

PRINCIPLES OF REMOVABLE DENTURE THERAPY

Dragos Nicolae FRATILA ^{1,*}

¹ Faculty of Dental Medicine, University of Medicine and Pharmacy Gr.T.Popa, Iasi, Romania

Abstract

An important field of gerontology is the determination of a person's biological age, in order to assess the changes produced in the body as time elapses. A considerable amount of research work conducted in this direction has proven that the morphological, physiological, biochemical, psychological and social involution changes are not identical in individuals of the same age, as such, the biological age does not usually correspond to the chronological, calendar age. Each individual has his/her own rate of aging, which follows more or less the physiological development of the senescence process. One of the most important categories of patients who go to the dentist today is the elderly. They usually present with a complex pathology due to the loss of a large number of dental units (very often subtotal edentulism), due to complications that have occurred over time and, last but not least, due to the pathophysiological specificity of this category of patients. The pathological conditions caused by the significant changes underwent by the dento-maxillary system functions may trigger severe homeostasis impairment in the remaining alveolar bone, in the oral mucosa, of the temporo-mandibular joint, of the masticatory and perioral muscles, as well as of the nervous system of the edentulous patient. Edentulism is an abnormal clinical condition in which the morphological and functional alteration processes were triggered long before, i.e. at the time of onset of the diseases that determined it.

Keywords: *biological age; old age; pathological conditions; edentulism.*

Introduction

The correct conservative treatment of these pathological conditions with the preservation of the remaining dental units regardless of their prosthetic value is, last but not least, a good prophylactic approach to the prosthetic field of the future completely edentulous patient by minimizing the phenomenon of mucosa membrane and bone atrophy in those areas. Restoration of dental arches lost to edentulism poses serious problems in the elderly, due to difficulties in achieving denture stability, in the vertical sizing of the lower floor, due to the physiognomic appearance that changes with age and cannot be completely restored, to difficulties in sanitizing and preserving dentures in good condition, which may be blamed either on the patient's not knowing the proper maintenance techniques and means to achieve it, or on the specificity of this category of patients [1,2].

In old age, the body loses some of its flexibility, and it is increasingly difficult to change one's habits, environment or behavior.

Adapting to new situations will be more difficult, sometimes even impossible, as the patients' resistance to change varies. This often materializes in the patient's inability to adjust to new or unusual situations, due to his/her impaired ability to recognize the shape and size of objects.

It seems that it takes shorter for patients to get used to partial dentures, the foreign body sensation is rarer and the satisfaction after denture fitting is higher. For all these reasons, it is

advisable to preserve the remaining teeth on the arches as long into old age as possible. Partial denture support structures (abutment teeth, edentulous alveolar ridges) are living tissues and are subject to the action of forces.

Great progress has been made over the last decade in studying the impact of chronic oral inflammation, especially periodontal disease, on the health of the whole body. Research has been done, but further research is still needed on the functions of the stomatognathic system, considering the high incidence of diseases such as cranio-mandibular dysfunction, edentulism, congenital or acquired abnormalities. Edentulism and inaccurate rehabilitation may lead to the decrease of the quality of life and even to the shortening of the life expectancy of the elderly population[3,4].

Denture development and fitting relies on a set of principles that directly govern the actual therapy.

Prophylactic principle--the systemic design of prophylactic measures applied to prevent stomatognathic diseases consists of a simultaneous approach of complex prophylactic methods and means aimed at preserving the health of all components of the stomatognathic system from a bio-psycho-social point of view, through both common and individual prophylactic actions, and within the denture fitting process itself. The stomatognathic system achieved through the functional convergence of apparently disparate elements operates based on both the laws of systemic homeostasis and those of local homeostasis, imposed by the macrosystem. The systemic or extra-systemic source of disease or dyshomeostasis must be determined in order to achieve effective prophylactic action at least in the pre-clinical onset stages. This requires clear etiopathogenic models that allow the targeted action of prophylactic factors at the biological, psychological and social levels[5,6].

The inclusion of prophylactic programs in the daily routine of denture-wearing patients with total edentulism has materializes in three directions: the application of general non-specific prophylaxis aimed at preventing diseases of any kind but especially contagious diseases (hepatitis, viral infections, lues, tuberculosis, etc.), in the prevention of which the dentist is also directly interested; the application of general specific prophylaxis, which refers to the fulfillment of the prerequisites necessary for the normal development of the stomatognathic system as a whole, from intrauterine to old age, knowing that genetic factors affect the individual's entire psychosomatic development; the application of local prophylaxis consisting of dentures, which addresses all the components of the stomatognathic system, and total edentulism prophylaxis starts as early as the dentate period by preventing or removing all the etiological factors, thus contributing to the preservation of teeth on the dental arch for as long as possible and hence delaying the occurrence of total edentulism as much as possible. The prophylaxis plan includes: intensive health education; dental caries prophylaxis; removal of parafunctions and bad habits (in total edentulous patients, their persistence may lead to artificial teeth abrasion, occlusion plane change, fractured dentures, worsening of existing dysfunctions); oral mucosa disease prophylaxis (in total edentulous patients, this involves maintaining the microbial balance within normal limits).

Oral cavity may be regarded as a biotope that has conditions suitable for the development of microbial flora. The main components of this complex ecosystem are represented by the oral epithelium, oral fluid and oral cavity biocenosis. The mucosal component is represented by a keratinized epithelium playing a mechanical and antimicrobial defense role. The salivary component depends on the secretion of the main and secondary salivary glands disseminated in the palatal arch, on the tongue, on the jugal mucosa[7,8].

Oral cavity biocenosis is very numerous and usually saprophytic. The saprophytic microbial flora of total edentulous patients is reduced, due to the diminution of ecological niches. The insertion of dentures upsets this sensitive and carefully balanced environment, which readjusts itself to achieve a new balance, from another level; if the denture is accurate, the ecosystem does not change significantly; if the denture has numerous retentive areas, artificial

ecological niches appear. Given the development of a wide range of new materials and to technological breakthroughs, the last decades have seen the rise of a new field of prosthetics, namely the biocompatibility of dental materials. The use of macromolecular products, ceramic masses and biocompatible dental alloys is an act of great responsibility for the doctor[9,10].

The biological principle underlines the removable denture development and fitting process and imposes two desiderata for the two structures that touch each other, namely the fully removable acrylic denture and the prosthetic field; the total removable acrylic denture must be made of biocompatible materials, not injure the surrounding tissues, and not trigger any pathological reaction in the living tissues with which it comes into contact, and the living tissues of the oral cavity(Fig. 1).



Fig. 1. Aspects of negative clinical-biological indices

In order to achieve a biocompatible denture, one needs to know beforehand the quality of the tissues with which it comes into contact, with a view to stimulating tissue defense ability and to accurately designing this device. A set of clinical-biological indices of the local condition were defined to assess the quality of the prosthetic field, i.e. bone-related factors, which are positive, when the bone exhibits a low resorption and atrophy rate, and negative, when the resorption rate is high. Among the positive indices, one may distinguish an alveolar ridge higher than 4 mm, with a regular profile, rounded edge, high maxillary tuberosities, deep or medium palate, prominent piriform tubercles, rounded mylohyoid ridge and no palatine torus[11,12]. Negative clinical-biological indices are characterized by a ridge less than 4 mm high, with resorbed maxillary tuberosities and piriform tubercles, flat palate, preserved palatine and mandibular torus, sharp mylohyoid edges and hyperostotic formations that may occur in the prosthetic field; mucosa-related factors, which are positive when the mucosa color is normal, the mucosa is firm, painless on palpation, with a resilience rate ranging between 1-2 and 0% keratinization, with passive mobile mucosa wide enough to ensure good border seal, with insertion of palatal veil into middle or horizontal position, with the tongue in the middle or anterior position[13,14].

Negative clinical-biological indices are represented by congested mucosa, painful on palpation, with modified resilience, with narrow mobile passive mucosa, which may be as narrow as a mere line, with the palatal veil in a vertical position and the tongue in the posterior position; salivary factors refer to a correct assessment of the quality and quantity of saliva, as a small amount may generate denture instability, while too fluid saliva may decrease its adhesion force (Fig. 2).



Fig. 2. Aspects of negative clinical-biological indices related to general afestion

The clinical-biological indices of the loco-regional condition may be identified in both the temporo-mandibular joints and the muscles moving the stomatognathic system: in the TMJ – they are positive when joint dynamics is normal, the range of motion is symmetrical, synergetic and painless, and they are negative when pain and joint noises occur and when dynamics becomes asymmetric, asynergetic and it may even evolve to unilateral or bilateral condylar blockade; in the muscles – they are positive when normal muscle tonicity and trophicity are preserved, which ensure both static and dynamic facial symmetry, and they are negative when there are changes in muscle trophicity and/or tonicity, pain, spasms, muscle fatigue(Fig.3).



Fig. 3. Aspect of negative indeces –TMJ tomography

The clinical-biological indices of the general condition are considered positive when the general condition is good, the body is healthy, not receiving treatments and its functions are within normal parameters; the negative ones include bodies impaired by chronic diseases that reduce resistance to infections, as well as bodies that have difficulties adjusting to removable dentures.

According to the curative principle, the therapy of total edentulism must morphologically and functionally restore the stomatognathic system by restoring the gum and the dental arch with the help of artificial items, in order to allow it to regain its functionality. As far as functional restoration is concerned, it is a topic opened to debate, as many of the functions of the stomatognathic system cannot be fully recovered.

The mastication function cannot be 100% recovered in total edentulous patients, as removable dentures manage to recover only 1/20 to 1/5 of the edentulous patient's mastication capacity. This is due to the decreased mandibular dynamics control capacity, to the abolition of the desmodontal receptor field, to the generalized hypotonia impairing the mastication muscles, to the increased sensitivity to pain of the receptors in the lining mucosa, as well as to denture instability on the prosthetic field[15,16,17].

The physiognomic function is largely restored when the changes occurred are due to edentulism and not old age. Artificial teeth are chosen according to the desired color, shape and size. The false gum physiognomically completes and compensates any bone resorption asymmetries, and at the same time provides support for the soft components.

The speech function cannot be fully recovered, the denture is simply aimed at preserving the ability of the oral resonator to receive the sound and change it. The existence of the denture disturbs the speech, but the presence of artificial teeth provides the tongue with the necessary dental enunciation areas[8,19,20].

Swallowing is restored to normal parameters as long as the denture has good stability and allows the mandible to place itself in a middle position during swallowing; accurate border adjustment and proper positioning of the side parts of the tongue allow the tongue to perform its usual movements under normal conditions.

The biomechanical principle requires the solving of problems related to mechanical strength of dentures, the study of tissue strength in the prosthetic field and their adaptation to stain, and the stability of the denture-prosthetic field system. The biomechanical stability of dentures takes into account the resistance to strain, elastic deformation and mechanical stability.

The mechanical strength of the oral tissues that come into contact with the denture must be known to ensure low pressure by narrowing the artificial dental arches and dispersing the forces over as large an area as possible. The denture-prosthetic field system must achieve two major goals, namely: the mechanical strength of the denture and its abutment teeth; the static and dynamic stability of the denture on its abutment teeth. This goal will be achieved by designing the prosthesis in such a way that it does not yield under the pressure of mastication forces, by using sufficiently rigid up to 2mm-thick materials, which are good heat conductors and have a low degree of elasticity (methyl polymethacrylate)[Fig.4].



Fig. 4. Aspects of the optimal thickness of the acrylate according with biomechanical principle

The increase of the mechanical resistance of the denture may be achieved by intrinsic reinforcement by an accurate polymerization process or by extrinsic reinforcement using metal sheet, eel mesh, synthetic or glass fibers. The second goal may be attained by designing the denture so that, under the action of the active forces generated by the muscles, it is able to both fulfill its functions without budging and oppose the forces that tend to mobilize the denture, which may be vertical, horizontal, tilting or complex forces [21, 22, 23].

Vertical forces may be pressure and traction forces. The pressure exerted on the upper jaw is lower than on the lower jaw, which explains its more marked resorption. This force also

depends on age, gender, eating habits, muscle training, mastication pattern. The traction forces act on the borders of the denture, on the outside side of the false gum, on the vestibular side of the teeth in the retentive areas. These forces are generated by the mobile formations-mobile mucosa, muscles with perpendicular insertion, folds, frenulums, alveolo-jugal ligaments, as well as the action of sticky food or coronoid when opening the mouth.

The horizontal forces are parallel to the occlusion plane and have various directions: anterior, posterior or latero-lateral, being generated by the neuro-muscular imbalance of the muscles inside the arch, in relation to those outside it and the results of vertical forces. Antero-posterior displacement is enhanced by the significant resorption of the alveolar slopes in the anterior area and is due to the pressure exerted by the tongue during the exercise of incorrect functions, tics, occlusion contacts. The force acts on the tongue side of the arch and on the occlusal side of artificial teeth. The direction of displacement to the anterior or posterior side depends on the contraction of the muscle straps — either of the tongue and the displacement is anterior, or of the orbicularis and mylohyoid and the displacement is posterior. This type of displacement occurs in the case of Koller-Rusov class II clinical forms when the denture slides backwards as on two rails[24].

The latero-lateral displacement is due to the different tonicity of the cheek muscles and to some tongue tics, and it is enhanced by the atrophies of the alveolar ridges in distal areas.

The tilting forces are generated by the occurrence of a fulcrum that turns the denture into a lever (when there is a palatine torus, the denture tilts on either side of it, or when the acrylic teeth are placed outside the alveolar ridge, the tilting line is on the edge of the ridge).

The complex forces cause complex displacements by combining the action of horizontal and vertical forces.

The homeostatic principle → the biological components of the stomatognathic system are closely interrelated. When one of them is impaired, its disturbed functionality will disrupt the functioning of the other components. Up to a certain level, the loss suffered by the impairment is compensated by an additional adaptation effort of the other structures. This is called the self-maintenance function, homeostasis or intrasystemic balance preservation (Costa). The restoration of the homeostasis of the stomatognathic system on total edentulous patients aims through prosthetic restoration to achieve the morphological and functional framework that stimulates the intrasystemic self-regulatory factors. For this purpose, the correct repositioning of the condyles in the glenoid cavity will be attempted, thus achieving accurate mandibulo-cranial relations. The restoration work is aimed at the tonic and dynamic rebalancing of the mastication muscles and at accurately resizing the lower floor and properly positioning the mandible in the mid-sagittal direction. The restoration of the dento-alveolar arches will provide the mandible with the necessary support in the act of swallowing and will prevent at the same time the shrinking of the lower part of the face. The potential prosthetic space will be redistributed in such a way as to allow a correct tongue repositioning. The occlusion will be restored, as an important determinant of the mandible movement in the physiological act of mastication[25,26].

The calling into question of the ergonomic principle derives from the need for the thorough organization of the medical act. In the case of total edentulism, there is first of all the need for the unavoidable succession of several sessions, the patient keeping in touch with the dentist even after the end of denture fitting. Total edentulous patients, who are usually aged individuals, are weakened, have hearing and seeing problems, lack motor coordination and have reduced motility, making it difficult for the dentist to fit dentures and get the patients to cooperate. Moreover, all the psychological implications of total edentulism require the dentist to show extra care and empathy to these patients[27,28,29].

Therefore, several actions should be taken to facilitate the medical act performed. The sessions should be scheduled during the first part of the day, in order to avoid fatigue and drowsiness, and long waiting times in the waiting room should also be avoided in order not to undermine the cooperation and trust already achieved; the dentist should work simultaneously on

the lower and upper jaws, in order to provide an overall approach. The dentist should give clear orders, with the right intonation, and slowly enough to enable the patients to understand them.

The treatment sessions should be carried out in the same ergonomic framework of the dental room and according to a clear preset algorithm.

The use of removable dentures increases the amount of saliva secreted by partial and total edentulous patients. Wearing dentures improves saliva secretion, and occlusion support by the denture influences the saliva flow.

Conclusions

Prosthetics is a specialty that tackles the morpho-functional and aesthetic restoration of the dento-maxillary system with the help of biocompatible dentures; its purpose is to restore dental integrity, which may be altered by injuries or physiological degradation. Dental prostheses are generally rigid parts, made outside the oral cavity, in a dental laboratory.

References

- [1] Bratu D., Bratu E., Antonie S., **Restaurarea edentațiilor parțiale prin proteze mobilizabile**, Editura Medicală, București, 2008.
- [2] Antohe M., Andronache M., Girbea G., Forna N., *Materiale siliconice versus materiale acrilice in protezarea mobilizabila*, **Revista Medico-Chirurgicală**, Congresul Internațional de Medicină Dentară, 2007, pp. 330-335.
- [3] Aoda K., Shimamura I., Tahara Y., Sakurai K. - *Retainer design for unilateral extension base partial removable dental prosthesis by three-dimensional finite element analysis*, **J Prosthodont Res.** **54**(2), 2010, pp. 84-91.
- [4] Armellini D.B., Heydecke G., Witter D.J. , Creugers NHJ - *Effects of removable partial dentures on the quality of life in people with shortened dental arches*, **Nederlands tijdschrift voor tandheelkunde**, **12** , 2009.
- [5] Armellini D.B., Heydecke G., Witter D.J., Creugers Nico HJ, *Effect of removable partial dentures on oral health-related quality of life in subjects with shortened dental arches: a 2-center cross-sectional study*, **The International journal of prosthodontics**, 2008.
- [6] Burlui V., Forna N., **Clinica și terapia edentației totale**, Ed.Apollonia,Iași, 2004.
- [7] Burlui V.,Silvaș M.S., **Clinica și terapia edentației totale**, Ed.Apollonia,Iași, 2007.
- [8] Carvalho M.V., Iglesias D.P., do Nascimento G.J., Sobral A.P., *Epidemiological study of 534 biopsies of oral mucosal lesions in elderly Brazilian patients*, **Gerodontology** **28**(2):111-5, 2011.
- [9] Corrêa L., Frigerio M.L., Sousa S.C., Novelli M.D., *Oral lesions in elderly population: a biopsy survey using 2250 histopathological records*, **Gerodontology**; **23**(1):48-54, 2006.
- [10] De Rossi SS, Slaughter YA. *Oral changes in older patients: a clinician's guide*. **Quintessence Int** **38**(9), 2007, 773-80.
- [11] Fatima G., Sandesh N., Ravindra S., Kulkarni S., *Moving beyond clinical appearance: the need for accurate histological diagnosis*, **Gen Dent** **57**(5), 2009, 472-7; 478-9, 535-6.
- [12] Forna N.C., **Evaluarea stării de sănătate afectate prin edentație** Iași, Ed. Demiurg,2007.
- [13] Ghețău V., **Fațetele declinului demografic românesc (manuscris)**, Centrul de Cercetari Demograice Vladimir Trebici al Academiei Române, București, 2010.
- [14] Lanzieri G., **Long-term population projections at national levell**, **Statistic in Focus. Population and Social Conditions**, No.3, Eurostat, 2006.
- [15] Gonçalves J.S., Sasso-Cerri E., Cerri P.S., *Cell death and quantitative reduction of rests of Malassez according to age*, **J Periodontal Res**, **43**(4), 2008, 478-81.
- [16] Hashemipour M.A., Shoryabi A., Adhami S., Mehrabizadeh H., *Extensive focal epithelial hyperplasia*, **Arch Iran Med**, **13**(1), 2010, 48-52.

- [17] Hayakawa I. **Principles and Practices of Complete Denture**, Quintessence Publishing Co., Ltd. Tokyo, 111-230, 2001, pp.16-19.
- [18] Bratu D., Bratu E., Antonie S. - *Restaurarea edentațiilor parțiale prin proteze mobilizabile*, Editura Medicală, București, 2008.
- [19] Scrieciuc M., *Clinica și terapia edentației parțiale prin proteză scheletată, curs pentru uzul studenților anului VI*, Editura Craiova Medicală, 2007.
- [20] Despa E.G., Ionescu T., *Variabilitatea câmpului protetic edentate total*, comunicare **Congresul Internațional de Stomatologie**, București, 2005.
- [21] Hutu E., Despa E.G., Dan A., Giurescu R., **Edentatul total din România-pacient european**, Rev. Stomatologia, Vol LIII, Nr. 2, 2007, București.
- [22] Park H.S., Lee Y.J., Jeong S.H., Kwon T.G., *Density of the alveolar and basal bones of the maxilla and the mandible*, **Am J Orthod Dentofacial Orthop**.133, 2008, 30-37.
- [23] Pauna M, Preoteasa E., **Aspecte practice în protezarea edentației totale**, Ed.Cerma, București, 2002.
- [24] Rândașu I., Despa E.G., **Tratamente protetice dentare complexe**. Ed. Printech, București, 2008.
- [25] Ryan W., Hegarty D., *Tooth movement in the elderly: a case report*, **Gerodontology** **23**, 2006, 242–244.
- [26] Taba M., Kinney J., Kim A.S., Giannobile W.V., *Diagnostic biomarkers for oral and periodontal diseases*, **Dent. Clin. North Am** **49**(3), 2005, 551.
- [27] Tomiță D.I., Ursache M., Dragomirescu C., Dulharu A., Irimia T., *Aspecte privind percepția igienei orale la vârstnici*, **Rev. Medico-chirurgicală**, 110, 2, Supliment no. 1, 2006, 198-201.
- [28] Unluer S., *Oral health status of the elderly in a residential home in Turkey*, **Gerodontology** **24**(1), 2007, 22-29.
- [29] Ursache M., Gradinaru I., Tatarciuc M., Vlădoiu R., *Efecte adverse ale terapiei gnato-protetice amovibile la pacientul vârstnic*, **Rev. Medicină stomatologică**, **9**(2-3), **2005**, 54-58.

Received: November 11, 2021

Accepted: March 2, 2022