people who consume spirits regularly being more at risk than wine or beer drinkers. Consequently, strategies for the prevention of oral cancer should be focused on these behavioral factors. Elderly patients who smoke should be advised to quit smoking and those who consume alcohol daily should be advised to restrict the intake of alcoholic beverages and, in particular, avoid straight liquor.

Recently, studies have shown that oral cancer might be affected by the level of oral hygiene. The pathogenesis behind these observations is the fact that several oral microbial species metabolize ethanol to acetaldehyde, the latter chemical be-

ing carcinogenic. Thus, life-long good oral hygiene may reduce the risk of oral and upper gastrointestinal tract cancer.

Prevention of bone loss

Alveolar bone that supports the teeth is lost if teeth are being lost. When teeth are lost, chewing is greatly hindered and speaking may become difficult too. The facial structures look different without the support teeth normally provide for the lips, cheeks, nose and chin. The loss of alveolar bone may make getting dentures that are stable and retentive much harder. Consequently, keeping a healthy natural dentition is the prerequisite in the prevention of jaw bone loss. Because periodontal disease and dental caries are the leading causes for loss of teeth, preventive strategies should be focused on preventing these conditions. Systemic diseases such as osteoporosis, however, may greatly modify the clinical picture.

Osteoporosis was defined by WHO as bone mass that is two standard deviations or more below the young adult mean bone mass. The main consequence of osteoporosis is bone fracture. The majority of fractures are seen in older people, particularly postmenopausal women. By age 70, more than 25 % of European women have sustained at least one osteoporotic fracture. The highest incidence of hip fracture has been found in Scandinavian women older than age 50.

The association between osteoporosis and alveolar bone loss, however, is not clear. Most of the studies so far are confined to postmenopausal women and several other factors contributing to bone loss, such as hormone intake, sex, age, race, smoking and stress, need to be addressed when assessing the relationship between osteoporosis and alveolar bone loss. Nevertheless, periodontal disease inevitably leads to general horizontal alveolar bone loss and vertical bone pockets adjacent to the affected teeth. Consequently, effective plaque control should be emphasized for patients at risk. The management of osteoporosis is not without its oral consequences; bisphosphonates are drugs that inhibit osteoclastic activity and hence reduce bone loss. However, they are also associated with bisphosphonate-associated osteonecrosis of the jaws.

In addition to idiopathic osteoporosis, there are several secondary reasons for systemic bone loss. These include long-term corticosteroid medication, renal diseases, gastrointestinal diseases such as coeliac disease, hepatic diseases, Parkinson's disease and chronic pulmonary diseases. Obviously, successful prevention of alveolar bone loss in these cases calls for control of the systemic disease in question.

Prevention of temporomandibular dysfunction and myofascial pain

Elderly people rarely suffer from temporomandibular dysfunction (TMD) pain even though objective signs of joint dysfunction are prevalent in old age. TMD and myofascial pain disorders, on the other hand, seem to fluctuate with a relatively good remission capacity and objective radiographic signs of joint pathology do not associate with subjective symptoms. The etiology of TMD remains elusive, but it may be related to tension and neck symptoms in most cases where

no joint pathology is seen. However, temporomandibular joint osteoarthrosis may be a consequence of old age but even these patients seldom suffer from painful symptoms. Thus, prevention of these disorders is difficult if no distinct reason is to be found for the symptoms.

Planning preventive services

Elderly people are individuals like all people are. Subsequently, oral treatment and preventive services need to be planned and tailor-made on an individual basis. On this level, the manual dexterity and mental capacity of a patient largely dictates what kind of oral hygiene procedures, for example, can be recommended and implemented. In free living older people, daily oral hygiene and dietary recommendations, prescription of fluoride products and so on do not differ from those in a more youthful population. In dependent and/or institutionalized subjects, however, there may be problems in all areas of daily activities and maintaining oral hygiene at a satisfactory level often calls for outside help. Similarly, the planning of preventive oral health procedures and strategies is different on the population level than on the individual or special needs care level.

Public policies to support community awareness and acceptance of broad-based preventive behavior to preserve oral health in old age are essential. Policies also must provide guidance on how to proceed when disabling diseases occurs, provide for regular research and updating of information. However, there are no systematic cost-effectiveness studies on the effect of certain preventive programs on costs to the society and such studies would be unethical to conduct. There is enough evidence to show that maintaining good oral health does improve general health and affects the quality of life.

BIBLIOGRAPHY

1. *Carransa's* Clinical Periodontology / M. Newman et al. 12th ed. Elsevier, 2014. 904 p.
2. *Holm-Pedersen, P.* Textbook of geriatric dentistry / P. Holm-Pedersen, A. W. G. Walls, J. A. Ship. 3d ed. Wiley-Blackwell, 2015. 386 p.
3. *Lamster, I. B.* Improving oral health for the elderly / I. B. Lamster, M. E. Northridge. 1st ed. New York: Springer, 2008. 506 p.
4. *Mersel, A.* Oral rehabilitation for compromised and elderly patients.1st ed. New York: Springer, 2019. 196 p.

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